2012 Minnesota Water Quality:
Surface Water Section

(Abbreviated Narrative Report)

Report to the
Congress of the United States
Water Years 2010 - 2011

2012 Integrated Report

General Report to the Congress of the United States Pursuant to Section 305(b) of the 1972 Clean Water Act

Water Years 2010-2011

Beginning in 2004, the Minnesota Pollution Control Agency began providing the Water Quality Integrated Report to the U.S. Environmental Protection Agency. This report is intended to combine the requirements of Sections 305(b) and 303(d) through the following format: an annual electronic report accompanied biennially (in even years) by an abbreviated narrative report.

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Complete List of Acronyms

ADB	Assessment Database
AU	Assessment Unit
AUID	Assessment Unit Identification
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BWCAW	Boundary Waters Canoe Area Wilderness
BWSR	Minnesota Board of Water and Soil Resources
CALM	Consolidated Assessment and Listing Methodology
CECs	Contaminants of Emerging Concern
CDF	cumulative distribution function
ch.	chapter
chl-a or Chl	Chlorophyll-a
CS	Chronic Standard
CWA	Federal Clean Water Act
CWAMMS	Minnesota Comprehensive Wetland Assessment, Monitoring and Mapping Strategy
CWF	Clean Water Fund
CWLA	Clean Water Legacy Act
CWP	Clean Water Partnership
DLG	Digital Line Graph
DO	Dissolved Oxygen
E. Coli	Escherichia Coli
EDC	Endocrine Disrupting Chemical
EQuIS	Environmental Quality Information System
FAV	Final Acute Value
FQA	Floristic Quality Assessment
FY	Fiscal Year
gpd	gallons per day
GIS	Geographic Information System
Hg	Mercury
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
I&E	Information and Education
ISTS	Individual Sewage Treatment Systems
LGU	Local Governmental Unit
LRVW	Limited Resource Value Waters
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MDNR	Minnesota Department of Natural Resources
MIDS	Minimal Impact Design Standards
Minn.	Minnesota
$mg/_L$	Milligram/litre
MGS	Minnesota Geological Survey
MPCA	Minnesota Pollution Control Agency
MS	Maximum Standard
MS4	Municipal Separate Storm Sewer System

MWSTMP	Minnesota Wetland Status and Trends Monitoring Program
N2K	Need-to-know
NARS	National Aquatic Resource Survey
NE	Northeastern
NHD	National Hydrography Dataset
NLA	National Lake Assessment
NO_2/NO_3	Nitrite/Nitrate
NO_3-N	Nitrate Nitrogen
NPDES	National Pollution Discharge Elimination System
NPS	Nonpoint Source
NSMPP	Nonpoint Source Management Program Plan
NWCA	USEPA's National Wetland Condition Assessment
NWI	National Wetland Inventory
OIRW	Outstanding International Resource Water
ORVW	Outstanding Resource Value Waters
PAH	Polyaromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PFBA	Perfluorobutyric acid
PFC	Perfluorocarbon Chemicals
PFOA	Perfluorooctanic acid
PFOS	Perfluorooctanesulfonic acid
PJG	Professional Judgment Group
POC	Point of Contact
R.	Rule
SCSU	St. Cloud State University
SDS	State Disposal System
SRF	State Revolving Fund
SSC	Stormwater Steering Committee
SSTS	Subsurface Sewage Treatment System
Stat.	Statute
STORET	Storage and Retrieval Information System
subp.	Subpart
SWPPP	Stormwater Pollution Prevention Plan or Program
TCMA	Twin Cities Metropolitan Area
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSS	Total Suspended Solids
US	United States
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WAT	Watershed Assessment Team
WLA	Waste Load Allocations
WCA	Minnesota Wetland Conservation Act
WQ	Water Quality
WQS	Water Quality Standard
WRAPS	Watershed Restoration and Protection Strategy
WWTP	Wastewater Treatment Plant

Table of Contents

Part A. Introduction and Executive Summary

The Minnesota Pollution Control Agency (MPCA) surface and groundwater monitoring activities provide critical information to support our mission of helping Minnesotans protect the environment. To prevent and address problems, decision-makers need good information about the status of the resources, potential and actual threats, options for addressing the threats, and data on how effective management actions have been. The MPCA primarily follows a 10-year rotation for monitoring and assessing waters of the state on the level of Minnesota's 81 major watersheds. Some monitoring – namely monitoring of toxic parameters – continues to occur on a statewide basis. Assessment of those parameters is done statewide every two years, to reflect the monitoring design.

