Technical Memorandum

To: Richard Clark, Minnesota Pollution Control Agency
From: Cliff Twaroski and Denise Levitan
Subject: NorthMet Project: Estimate of Mercury Loading to the Lower St. Louis River, Version 3
Date: January 28, 2015
Project: NorthMet Project
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1.0 Introduction and Summary

Barr conducted an assessment to estimate the potential effects of the Poly Met Mining Inc. (PolyMet) NorthMet Project (Project) on the average annual concentration of total mercury[1] (HgT) in the lower St. Louis River. Discharges from the Mine Site will flow to the Upper Partridge River, and discharges from the Plant Site will flow to the Upper Embarrass River and to the lower Partridge River via Second Creek. The Partridge River and the Embarrass River are tributaries of the St. Louis River. The evaluation points used for this assessment are the Highway 7 Bridge in Forbes (EP1), located approximately 60 river miles downstream from the Project at river mile 125, and the Highway 33 Bridge in Cloquet (EP2), located approximately 150 river miles downstream from the Project at river mile 36 (Figure 1).

The assessment compares the average annual concentration of mercury in the lower St. Louis River at EP1 and EP2 under existing conditions with the estimated concentration at those locations when the Project is in long-term closure (starting approximately 55 years after mining begins, when the West Pit is estimated to overflow). This comparison requires four steps:

- determine the average annual total existing flow and mercury load at each evaluation point
- determine the portions of the existing flows and mercury loads that originate from the proposed Mine Site and Plant Site areas
- estimate the future average annual flows and mercury loads from the Mine Site and Plant Site with the Project in long-term closure
- calculate the change in average annual total mercury concentration at each Evaluation Point

Results indicate that under existing conditions, average annual flows from the Project area contribute approximately 2.7% of the flow in the lower St. Louis River at EP1 and approximately 0.6 % at EP2. The

[1] Unless otherwise specified, in this memorandum 'mercury' refers to total mercury, based on unfiltered samples.

effect of the Project in long-term closure would be to slightly decrease average annual flow from the Project area (e.g., Plant Site flow of 9.2 cfs in closure compared to 10.5 cfs for existing conditions), which is expected because of evaporative losses associated with the Project water treatment plants. With the Project in long-term closure, average annual flows from the Project area will contribute approximately 2.4% and 0.6% of the flow at EP1 and EP2, respectively. Under existing conditions, the Project area contributes approximately 1.6% and 0.3% of the average annual total mercury load at EP1 and EP2, respectively. With the Project in long-term closure, there would be a slight decrease in average annual mercury loading (-1.0 g/yr) and no detectable change in total mercury concentrations at the Evaluation Points given the variability in concentrations and the current laboratory detection limits (typically 0.5 ng/L but as low as 0.05 ng/L when using special procedures for USEPA Method 1631E [Reference (1)]).

Table 1 presents a summary of assessment results. The following sections describe the methods used for the assessment, present existing conditions at the Evaluation Points and in the Project area, estimate average annual mercury loading from the Project during long-term closure, and detail the estimated effect of the Project on average annual total mercury concentrations at the Evaluation Points with the Project in long-term closure.

Table 1 Summary of Estimated Average Annual Flows, Mercury Loading, and Total Mercury (HgT) Concentration: Existing Conditions and Conditions with the Project in Long-Term Closure

Components of the Analysis	Flow cfs	Flow liters/yr	HgT conc. ng/L	HgT Load g/yr	Project Flow % of total at EP	Project Load % of total at EP
Existing Conditions (without Project impacts)						
Mine Site Watershed Area (entire flow is to Upper Partridge River)	3.8	3.39E+09	3.6	12.2		
Plant Site Watershed Area (portion flowing to Upper Embarrass River)	10.5	9.39E+09	2.1	20.0		
Plant Site Watershed Area (portion flowing to Second Creek)	0.5	4.58E+08	1.0	0.5		
Existing Project Area total	14.8	1.32E+10	2.5	32.6		
Existing EP1 – including flow and load from Project area	559.0	4.99E+11	4.1	2,061.6	2.7%	1.6%
Existing EP2 – including flow and load from Project Area	2284.0	2.04E+12	4.6	9,382.0	0.6%	0.3%
Conditions with Project in long-term closure						
Mine Site Watershed Area	3.8	3.39E+09	3.2	10.8		
Plant Site Watershed Area (portion flowing to Upper Embarrass River)	9.2	8.18E+09	2.5	20.2		
Plant Site Watershed Area (portion flowing to Second Creek)	0.5	4.62E+08	1.3	0.6		
Long-term closure Project total	13.5	1.20E+10	2.6	31.6		
EP1 with Project in long-term closure	557.7	4.98E+11	4.1	2,060.6	2.4%	1.5%
Potential Change at EP1 Due to Project	**-1.3**	**-1.20E+09**	**<0.05**	**-1.0**	**-0.24%**	**-0.05%**
EP2 with Project in long-term closure	2282.7	2.04E+12	4.6	9,381.0	0.6%	0.3%
Potential Change at EP2 Due to Project	**-1.3**	**-1.20E+09**	**<0.05**	**-1.0**	**-0.06%**	**-0.01%**

Components may not sum to totals due to rounding

2.0 Assessment Method

Several approaches were considered to assess the potential Project impact. One approach would be to consider discharge from the future Plant Site and Mine Site as a new additional mercury load to the St. Louis River. This approach, however, would be correct only if the proposed Mine Site and Plant site contributed no mercury load under existing conditions. Clearly, the proposed Mine Site and Plant Site areas do contribute mercury load under existing conditions, so a better representation of the Project's potential impact is to compare the current mercury load from the watersheds containing the Project area

with the future mercury load from these same watersheds, including discharges from the Project. This second, more detailed approach, proceeded according to the following steps:

1. Determine existing average annual flow and mercury load at each Evaluation Point.

2. Determine existing average annual flow and mercury load from the Project area. Subtract current Project area contribution from existing conditions at the Evaluation Points. These results are termed the "Adjusted Evaluation Point" values.

    a. From the proposed Mine Site area, existing flows and mercury loads come from the relatively undisturbed watershed in the form of stormwater runoff and groundwater flow (i.e., watershed yield) to the Upper Partridge River.

    b. From the proposed Plant Site area, existing flows and mercury loads come from stormwater runoff, existing LTV Steel Mining Co. (LTVSMC) Tailings Basin seepage to the Upper Embarrass River and existing LTVSMC Tailings Basin seepage to Second Creek.

3. Estimate future average annual flow and mercury load from the Project area with the Project in long-term closure. Add future Project area contributions to Adjusted Evaluation Point values to estimate future flows and mercury loads at the Evaluation Points. The results are termed the "Evaluation Point with Project" values.

    a. From the Mine Site during long-term closure, flows and mercury loads will come from discharge from the Waste Water Treatment Facility (WWTF), groundwater flow from the mine pits, and watershed yield (stormwater runoff and groundwater flow).

    b. From the Plant Site during long-term closure, flows and mercury loads will come from discharge from the Waste Water Treatment Plant (WWTP) which is directed to the Upper Embarrass River and Second Creek, Flotation Tailings Basin (FTB) groundwater seepage not captured by the FTB Containment System, and stormwater runoff not captured by the FTB Containment System.

4. Calculate the change in average annual total mercury concentration at each Evaluation Point.

    a. The potential total mercury concentration at each "Evaluation Point with Project" is then calculated by dividing the summed (total) mercury load by the summed (total) flow.

    b. The potential change in total mercury concentration caused by the Project is determined by comparing each "Evaluation Point with Project" to its corresponding "Evaluation Point Existing Conditions".

This analysis assesses potential impacts of the Project during long-term closure because this is the time period when the project has the greatest potential to impact total mercury concentrations in the St. Louis River. Long-term closure is the period of the Project with maximum sustained water discharges from both the Mine Site and the Plant Site.

The Mine Site and Plant Site GoldSim models (Reference (2) and Reference (3)) were used to calculate existing average annual flows and average annual flows during long-term closure. Average annual total mercury concentrations were based on monitoring data, research literature, and applicable water quality standards for Project discharges. Please note that these data sources generally report total mercury concentrations to one significant digit after the decimal. Therefore, the results presented in this memo are also rounded to one significant digit after the decimal. The calculation spreadsheets are presented as Large Table 1 through Large Table 7.

3.0 Existing Conditions

Estimated average annual flows at the St. Louis River Evaluation Points are from summary information in Lindgren et al. (Reference (4)) (for EP2) and from USGS gauge flow data (for EP1). Existing average annual total mercury concentrations for these Evaluation Points are from unfiltered sampling data from Berndt and Bavin (Reference (5)). Figure 2 illustrates the contributions of flows under existing conditions at these Evaluation Points.

The Plant Site and Mine Site areas comprise a relatively small portion of the Upper Embarrass River and Partridge River watersheds. In turn, these watersheds make up a very small portion of the St. Louis River flows at the Evaluation Points. The contribution of water from the Plant Site and the Mine Site represents 2.7% of the estimated average annual flow at EP1 and 0.6% of the flow at EP2. The combined contribution of the Upper Embarrass River, Upper Partridge River and Second Creek watersheds to Evaluation Point 2 is minor compared to the contributions from other tributaries such as the Whiteface River (50% of the average annual flow at point of entry) and the Cloquet River (33% of the average annual flow at point of entry) (Reference (4)). Berndt and Bavin (Reference (5)) found that the mercury loading at EP2 was dominated by non-mining tributary streams such as the Floodwood River, Whiteface River and Cloquet River. Therefore, the mercury loading and concentrations in the lower St. Louis River are almost entirely determined by portions of the watershed not impacted by the Project.

Water from the Mine Site flows to the Upper Partridge River (Figure 3). The Mine Site is not developed under existing conditions. Therefore, flow consists entirely of watershed yield (which includes both runoff and groundwater flow) and is assumed to have a combined total mercury concentration of 3.6 ng/L, equal to the average of monitoring data in the Upper Partridge River using unfiltered samples (Reference (2)). GoldSim modeling (Reference (2)) indicates that the Project will not significantly change flows in the

Upper Partridge River, so the existing average annual flow rate from the Mine Site area is assumed to be equal to Project long-term closure flows. Figure 4 shows key Mine Site flow features and the extent of the watershed area included in the Mine Site analysis.

Most of the water from the Plant Site flows to the Upper Embarrass River, but a small amount flows to the lower Partridge River watershed via Second Creek (Figure 5). Under existing conditions, the flow from the Plant Site consists of seepage from the existing LTVSMC Tailings Basin, runoff from the exterior dams of the basin, and runoff from the nearby watersheds, as shown in Figure 6. Each of these flows was individually modeled using GoldSim. The modeled flows of LTVSMC Tailings Basin seepage include contributions from the watershed area draining into the existing LTVSMC Tailings Basin. Annual average total mercury concentrations of the seepage are assumed to be 1.0 ng/L based on monitored data using unfiltered samples for SD004 and SD026 from 2005-2013 (Reference (3)). Other stormwater runoff is assumed to have an average annual total mercury concentration of 3.5 ng/L (Reference (6)). The runoff from the exterior banks of the Tailings Basin is assumed to minimally interact with tailings and is therefore estimated to have the same total mercury concentration as other stormwater runoff (3.5 ng/L).

Table 1 summarizes the average annual flows and mercury loads under existing conditions. Large Table 1 details the assessment of existing conditions, including data sources and assumptions used in the calculations.

4.0 Mercury Loading from Project during Long-Term Closure

Estimated loading of mercury from the Project (Mine Site and Plant Site) to the Evaluation Points is summarized in Table 1. Large Table 2 details the assessment of future conditions with the Project in long-term closure, including data sources and assumptions used in the calculations. Assessments of potential average annual mercury loading from the Mine Site and Plant Site are presented in Sections 4.1 and 4.2.

The critical simplifying assumption for the estimation of potential future mercury concentrations is that the Project releases water directly to the Evaluation Points. This assumption results in an overestimation of the potential contribution from the project area, because it neglects the effects of biogeochemical and hydrological factors (e.g., burial and volatilization), which act as water flows downstream from the Project area to the Evaluation Points, that will generally reduce mercury concentrations. Including these effects is beyond the scope of this assessment.

The assessment of potential effects of the Project on mercury concentrations in the St. Louis River focuses on the long-term closure period because this is the phase of the Project with maximum sustained Project discharges. Note that all permitted discharges from the Mine and Plant site during long-term closure will occur via reverse osmosis (RO) treatment plants, but mercury removal in the RO plants is not incorporated in the mercury loading calculations, even though RO plants are likely to achieve additional removal

(Reference (7)). Therefore, the assessment likely overestimates potential total mercury loading from the Project in long-term closure. Given the variability of background mercury concentrations, however, the potential mercury concentration decrease at the Evaluation Points due to removal by the RO plant would not be statistically discernible.

4.1 Mine Site Mercury Loading Analysis

The Project is not projected to significantly alter the total flow of water to the watershed from the Mine Site during long-term closure. In long-term closure, the average annual flow of water from the Mine Site consists of WWTF discharge, groundwater seepage from the East Pit and West Pit, and watershed yield from undisturbed and reclaimed areas, as shown in Figure 4. As noted in Section 3.0 and Reference (2), GoldSim modeling indicates that flows will not change significantly as a result of the Project in long-term closure.

Estimates of average annual flow and mercury load from the Mine Site in long-term closure are provided in Large Table 3. Watershed yield from the undisturbed and reclaimed portions of the Mine Site (about 2,362 acres) represents approximately 82% of the estimated future total Mine Site flow and 92% of the estimated Mine Site loading of total mercury to the Upper Partridge River. Because the stockpiles are not directly adjacent to the river and will be reclaimed with vegetated slopes in long-term closure, the total mercury concentration of the future watershed yield flow is assumed to remain at 3.6 ng/L, consistent with existing conditions. The West Pit discharge via the WWTF is estimated to account for about 18% of the Mine Site flow and about 7% of the mercury loading in the long-term closure time period (Large Table 3). The total mercury concentration of the WWTF discharge is assumed to be 1.3 ng/L based on the applicable water quality standard. Additional mercury reduction that may result from WWTF treatment is not accounted for in the calculations. The groundwater outflow from the West Pit and East Pit is estimated to contribute about 0.6% of the estimated water flow from the Mine Site in long-term closure, with a total mercury concentration of 3.0 ng/L (Reference (8)).

Flows from the Mine Site will enter the Upper Partridge River somewhere between monitoring sites SW004 and SW004a (Mine Site Evaluation Point). For the Mine Site mercury loading analysis, the average annual flow and mercury loading from the portion of watershed encompassed by the proposed Mine Site are evaluated for current conditions and for the future condition in long-term closure. The contribution from the portion of the watershed encompassed by the Mine Site is separated out of the flow and load estimated for the Upper Partridge River as a whole for the Mine Site Evaluation Point (SW004a). This separating out of the existing flow and mercury load for the Project area watershed, and then adding that specific component back into the analysis to reflect the Mine Site in long-term closure is summarized in Large Table 4.

When the potential mercury load from the Mine Site area watershed in long-term closure is added to the Mine Site Evaluation Point (SW004a), results show a small potential decrease in the mercury load (- 1.4 g/yr) and no detectable change in concentration due to the Project (Large Table 4), given the current analytical detection limits (Reference (1)) and the variability in background concentrations.

The average annual mercury load from the Mine Site will slightly decrease during long-term closure, because a portion of the flow that is currently watershed yield (with a total mercury concentration of 3.6 ng/L) will be captured in the West Pit lake and discharged via the WWTF at a conservatively assumed maximum permitted total mercury concentration of 1.3 ng/L. Flows from the Mine Site are not expected to change; therefore, the decrease in total mercury concentration results in a decrease in estimated loading.

These results indicate that the potential average annual mercury load from the Mine Site will not degrade or lower water quality with respect to total mercury concentrations in the Upper Partridge River. Overall, the Mine Site is not expected to have a measurable effect on mercury loading or concentrations in the Upper Partridge River.

4.2 Plant Site Mercury Loading Analysis

Estimating average annual flows and mercury loading at the Plant Site is more complex than at the Mine Site, because the Plant Site includes the existing LTVSMC Tailings Basin, and because the Plant Site drains to both the Upper Embarrass River watershed and the lower Partridge River watershed (via Second Creek.) In long-term closure, the flow of water from the Plant Site consists of WWTP discharge, stormwater runoff from watersheds downstream of the FTB Containment System, and a small amount of seepage to groundwater that isn't captured by the FTB seepage capture systems, as shown in Figure 7.

The Project will alter water flows at the Plant Site in several ways. Most importantly, Project Flotation Tailings will be stored on top of the existing LTVSMC Tailings Basin, and a containment system will be installed to capture seepage through the combined Flotation Tailings Basin and LTVSMC Tailings Basin. Collected seepage will be treated at the WWTP before discharge. Overall, the Project will slightly decrease average annual flows from the Plant Site during long-term closure (9.2 cfs in closure, 10.5 cfs existing), due to evaporative losses from the WWTP.

Compared to existing conditions, there are two primary differences when the Plant Site is in long-term closure. First, most of the seepage from the existing LTVSMC Tailings Basin area, as well as runoff from the exterior slopes of the FTB and the strip of land surrounding the FTB, will be captured by the containment system and treated in the WWTP. Second, a portion of the watershed that currently drains into the existing LTVSMC Tailings Basin will be redirected to runoff toward the Embarrass River.

Estimates of average annual flow and mercury load from the Plant Site in long-term closure are provided in Large Table 5. WWTP discharge represents approximately 46% of the total Plant Site flow and 25% of the estimated Plant Site loading of total mercury to the Upper Embarrass River. The WWTP discharge is assumed to be at a total mercury concentration of 1.3 ng/L based on the applicable water quality standard. Additional mercury reduction that may result from WWTP treatment is not accounted for in the calculations. Groundwater discharge (that bypasses the FTB Containment System) is estimated to account for less than 1% of flow and mercury loading in the long-term closure time period (Large Table 5). Stormwater runoff accounts for the balance, or approximately 53% of total Plant Site flow and 75% of total Plant Site mercury load. Consistent with existing conditions, seepage interacting with tailings is assumed to have a total mercury concentration of 1.0 ng/L, while runoff from the Tailings Basin banks and the rest of the watershed has a total mercury concentration of 3.5 ng/L. Note that the runoff concentration used for the Plant Site differs from the concentration for watershed yield used for the Mine Site, because the latter includes groundwater flows and is based on Upper Partridge River monitoring data.