Sections 305(b) and 303(d) of the Federal Clean Water Act (CWA) both call for states to report on their waters to help measure progress toward the national goals of fishable and swimmable waters. The United States Environmental Protection Agency's (USEPA) Consolidated Assessment and Listing Methodology (CALM) integrates the 305(b) Report with the 303(d) Total Maximum Daily Loads (TMDL)s List. Data analyses, determine the extent that all waters are attaining water quality standards (WQS)s, identify impaired waters and the need to be added to the 303(d) list, and identify waters attaining standards that can be removed from the List.

The USEPA website has a significant amount of information on CALM and how it was developed at: http://www.epa.gov/owow/monitoring/calm.html.

Water Quality Assessments for Rivers, Lakes and Certain Wetlands

Presented in Tables I-1 through I-6, are the summary tables for statewide river and lake assessments, using information from the Assessment Database (ADB). An electronic update of the entire ADB is also being submitted to the USEPA.

Water body specific information will be posted on the MPCA website, http://www.pca.state.mn.us/enzqafb. For a watershed specific listing of impaired waters with links to additional information, go to the watersheds webpage: http://www.pca.state.mn.us/jsrid8f.

The methodology for determining these assessments is presented in Part C of this report.

A note to readers about the summary tables:
The summaries in these tables reflect the cumulative assessments from the current reporting cycle and the previous reporting cycles that have not been changed by newer data. They are current with data contained in the 2012 Cycle of the ADB on a particular date. Because there are many steps in developing this document occurring over time, there may be minor differences between the mileage and acreage in the summaries and those in the final ADB submittal if last minute changes occur. Tables 4, 5 and 6 include Minnesota's estimated portion of Lake Superior.

Table I-1. Summary of Fully Supporting and Impaired Waters – Streams

Degrees of Use Support	Miles
Supporting All Assessed Uses - Category 1	**0**
Supporting at Least One Use & None Impaired – Category 2	**3334**
Impaired for One or More Uses – Categories 4 & 5	**12840**
Reviewed but having Insufficient Data to Assess as Impaired or Supporting - Category 3	**3110**
Total:	**19284**

Based on ADB 2012 Cycle data from March 6, 2012

Table I-2. Individual Use Support Summary – Streams

Goals	Use	Miles Reviewed	Miles Supporting	Miles Insufficient Information to Assess	Miles Not Supporting
Protect & Enhance Ecosystems	Aquatic Life	**17478**	**4958**	**3770**	**8750**
	Limited Value Resource Waters	**247**	**0**	**138**	**109**
Protect & Enhance Public Health	Aquatic Consumption	**5922**	**0**	**344**	**5578**
	Aquatic Recreation	**8300**	**1950**	**1303**	**5047**
	Drinking Water	**1944**	**0**	**1817**	**127**

Based on ADB 2012 Cycle data from March 6, 2012

Table I-3. Total Miles of Waters Impaired by Various Cause/Stressor Categories – Streams

Cause/Stressor Name	Impaired Miles
Acetochlor	**9**
Ammonia (Un-ionized)	**88**
Aquatic Macroinvertebrate Bioassessments	**1785**
Arsenic	**147**
Chloride	**206**
Chlorpyrifos	**5**
DDT	**19**
Dieldrin	**19**
Dioxin (including 2, 3, 7, 8-TCDD)	**13**
Escherichia coli	**1891**
Fecal Coliform	**3238**
Fish Bioassessments	**2946**
Lack of Coldwater Assemblage	**38**
Mercury in Fish Tissue	**5324**
Mercury in Water Column	**434**
Nitrates	**127**
Oxygen, Dissolved	**1943**
PCB in Fish Tissue	**1324**
PCB in Water Column	**43**
Perfluorooctane Sulfonate (PFOS) in Fish Tissue	**31**
pH	**118**
Temperature	**10**
Toxaphene	**13**
Turbidity	**5966**

Based on ADB 2012 Cycle data from March 6, 2012

Table I-4. Summary of Fully Supporting and Impaired Waters – Lakes*

Degrees of Use Support	Acres
Supporting All Assessed Uses – Category 1	**0**
Supporting at Least One Use & None Impaired – Category 2	**159313**
Impaired for One or More Uses – Categories 4 & 5	**3654234**
Reviewed but having Insufficient Data to Assess as Supporting or Impaired – Category 3	**181753**
Total:	**3995300**

Based on ADB 2012 Cycle data from February 15, 2012

Table I-5. Individual Use Support Summary – Lakes*

Goals	Use	Acres Reviewed	Acres Supporting	Acres Insufficient Information to Assess	Acres Not Supporting
Protect and Enhance Ecosystems	Aquatic Life	**52420**	**51923**	**0**	**497**
Protect and Enhance Public Health	Aquatic Consumption	**3533031**	**0**	**11429**	**3521602**
	Aquatic Recreation	**2316105**	**761585**	**9900538**	**563982**

Based on ADB 2012 Cycle data from February 15, 2012

Table I-6. Total Acres of Waters Impaired by Various Cause/Stressor Categories – Lakes*

Cause/Stressor Name	Acres
Chloride	**497**
Mercury in Fish Tissue	**3521233**
Mercury in Water Column	**6968**
Nutrient/Eutrophication Biological Indicators	**563982**
PCB in Fish Tissue	**1627560**
Perflurorooctane Sulfonate (PFOS) in Fish Tissue	**1575**

Based on ADB 2012 Cycle data from February 15, 2012

*Data include Lake Superior.