Approximately 0.5 cfs of the WWTP discharge will be directed to the Lower Partridge River watershed via SD026 to Second Creek. This portion of the WWTP discharge has been excluded from the loading analysis of the Upper Embarrass River and included in the loading analysis of the lower Partridge River and at the evaluation points in the lower St. Louis River (EP1 at Forbes and EP2 at the Highway 33 bridge in Cloquet).

4.2.1 Embarrass River

The potential contribution of mercury from the Plant Site to the Embarrass River will occur somewhere between monitoring sites PM-12 and PM-13 (i.e., the Plant Site Evaluation Point). The flow and mercury loading from the portion of watershed encompassed by the proposed Plant Site are specifically evaluated for current conditions and for future conditions in long-term closure. The contribution from the portion of the watershed encompassed by the Plant Site is separated out of the flow and load estimated for the Upper Embarrass River as a whole for monitoring site PM-13. This separation of the flow and mercury load for the Project area watershed, and later addition of that specific component back into the analysis to reflect the Plant Site in long-term closure is summarized in Large Table 6.

When the potential mercury load from the Project area watershed in long-term closure is added to the Plant Site Evaluation Point (PM-13), results show a slight increase in the mercury load (+ 0.2 g/yr, or an increase of about 0.1%) and no detectable change in concentration due to the Project (+ 0.05 ng/L) (Large Table 6), given the current analytical detection limits (Reference (1)) and the variability in background concentrations.

The average annual mercury load from the Plant Site will slightly increase during long-term closure for two reasons. First, the seepage from the existing LTVSMC Tailings Basin has a total mercury concentration of 1.0 ng/L (based on monitoring data), while the future combined seepage collected by the FTB Containment System and excess FTB pond water which will be discharged via the WWTP is conservatively assumed to have a maximum permitted total mercury concentration of 1.3 ng/L. Second, runoff from the vicinity of the East Dam that currently flows into the existing LTVSMC Tailings Basin and emerges as seepage (with a total mercury concentration of 1.0 ng/L), will become surface runoff to the Embarrass River watershed via Mud Lake Creek (with an assumed total mercury concentration of 3.5 ng/L). If the impact of redirecting a portion of the watershed runoff from the Tailings Basin to Embarrass River is removed from the calculation (which is a change that restores that portion of the watershed to its natural condition), the Project would result a net decrease in mercury load at the Plant Site.

These results indicate that the potential mercury load from the Plant Site will not degrade or lower water quality with respect to total mercury concentrations in the Upper Embarrass River. Overall, the Plant Site is not expected to have a discernible effect on mercury loading or concentrations in the Upper Embarrass River.

4.2.2 Second Creek

The Project's potential impacts to the average annual flow and mercury load to the lower Partridge River via Second Creek are minimal and easily quantified, and can be addressed without the more formal process used at other evaluation points. Under existing conditions, approximately 0.5 cfs of seepage from the existing LTVSMC Tailings Basin flows from the Plant Site area to Second Creek via SD026, with an estimated total mercury concentration of 1.0 ng/L based on monitoring data. In long-term closure, approximately 0.5 cfs (equal to 500 million L/yr) of WWTP discharge with a maximum concentration of 1.3 ng/L will be directed to Second Creek via SD026, resulting in a slight increase in load of 0.1 g/yr.

The average flow at the USGS 04015500 gauging station on Second Creek was 22.4 cfs (equal to 20 billion L/yr). Baseline water quality sampling for Mesabi Nugget (Reference (9)) indicated an average total mercury concentration of approximately 3.4 ng/L at MNSW8, near the USGS gauging station. Therefore, current mercury loading at this point is estimated to be 68 g/yr, and the potential increased load resulting from the Project at this point is negligible (a potential increase of about 0.1%), with no measurable change in the total mercury water column concentration.

In summary, the analysis indicates that the Plant Site in long-term closure is not expected to have a measurable effect on average annual total mercury loading or concentrations in the Upper Embarrass River or Second Creek.

5.0 Estimated Effect of the Project on Mercury Loading in the St. Louis River

As discussed in Section 4, the Project in long-term closure will result in very small changes to average annual flows and mercury loading in the Partridge River and Embarrass River. Note that all discharges from the Mine Site and Plant Site will occur via RO treatment plants, but mercury removal in the RO plants is not incorporated in the mercury loading calculations. Therefore, the assessment likely overestimates potential total mercury loading from the Project in long-term closure.

The mercury load from the Mine Site will slightly decrease during long-term closure, because a portion of the flow that is currently watershed yield (total mercury concentration of 3.6 ng/L) will be captured in the West Pit lake and discharged via the WWTF at a conservatively assumed total mercury concentration of 1.3 ng/L. Flows from the Mine Site in long-term closure are not expected to change from existing conditions, therefore the change in total mercury concentration from 3.6 ng/L to 1.3 ng/L for a portion of the flow from the Mine Site results in reduced loading to the Partridge River.

The mercury load from the Plant Site will slightly increase during long-term closure for two reasons. First, the seepage from the existing LTVSMC Tailings Basin is assumed to have a total mercury concentration of 1.0 ng/L, while the combined seepage collected by the FTB Containment System and excess FTB pond water which will be discharged via the WWTP is conservatively assumed to have a total mercury concentration of 1.3 ng/L. Second, runoff from the vicinity of the East Dam that currently flows into the existing LTVSMC Tailings Basin and emerges as seepage (total mercury concentration of 1.0 ng/L), will become surface runoff to the Embarrass River watershed via Mud Lake Creek (total mercury concentration of 3.5 ng/L). Flows from the Plant Site in long-term closure (9.2 cfs) will slightly decrease from existing conditions (10.5 cfs) due to evaporative losses from the WWTP, the assumed small changes in mercury concentrations for seepage water and runoff from near the East Dam, resulting in a slight increase in mercury concentration and loading to the Embarrass River.

Overall, the changes in total mercury concentrations associated with the Project in long-term closure at the respective Mine Site and Plant Site Evaluation Points are estimated to be too small to distinguish from natural background variability in the Partridge River and the Embarrass River using available laboratory methods

The Project and Project area watershed information used to assess the potential effects on average annual mercury loading and concentrations at the Plant Site and Mine Site Evaluation Points (Upper Embarrass River and Upper Partridge River, respectively) were also used in assessing the potential effects from the Project on mercury loading in the St. Louis River. At the lower St. Louis River Evaluation Points, approximately 60 and 150 miles downstream, estimated changes in average annual total mercury concentration from the Project were smaller than the estimated changes for the respective Evaluation

Points in the Upper Embarrass River and the Upper Partridge River. Large Table 7 summarizes the calculations showing the potential mercury load from the Project area for existing conditions to the St. Louis River (12 + 20 = 32 g/yr), which is about 1.5% and 0.3% of the estimated load at EP1 and EP2 (2,100 and 9,400 g/yr, respectively).

When the potential mercury load from the Project in long-term closure is added to the respective St. Louis River Evaluation Points without accounting for the 60 miles of water between the Project and EP1 nor the 125 miles of water between the Project and EP2, there is a slight decrease in mercury loading (- 1.0 g/yr) and no detectable change in the mercury concentration (change less than 0.05 ng/L) (Large Table 7), given the variability in environmental concentrations and the current laboratory detection limits (USEPA Method 1631E [Reference (1)]; ~0.05 ng/L). These results indicate that the potential mercury load from the Project will not degrade or lower water quality with respect to average annual total mercury concentrations at the respective Evaluation Points. Overall, the Project is not expected to have a statistically discernible effect on mercury loading or concentrations at the St. Louis River Evaluation Points.

References

1. **U.S. Environmental Protection Agency.** Method 1631, Revision E: Mercury in water by oxidation, purge and trap, and cold vapor atomic fluorescence spectrometry. August 2002.

2. **Poly Met Mining, Inc.** NorthMet Project Water Modeling Data Package Volume 1 - Mine Site (v13). December 2014.

3. —. NorthMet Project Water Modeling Data Package Volume 2 - Plant Site (v10). January 2015.

4. **Lindgren, John, et al.** *A Study of the St. Louis River.* s.l. : Minnesota Department of Natural Resources, 2006.

5. **Berndt, Michael and Bavin, Travis.** Sulfate and mercury chemistry of the St. Louis River in northeastern Minnesota. Final Report. Minerals Mining Coordinating Committee. Minnesota Department of Natural Resources. December 2009.

6. **Grigal, D. F.** Inputs and Outputs of Mercury from Terrestrial Watersheds: A Review. *Environmental Reviews.* 2002, Vol. 10, pp. 1-39.

7. **Urgun-Demirtas, Meltem, et al.** Achieving very low mercury levels in refinery wastewater by membrane filtration. *Journal of Hazardous Materials.* 2012, Vols. 215-216, pp. 98-107.

8. **Krabbenhoft, David P., et al.** Mercury cycling in the Allequash Creek Watershed, Northern Wisconsin. *Water, Air and Soil, Pollution.* 1995, Vol. 80, pp. 425-433.

9. **Barr Engineering Company.** *Sulfate, Mercury, and Methyl Mercury in Second Creek.* 2009.

Large Tables

The following conversion factors are used in large tables:

gallons per minute to cubic feet per second	0.00223
liters per cubic feet	28.31625
seconds per year	31,536,000

Large Table 1 Existing Conditions: Estimated Flows and Total Mercury (HgT) Load for the Upper Partridge River, Upper Embarrass River, SD026 and Lower St. Louis River

Water Body	Data and Source of Information for Estimated Flow and HgT Concentration	Average Annual Flow cfs	Average Annual Flow (liters/yr.)	HgT Conc. Total (ng/L)	Annual Loading (ng/yr)	Flow as a % of Flow at EP1	Load as a % of Load at EP1	Flow as a % of Flow at EP2	Load as a % of Load at EP2
Mine Site Watershed Area Yield (stormwater runoff and groundwater flow; entire flow is to Upper Partridge River)	Flow: Assumed to be equal to GoldSim-predicted Project flows HgT CONCENTRATION (total): Monitoring data for the NorthMet Project for Site PM-16. Range in HgT concentrations from unfiltered samples = 1.1 to 5.2 ng/L; mean = 3.6 ng/L.	3.79	3.39E+09	3.6	1.2E+10	0.7%	0.6%	0.2%	0.1%
Current seepage from existing LTVSMC Tailings Basin (flow to groundwater and flow that becomes surface flow near the toe)	FLOW: GoldSim model estimated annual average flow is 5.78 cfs, excluding the portion flowing to Second Creek via SD026. HgT CONCENTRATION (total): A 1.0 ng/L concentration is assumed for the groundwater leaving the FTB based on data from monitoring locations SD004 and SD026 (Reference (3)).	5.78	5.16E+09	1.0	5.2E+09	1.0%	0.3%	0.3%	0.1%
Current runoff from the exterior banks of the existing LTVSMC Tailings Basin	FLOW: GoldSim model estimated annual average flow is 0.35 cfs. HgT CONCENTRATION (total): 3.5 ng/L concentration assumed to match the watershed runoff from stormwater.	0.35	3.11E+08	3.5	1.1 E+09	0.1%	0.1%	0.0%	0.0%
Current stormwater runoff from Plant Site watershed area	FLOW: GoldSim model estimated annual average flow is 4.39 cfs. HgT CONCENTRATION (total): 3.5 ng/L concentration represents a median concentration for shallow groundwater and runoff water in a boreal forest watershed (data from Reference (6)) and NorthMet Project).	4.39	3.92E+09	3.5	1.4E+10	0.8%	0.7%	0.2%	0.1%
Plant Site Watershed Area (portion flowing to Upper Embarrass River)	FLOW: Sum of seepage and stormwater runoff. HgT CONCENTRATION (total): Calculated by dividing the load from seepage and Plant Site property stormwater runoff by their flow	10.51	9.39E+09	2.1	2.0E+10	1.9%	1.0%	0.5%	0.2%
SD026 (headwaters of Second Creek; lower Partridge River watershed)	Flow: SD026 receives seepage water from the existing LTVSMC Tailings Basin. Estimated flow is ~ 0.5 cfs (Reference (3)). HgT CONCENTRATION (total): A 1.0 ng/L concentration is assumed for the groundwater leaving the FTB based on data from monitoring locations SD004 and SD026 (Reference (3)).	0.51	4.58E+08	1.0	4.6E+08	0.1%	0.02%	0.02%	0.00%
Evaluation Point 1 (Forbes)	FLOW: Annual flows based on USGS data from 1964-1988. Average Annual Flow = 559 cfs (at USGS 4018750). HgT CONCENTRATION (total): Maximum = 8.9 ng/L; minimum = 1.5 ng/L; average = 4.1 ng/L. Average of 4.1 ng/L selected for use in this assessment. Data from: Berndt and Bavin, (Reference (5)). Total concentrations for river mile 125 (unfiltered samples).	559.0	4.99E+11	4.1	2.1E+12	--	--	--	--
Evaluation Point (Cloquet)	FLOW: Annual flows as discussed in Lindgren et al. (Reference (4)). Average Annual Flow = 2,284 cfs (at the Scanlon Dam). HgT CONCENTRATION (total): Maximum = 9.4 ng/L; minimum = 1.1 ng/L; average = 4.6 ng/L. Average of 4.6 ng/L selected for use in this assessment. Data from: Berndt and Bavin, (Reference (5)). Total concentrations for river mile 36 (unfiltered samples).	2284.0	2.04E+12	4.6	9.4E+12	--	--	--	--

Large Table 2 Estimated Total Mercury (HgT) Load from the NorthMet Project in Long-term Closure

NorthMet Project Loading	Data and Source of Information for Estimated Flow and HgT Concentration	Average Annual Flow cfs	Average Annual Flow (Liters/yr)	HgT Conc. Total (ng/L)	Annual Loading (ng/yr)	% of Flow at EP1	% of Load at EP1	% of Flow at EP2	% of Load at EP2
1. Mine Site: Discharge to Upper Partridge River									
West Pit Discharge (after Yr. 60)	FLOW: GoldSim modeling estimated annual average flow at 0.67 cfs. This includes stormwater runoff routed to the West Pit from the direct drainage watershed of the East Pit and West Pit. HgT CONCENTRATION (total): 1.3 ng/L is highest allowable concentration from a new discharge in the Lake Superior Basin.	0.67	5.97E+08	1.3	7.8E+08	--	--	--	--
Groundwater Flow	FLOW: GoldSim modeling estimated an total annual average flow of 0.02 cfs from East Pit and West Pit) HgT CONCENTRATION (total): 3 ng/L concentration based on data from shallow groundwater at the Mine Site and is consistent with data from northern Wisconsin (Reference (8)).	0.02	1.99E+07	3.0	6.0E+07	--	--	--	--
Watershed Yield (Stormwater Runoff and Groundwater Flow) from Undisturbed or Reclaimed Areas	FLOW: Estimate of approximately 3.10 cfs from a 2,362 acre watershed with a water yield of 0.84 cfs/sq. mile (Reference (2)). Total acreage of the Mine Site = 3,016 acres; after reclaiming 2,362 acres expected to contribute runoff water to the Upper Partridge River. The remaining 654 acres of Mine Site area is included in the estimate of the West Pit discharge. HgT CONCENTRATION (total): Monitoring data for the NorthMet Project for Site PM-16. Range in HgT concentrations from unfiltered samples = 1.1 to 5.2 ng/L; mean = 3.6 ng/L.	3.10	2.77E+09	3.6	1.0E+10	--	--	--	--
Total for Mine Site		**3.79**	**3.39E+09**	**3.2**	**1.1E+10**	**0.7%**	**0.5%**	**0.2%**	**0.1%**
2. Plant Site & Flotation Tailings Basin (FTB): Discharge to Embarrass River (upstream of Sabin Lake; Site PM-13) or to SD026 (Second Creek, lower Partridge River watershed)									
Groundwater Flow from FTB	FLOW: GoldSim modeling estimated an annual average total flow of 0.05 cfs (Estimated flow bypassing the containment system; 90% of existing seepage to groundwater). HgT CONCENTRATION (total): A 1.0 ng/L concentration is assumed for the groundwater leaving the FTB based on data from monitoring locations SD026 and SD004 (Reference (3)).	0.05	4.18E+07	1.0	4.2E+07	--	--	--	--
Wastewater Treatment Plant (discharge to Upper Embarrass River)	FLOW: GoldSim model estimated annual average flow at 4.25 cfs in long-term closure for the WWTP discharge to the Upper Embarrass River, based on treatment of FTB pond seepage and dewatering, exclusive of the discharge to SD026. HgT CONCENTRATION (total): 1.3 ng/L is the maximum allowed concentration from a new discharge in the Lake Superior Basin. Because the Reverse Osmosis technology to be used at the WWTP removes Hg, the actual concentration of the discharge water is likely to be less than 1.3 ng/L.	4.25	3.80E+09	1.3	4.9E+09	--	--	--	--
Wastewater Treatment Plant (discharge to SD026; lower Partridge River watershed)	FLOW: Seepage water at SD026 will be collected and routed to the WWTP. GoldSim Model estimated average flow of 0.52 cfs of treated water routed from the WWTP back to SD026 for discharge to Second Creek (lower Partridge River watershed). HgT CONCENTRATION (total): 1.3 ng/L is the maximum allowed concentration from a new discharge in the Lake Superior Basin. Because the Reverse Osmosis technology to be used at the WWTP removes Hg, the actual concentration of the discharge water is likely to be less than 1.3 ng/L.	0.52	4.62E+08	1.3	6.0E+08	--	--	--	--
Stormwater Runoff	FLOW: Estimate of approximately 4.86 cfs from the watershed area outside of the containment system. HgT CONCENTRATION (total): 3.5 ng/L concentration represents a median concentration for	4.86	4.34E+09	3.5	1.5E+10	--	--	--	--

NorthMet Project Loading	Data and Source of Information for Estimated Flow and HgT Concentration	Average Annual Flow cfs	Average Annual Flow (Liters/yr)	HgT Conc. Total (ng/L)	Annual Loading (ng/yr)	% of Flow at EP1	% of Load at EP1	% of Flow at EP2	% of Load at EP2
	shallow groundwater and runoff water in a boreal forest watershed (data from Reference (6)) and NorthMet Project).								
Total for Plant Site (with water to SD026)		**9.68**	**8.64E+09**	**2.4**	**2.1E+10**	**1.7%**	**1.0%**	**0.4%**	**0.2%**
Total for Plant Site (without water to SD026)		**9.16**	**8.18E+09**	**2.5**	**2.0E+10**				
3a. Lower St. Louis River (Forbes) (Evaluation Point 1, EP1)	FLOW: Annual flows based on USGS data from 1964-1988. Average Annual Flow = 559 cfs (at USGS 4018750). HgT CONCENTRATION (total): Maximum = 8.9 ng/L; minimum = 1.5 ng/L; average = 4.1 ng/L. Average of 4.1 ng/L selected for use in this screening assessment. Data from: Berndt and Bavin, (Reference (5)). Total concentrations for river mile 125 (unfiltered samples).	559.0	4.99E+11	4.1	2.1E+12	--	--	--	--
3b. Lower St. Louis River (Cloquet) (Evaluation Point 2, EP2)	FLOW: Annual flows as discussed in Lindgren et al. (Reference (4)). Average Annual Flow = 2,284 cfs (at the Scanlon Dam). HgT CONCENTRATION (total): Maximum = 9.4 ng/L; minimum = 1.1 ng/L; average = 4.6 ng/L. Average of 4.6 ng/L selected for use in this screening assessment. Data from: Berndt and Bavin, (Reference (5)). Total concentrations for river mile 36 (unfiltered samples).	2284.0	2.04E+12	4.6	9.4E+12	--	--	--	--

Large Table 3 Estimated Flows and Mercury Loads from the Mine Site in Long-Term Closure

NorthMet Project Loading	Data and Source of Information for Estimated Flow and HgT Concentration	Average Annual Flow cfs	Average Annual Flow (Liters/yr.)	HgT Conc. Total (ng/L)	Annual Loading (ng/yr)	% of Total Flow	% of Total Load
West Pit Lake Discharge via WWTF (after Mine Yr. 40)	FLOW: GoldSim modeling estimated annual average flow at 0.67 cfs. This includes stormwater runoff routed to the West Pit from the direct drainage watershed of the East Pit and West Pit. HgT CONCENTRATION (total): 1.3 ng/L is highest allowable concentration from a new discharge in the Lake Superior Basin.	0.67	5.97E+08	1.3	7.8E+08	18%	7%
Groundwater Flow from Mine Pits	FLOW: GoldSim modeling estimated an total annual average flow of 0.02 cfs from East Pit and West Pit HgT CONCENTRATION (total): 3 ng/L concentration based on data from shallow groundwater at the Mine Site and is consistent with data from northern Wisconsin (Reference (8)).	0.02	1.99E+07	3.0	6.0E+07	0.6%	0.6%
Watershed Yield (Stormwater Runoff and Groundwater Flow) from Undisturbed or Reclaimed Areas	FLOW: Estimate of approximately 3.10 cfs from a 2,362 acre watershed with a water yield of 0.84 cfs/sq. mile (Reference (2)). Total acreage of the Mine Site = 3,016 acres; after reclaiming 2,362 acres expected to contribute runoff water to the Upper Partridge River. The remaining 654 acres of Mine Site area is included in the estimate of the West Pit discharge. HgT CONCENTRATION (total): Monitoring data for the NorthMet Project for Site PM-16. Range in HgT concentrations from unfiltered samples = 1.1 to 5.2 ng/L; mean = 3.6 ng/L.	3.10	2.77E+09	3.6	1.0E+10	82%	92%
Total for Mine Site	**HgT concentration calculated (HgT load / flow)**	**3.79**	**3.39E+09**	**3.2**	**1.1E+10**	--	--

Large Table 4 Summary of the Potential Effect of the Mine Site in Long-Term Closure on Mercury Loading to the Upper Partridge River

Components of the Analysis	Flow (cfs)	Flow (liters/yr)	HgT Conc. Total ng/L	HgT Load ng/yr	Flow as % of UPR %	Load as % of UPR %
Upper Partridge River (UPR) between Monitoring Sites SW004 and SW004a includes flow from Project area watershed Total flow = 45.9 cfs and includes flow from the Project area watershed (Mine Site). Total flow of 45.9 cfs converts to 4.10E+10 liters/yr.) Total mercury concentration from NorthMet Project monitoring data = 3.6 ng/L	45.9	4.10E+10	3.6	1.5E+11	--	--
Mine Site Watershed Area (entire flow is to Upper Partridge River) Flow assumed equal to flow with Project HgT CONCENTRATION (total): Monitoring data for the NorthMet Project for Site PM-16. Range in HgT concentrations from unfiltered samples = 1.1 to 5.2 ng/L; mean = 3.6 ng/L.	3.79	3.39E+10	3.6	1.2E+10	--	--
Mine Site (estimated flow with GoldSim model) to UPR.	3.79	3.39E+09	3.2	1.1E+10	9.0%	7.9%
Impact Assessment: Assess the Project's Effect on HgT Load and Concentration at the Evaluation Point, EP (EP = portion of the UPR between Site SW004 and SW004a)						
Evaluation Point (existing conditions)	45.9	4.10E+10	3.6	1.5E+11	--	--
Step 1. Subtract Existing Flows and Load from the Evaluation Point (Existing Evaluation Point without flow or HgT load from the Mine Site = "Adjusted Evaluation Point")	42.1	3.76E+10	3.6	1.4E+11	--	--
Step 2: Add in the Project: Mine Site (flow and HgT load)	3.79	3.39E+09	3.2	1.1E+10	9.0%	7.9%
Step 3. Add the Project to the "Adjusted Evaluation Point" (Evaluation Point + Project) (HgT conc. = load / flow)	45.9	4.10E+10	3.6	1.5E+11	--	--
Potential Change Due to Project						
Change = (Evaluation Pt. + Project) – Evaluation Pt. (existing)	**0.00**	**0.00E+00**	**<0.05**	**-1.4E+09**	--	--

Large Table 5 Estimated Flows and Mercury Loads from the Plant Site in Long-Term Closure

NorthMet Project Loading	Data and Source of Information for Estimated Flow and HgT Concentration	Average Annual Flow (cfs)	Average Annual Flow (Liters/yr.)	HgT Conc. Total (ng/L)	Annual Loading (ng/yr)	% of Flow	% of Load
Plant Site & Flotation Tailings Basin (FTB): Discharge to Embarrass River (upstream of Sabin Lake; Site PM-13)							
Wastewater Treatment Plant (discharge to upper Embarrass River)	FLOW: GoldSim model estimated annual average flow at 4.25 cfs in long-term closure for the WWTP discharge to the Upper Embarrass River, based on treatment of FTB pond seepage and dewatering, exclusive of the discharge to SD026. HgT CONCENTRATION (total): 1.3 ng/L is the maximum allowed concentration from a new discharge in the Lake Superior Basin. Because the Reverse Osmosis technology to be used at the WWTP removes Hg, the actual concentration of the discharge water is likely to be less than 1.3 ng/L.	4.25	3.80E+09	1.3	4.9E+09	46%	25%
Groundwater Flow from FTB	FLOW: GoldSim modeling estimated an annual average total flow of 0.05 cfs (Estimated flow bypassing the containment system; 90% of existing seepage to groundwater). HgT CONCENTRATION (total): A 1.0 ng/L concentration is assumed for the groundwater leaving the FTB based on data from monitoring locations SD026 and SD004 (Reference (3)).	0.05	4.18E+07	1.0	4.2E+07	0.5%	0.2%
Stormwater Runoff	FLOW: Estimate of approximately 4.86 cfs from the watershed area outside of the containment system. HgT CONCENTRATION (total): 3.5 ng/L concentration represents a median concentration for shallow groundwater and runoff water in a boreal forest watershed (data from (Reference (6)) and the NorthMet Project).	4.86	4.34E+09	3.5	1.5E+10	53%	75%
Total for Plant Site		**9.16**	**8.18E+09**	**2.5**	**2.0E+10**	--	--

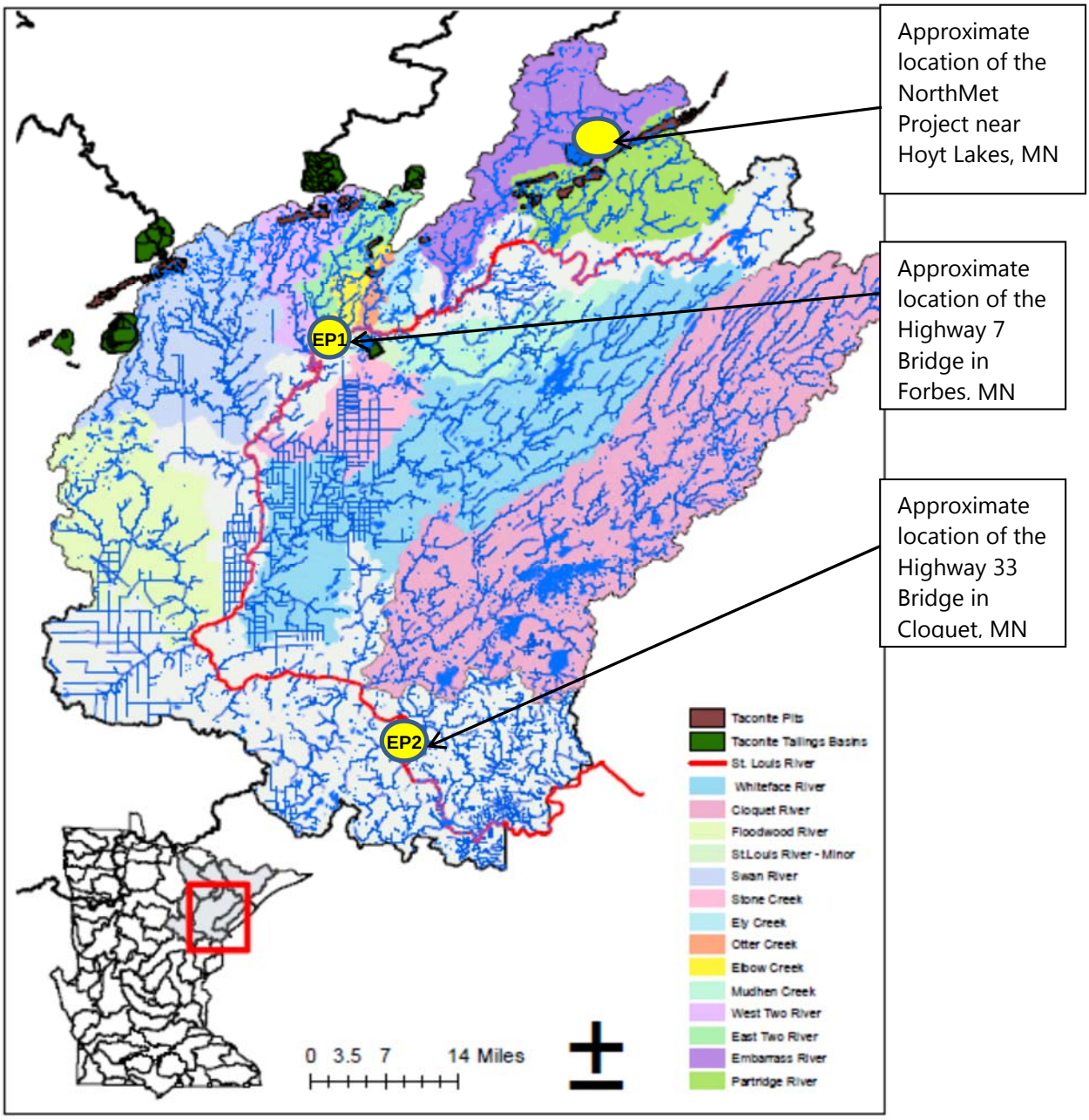
Large Table 6 Summary of the Potential Effect of the Plant Site in Long-Term Closure on Mercury Loading to the Upper Embarrass River

Components of the Analysis	Flow (cfs)	Flow (liters/yr)	HgT Conc ng/L	HgT Load ng/yr	Flow as % of UER %	Load as % of UER %
Existing or Background Conditions						
Upper Embarrass River (UER) at PM-13	84.3	7.53E+10	3.1	2.3E+11	--	--
Current Existing LTVSMC Tailings Basin seepage of 5.78 cfs (including both groundwater and surface flows)	5.78	5.16E+09	1.0	5.2E+09	--	--
Current runoff of 0.35 cfs from the exterior banks of the existing LTVSMC Tailings Basin	0.35	3.11E+08	3.5	1.1E+09	--	--
Current watershed runoff of 4.39 cfs (Plant Site watershed area)	4.39	3.92E+09	3.5	1.4E+10	--	--
Upper Embarrass River (UER) excluding flow and HgT load from Project area watershed (used in Step 1 below)	73.8	6.59E+10	3.2	2.1E+11	--	--
Project (in long-term closure – see Large Table 5 for detailed assumptions)						
WWTP Discharge	4.25	3.80E+09	1.3	4.9E+09	--	--
Groundwater flow	0.05	4.18E+07	1.0	4.2E+07	--	--
Stormwater runoff	4.86	4.34E+09	3.5	1.5E+10	--	--
Plant Site total (used in Step 2 below)	9.16	8.18E+09	2.5	2.0E+10	12.2%	9.5%
Impact Assessment: Assess the Project's Effect on HgT Load and Concentration at the Evaluation Point						
Existing Evaluation Point (with flow and load from watershed encompassed by the Plant Site	84.3	7.53E+10	3.1	2.3E+11	--	--
Step 1. Subtract out the flow and HgT load from the watershed area encompassed by the Plant Site. (Adjusted EP).	73.8	6.59E+10	3.2	2.1E+11	--	--
Step 2: Add Project (Plant Site) flow and HgT load	9.16	8.18E+09	2.5	2.0E+10	12.2%	9.5%
Step 3. Evaluation Point + Project (HgT conc. = load / flow)	82.9	7.41E+10	3.2	2.3E+11	--	--
Potential Change Due to Project (Change = (Evaluation Point + Project) - Existing Evaluation Point	-1.4	-1.21E+09	0.05	2.0E+08	--	0.1%

Large Table 7 Summary of Potential Total Mercury (HgT) Concentration and Load from the NorthMet Project to the Lower St. Louis River

Components of the Analysis	Flow (cfs)	(liters/yr)	HgT Conc Total ng/L	HgT Load ng/yr	Flow as % of EP1 %	Load as % of EP1 %	Flow as % of EP2 %	Load as % of EP2 %
Existing or Background Conditions (without Project impacts)								
Mine Site Watershed Area (entire flow is to Upper Partridge River)	3.8	3.39E+09	3.6	1.2E+10	--	--	--	--
Plant Site Watershed Area (portion flowing to Upper Embarrass River)	10.5	9.39E+09	2.3	1.9E+10	--	--	--	--
Plant Site Watershed Area (portion flowing to Second Creek)	0.5	4.58E+08	1.0	1.0E+09	--	--	--	--
Evaluation Point 1 (EP1, at Forbes) (including UPR, UER and Second Creek)	559	4.99E+11	4.1	2.1E+12	--	--	--	--
Evaluation Point 2 (EP2, at Cloquet) (including UPR, UER and Second Creek)	2284	2.04E+12	4.6	9.4E+12	--	--	--	--
Conditions with Project (in long-term closure)								
Mine Site Watershed Area	3.8	3.39E+09	3.2	1.1E+10	--	--	--	--
Plant Site Watershed Area (portion flowing to Upper Embarrass River)	9.2	8.18E+09	2.5	2.0E+10	--	--	--	--
Plant Site Watershed Area (portion flowing to Second Creek)	0.5	4.62E+08	1.3	6.0E+08	--	--	--	--
Impact Assessment 1: Assess the Project's Effect on HgT Load and Concentration at Evaluation Point 1 (St Louis River at Forbes)								
Step 1. Subtract Existing Project Watershed Area from the Evaluation Point								
Evaluation Point: without flow or HgT load from the Project	559	4.99E+11	4.1	2.1E+12	--	--	--	--
Subtract Mine Site Watershed Area	-3.8	-3.39E+09	3.6	-1.2E+10	-0.7%	-0.6%	--	--
Subtract Plant Site Watershed Area (Embarrass River portion)	-10.5	-9.39E+09	2.1	-2.0E+10	-1.9%	-1.0%	--	--
Subtract Plant Site Watershed Area (Second Creek portion)	-1.5	-4.58E+08	1.0	-4.6E+08	-0.1%	-0.02%	--	--
Adjusted Evaluation Point 1 (without Project watershed areas)	544.2	4.86E+11	4.2	2.0E+12	--	--	--	--
Step 2. "Adjusted EP" + Project Watershed Area = EP with Project								
Add Project: Mine Site (flow and HgT load)	3.8	3.39E+09	3.2	1.1E+10	0.7%	0.5%	--	--
Add Project: Plant Site (flow and HgT load to UER and to Second Creek)	9.7	8.64E+09	2.4	2.1E+10	1.7%	1.0%	--	--
Sum = Evaluation Point 1 with Project	557.7	4.98E+11	4.1	2.1E+12	100.0%	100.0%	--	--
Potential Change Due to Project	-1.3	-1.20E+09	<0.05	-1.0E+09	-0.24%	-0.051%	--	--
Impact Assessment 2: Assess the Project's Effect on HgT Load and Concentration at Evaluation Point 2 (St. Louis River at Cloquet)								
Step 1. Subtract Existing Project Watershed Area from the Evaluation Point								
Evaluation Point: without flow or HgT load from the Project	2284	2.04E+12	4.6	9.4+12	--	--		
Subtract Mine Site Watershed Area	-3.8	-3.39E+09	3.6	-1.2E+10	--	--	-0.2%	-0.1%
Subtract Plant Site Watershed Area (Embarrass River portion)	-10.5	-9.39E+09	2.1	-2.0E+10	--	--	-0.5%	-0.2%
Subtract Plant Site Watershed Area (Second Creek portion)	-0.5	-4.58E+08	1.0	-4.6E+08	--	--	-0.02%	-0.0%
Adjusted Evaluation Point 1 (without Project watershed areas)	2269.2	2.03E+12	4.6	9.4E+12	--	--		
Step 2. "Adjusted EP" + Project Watershed Area = EP with Project								
Add Project: Mine Site (flow and HgT load)	3.8	3.39E+09	3.2	1.1E+10	--	--	0.2%	0.1%
Add Project: Plant Site (flow and HgT load to UER and to Second Creek)	9.7	8.64E+09	2.4	2.1E+10	--	--	0.4%	0.2%
Sum = Evaluation Point 2 with Project	2282.7	2.04E+12	4.6	9.4E+12	--	--	100.0%	100.0%
Potential Change Due to Project	-1.3	-1.20E+09	<0.05	-1.0E+09	--	--	-0.06%	-0.011%

Figures



(Adapted from Berndt and Bavin (Reference (5))

Figure 1 Approximate Location of the NorthMet Project in the Northern Part of the St. Louis River Watershed in Northern Minnesota (~ river mile 185) and the Approximate Location of Evaluation Points EP1 (Highway 7 Bridge near Forbes – river mile 125) and EP2 (Highway 33 Bridge near Cloquet ~ river mile 36).

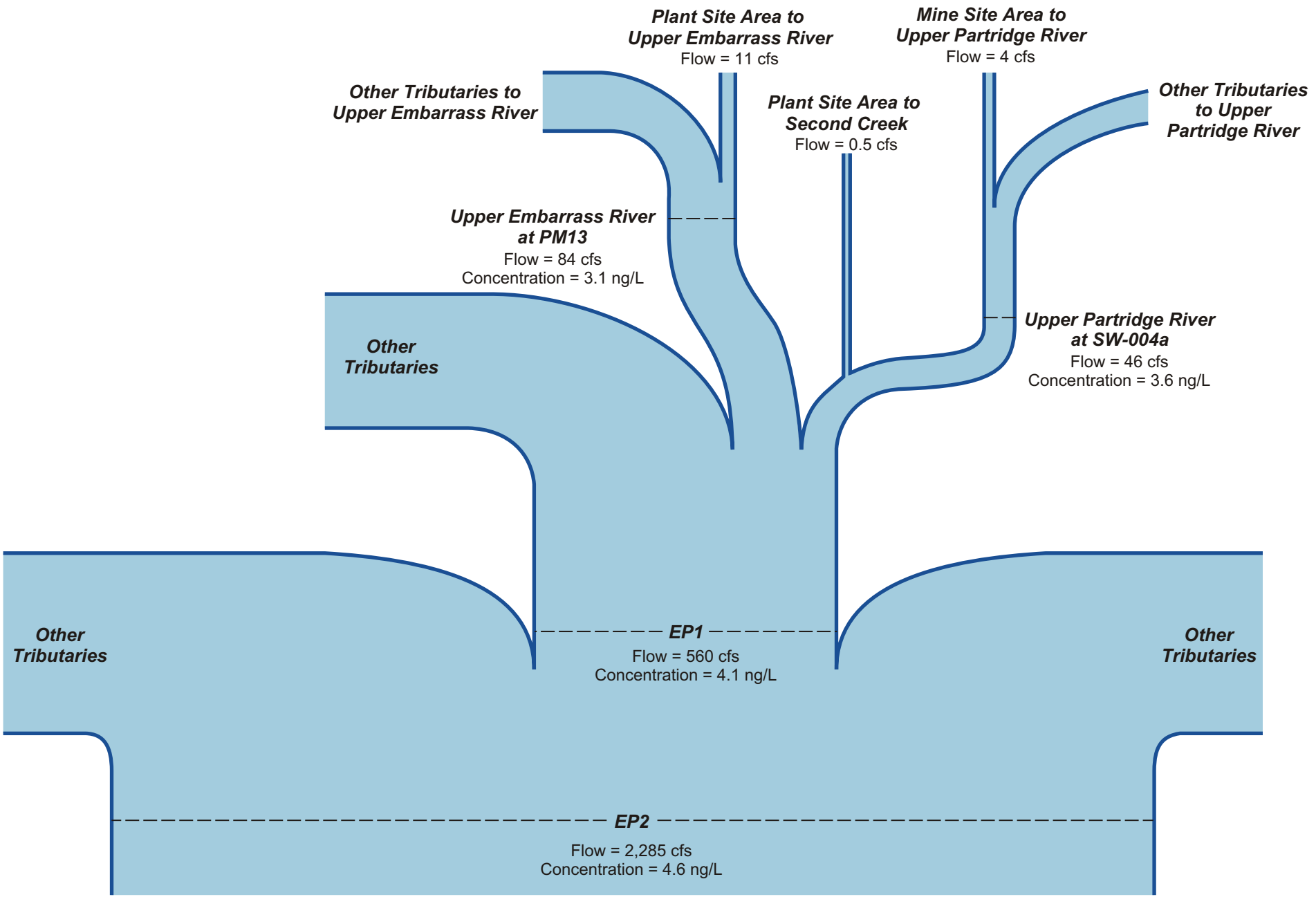


Figure 2 Existing Flows from the Project Area and Other Tributaries into the lower St. Louis River at Evaluation Points EP1 and EP2

Barr Foster ArcGIS 10.2.2, 2015-01-19 17:12 File: I:\Client\PolyMet_Mining\Work Orders\Agency_Preferred_Alternative\Maps\Support Documents\Mercury Loading to Sit Louis River\Figure 3 Partridge River Watershed and Surface Water Evaluation Locations.mxd User: amr2

Embarrass River
Peter Mitchell Open Pit
Taconite Mine
SW001
SW002
Yelp Creek
PLANT SITE AREA
MINE SITE AREA
SW003
Stubble Creek
SW004
SW004a
Stephens Creek
Second Creek
Wyman Creek
Wetlegs Creek
Longnose Creek
SW004b
South Branch Partridge River
Unnamed Creek
Colby Lake
SW006
First Creek
Partridge River
SW005
Cranberry Creek
Colvin Creek
Partridge River
Whitewater
Reservoir
Saint Louis River
Saint Louis River

Surface Water Evaluation Locations
Partridge River Watershed
Project Areas
Streams/Rivers

N

0 0.75 1.5 3
Miles

Figure 3
PARTRIDGE RIVER WATERSHED AND
SURFACE WATER EVALUATION LOCATIONS
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN

PETER MITCHELL OPEN PIT
TACONITE MINE

Area within the Mine Site boundary that remains as contributing watershed to the Partridge River.

Portions of the Mine Site that contribute to the West Pit, the East Pit Wetland, or the WWTF in long-term closure. These areas are discharged to SW-004a via the WWTF.

Yelp Creek

Partridge River

EAST PIT AREA

CATEGORY 1 - RECLAIMED

WWTF AREA

WEST PIT AREA

TREATED WATER PIPELINE

Unnamed Creek

Partridge River

Stubble Creek

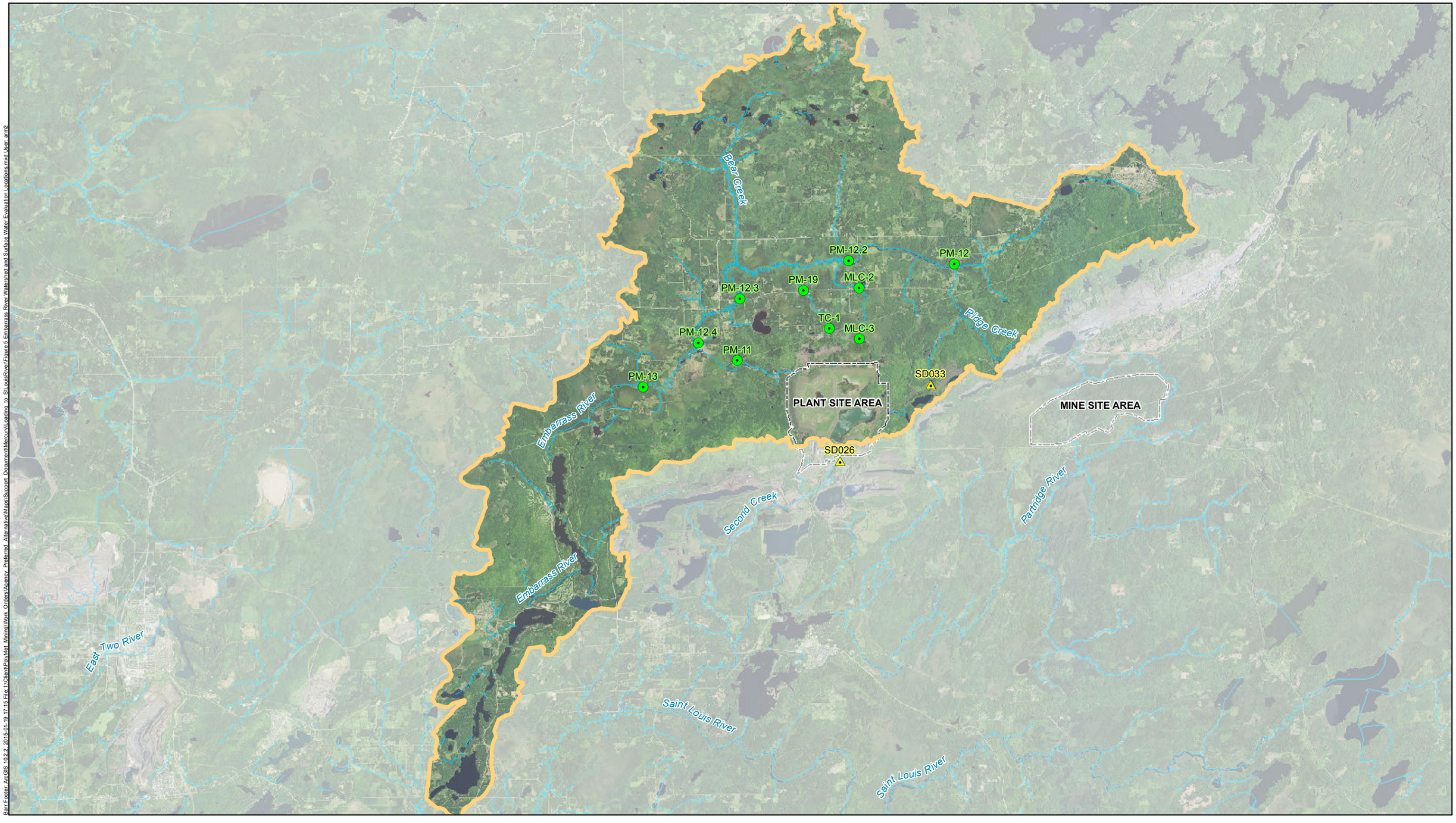
Barr Footer: ArcGIS 10.2.2, 2015-01-19 17:13 File: I:\Client\PolyMet Mining\Work Orders\Agency Preferred Alternative\Maps\Support Documents\Mercury\Loading to StLouisRiver\Figure 4 Mine Site Area Watersheds.mxd User: arm2

Contributing Areas
Non-Contributing Areas
Mine Site
Covered Stockpile
Treated Water Pipeline
Process Water Pipes
Streams/Rivers

N

0 750 1,500 3,000
Feet

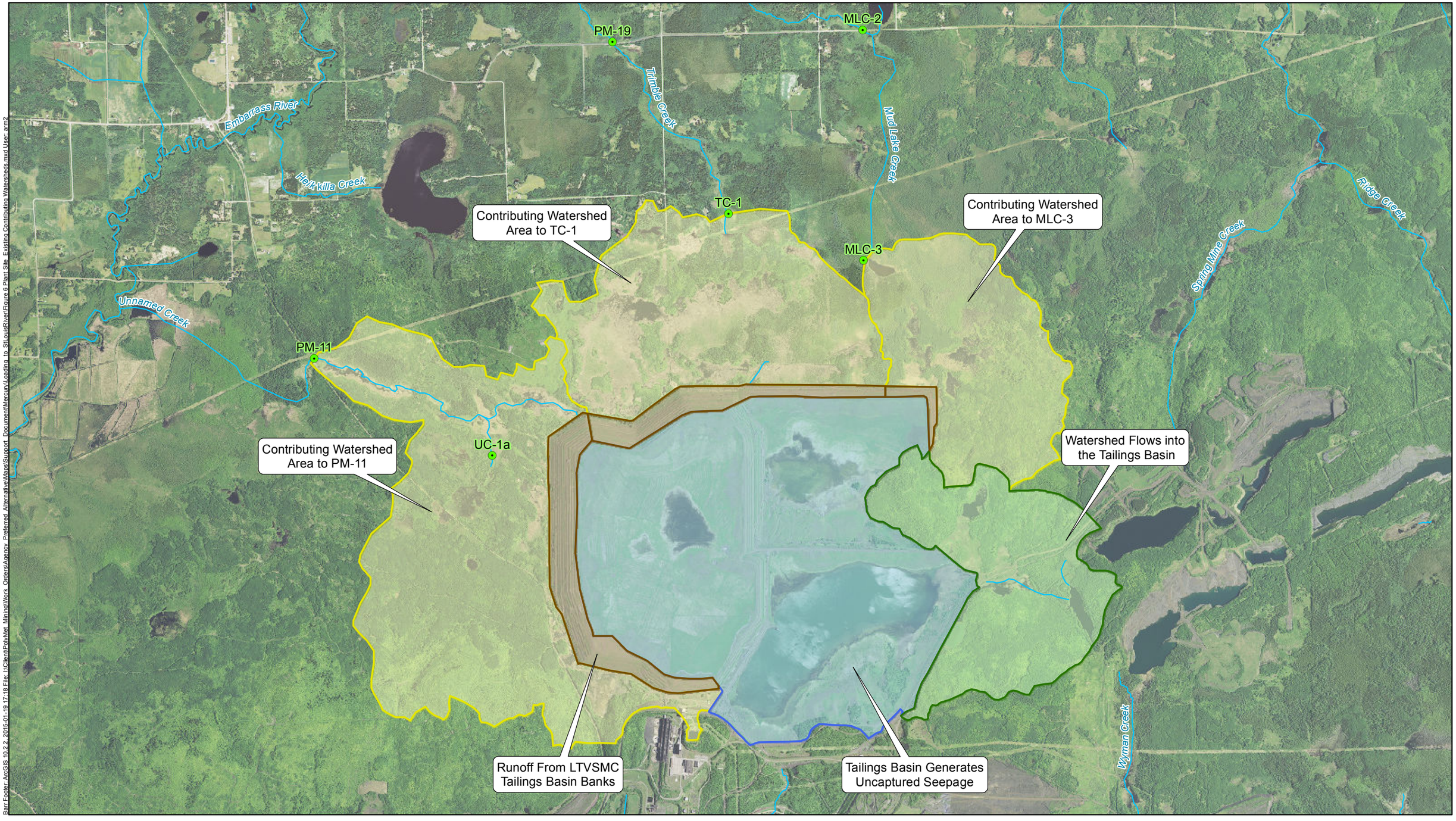
Figure 4
MINE SITE AREA WATERSHEDS
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN



Existing Surface Discharge
Surface Water Evaluation Locations
Embarrass River Watershed
Project Areas
Streams and Rivers

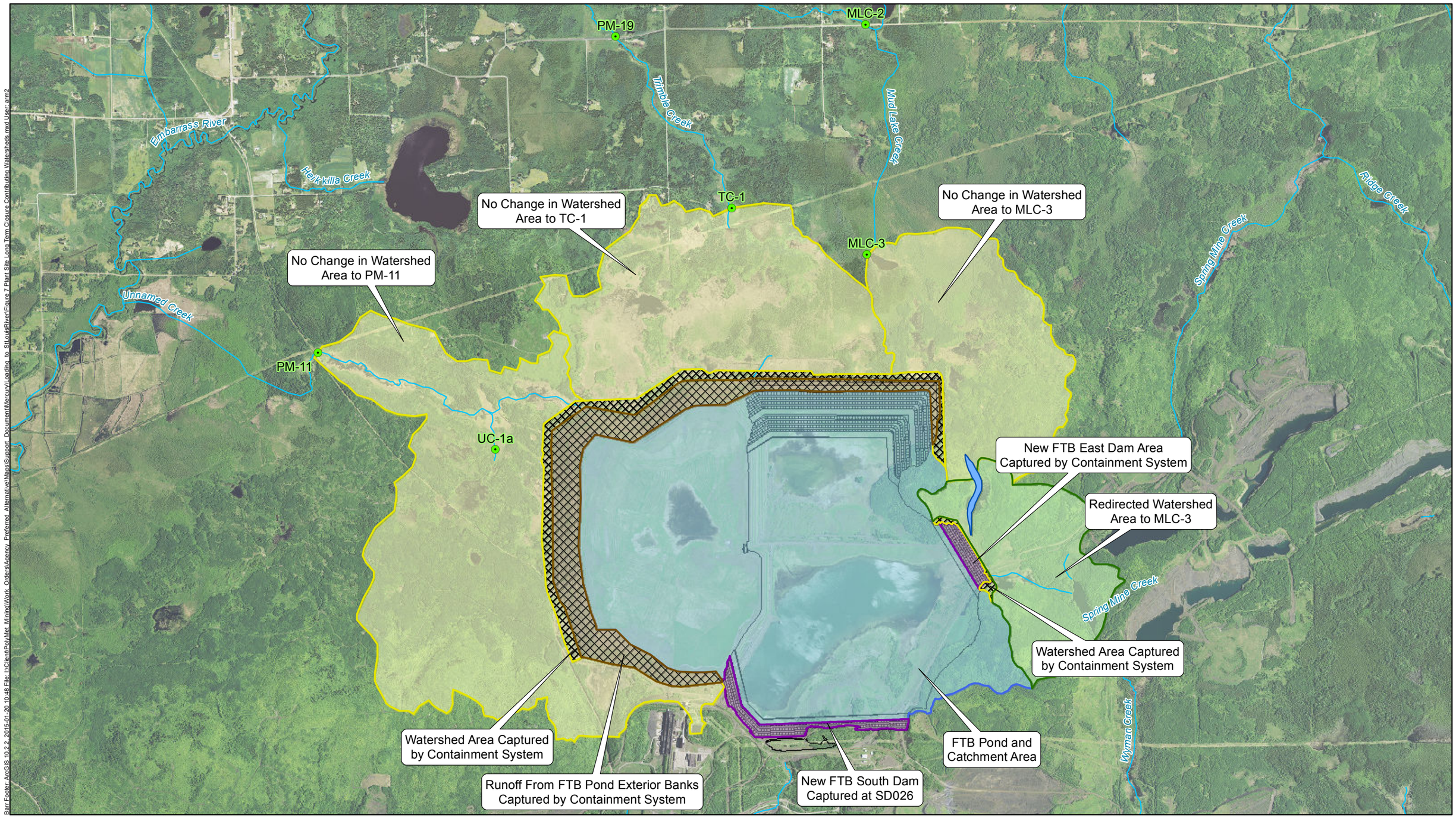
0 1.25 2.5 5
Miles

Figure 5
EMBARRASS RIVER WATERSHED AND
SURFACE WATER EVALUATION LOCATIONS
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, MN



Barr.Foster; ArcGIS 10.2.2, 2015-01-19 17:18 File: I:\Client\PolyMet Mining\Work Orders\Agency Preferred Alternative\Maps\Support Document\MercuryLoading to StLouisRiver\Figure 6 Plant Site Existing Contributing Watersheds.mxd User: arm2

Figure 6
PLANT SITE - EXISTING CONTRIBUTING WATERSHEDS
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, MN



Surface Water Evaluation Location
Streams/Rivers
Drainage Swale
Redirected Watershed Area
Captured LTVSMC Banks
Captured Watershed Area
Existing Watershed Area
New Runoff from Dams
Contributes to Captured Seepage

0 1,500 3,000 6,000
Feet

Figure 7
PLANT SITE - LONG-TERM CLOSURE
CONTRIBUTING WATERSHEDS
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, MN