Water Quality Assessments for Wetlands

Minnesota's approximately 10.6 million wetland acres comprise about 19 percent of the state. Historically, Minnesota is believed to have had as much as 21 million acres of wetland. Minnesota wetland protection agencies have traditionally placed support for wetland regulatory programs ahead of monitoring and assessing status and trends in this resource. In recent years additional resources have been directed toward wetland monitoring as well as regulatory program delivery. Effective management and assessment of wetland status and trends is challenging and will require continued efforts by local, state and federal agencies.

The Wetland Conservation Act (WCA) continues to be the principal wetland regulatory program in Minnesota. Central to the WCA is the enactment of state policy to achieve a 'no net loss' and to increase the "quantity, quality and biological diversity of wetlands in the state" (Minn. Stat. § 103A.201). Several water-related regulatory programs including the 404/401 certification permit program, the Minnesota Department of Natural Resources (MDNR) Protected Waters Permit Program and the National Pollution Discharge Elimination System (NPDES) (including stormwater), align with the WCA to provide broad oversight of most types of direct physical wetland alteration in Minnesota.

With support from USEPA, Minnesota developed a multi-agency framework to measure the state's progress in meeting the 'no net loss' policy called the Minnesota Comprehensive Wetland Assessment, Monitoring, and Mapping Strategy (CWAMMS). The overall goal of the CWAMMS was to develop a broadly understood, scientifically sound strategy for monitoring and assessing the status and trends of

wetland quantity and quality statewide. Three general approaches were recommended: 1) implement status and trends surveys of wetland quantity and quality, 2) develop an integrated accounting system for wetland permitting and conservation activities, and 3) update the National Wetland Inventory (NWI) in Minnesota.

Through 2011, a number of activities have been initiated to meet the CWAMMS recommendations:

- In 2006, the MDNR began a statewide remote sensing survey to monitor the status and trends of wetland quantity. The first cycle was completed in 2010 and results will be reported every three years moving forward.
- The MPCA conducted a probabilistic statewide wetland quality survey of depressional wetlands from 2007-09 to begin monitoring the status and trends of wetland quality in the state. Reporting will be completed by mid-2012.
- In conjunction with USEPA's National Wetland Condition Assessment (NWCA), the MPCA expanded probabilistic monitoring to all wetland types in Minnesota by conducting the NWCA sampling in Minnesota and beginning a statewide intensification study in 2011. The MPCA will continue to collaborate with the NWCA team as we report results in 2013 and anticipate continuing the next cycle of wetland quality status and trends monitoring according to the NWCA schedule in 2016.
- In 2010, the MDNR began the first phase of NWI updates of Minnesota.
- The United States (US) Army Corps of Engineers has launched an improved mitigation and wetland bank accounting system called RIBITS that the Board of Water and Soil Resources (BWSR) is using for wetland bank accounting.

Point of contact (POC) is Mike Bourdaghs at 651-757-2239 or michael.bourdaghs@state.mn.us.

Table I-7. Summary of Fully Supporting and Impaired Waters – Wetlands

Degrees of Use Support	Acres
Supporting All Assessed Uses – Category 1	**0**
Supporting at Least One Use and None Impaired – Category 2	**0**
Impaired for One or More Uses – Categories 4 & 5	**940**
Reviewed but Insufficient Data to Assess as Supporting or Impaired – Category 3	**848**
Total:	**1788**

Based on ADB 2012 Cycle data from February 15, 2012

Table I-8. Individual Use Support Summary – Wetlands

Goals	Use	Acres Reviewed	Acres Supporting	Acres Insufficient Information to Assess	Acres Not Supporting
Protect and Enhance Ecosystems	Aquatic Life	**940**	**0**	**0**	**940**
Protect and Enhance Public Health	Aquatic Recreation	**848**	**0**	**848**	**0**

Based on ADB 2012 Cycle data from February 15, 2012

Table I-9. Total Acres of Waters Impaired by Various Cause/Stressor Categories – Wetlands

Cause/Stressor Name	Acres
Aquatic Macroinvertebrate Bioassessments	**323**
Aquatic Plant Bioassessments	**878**

Based on ADB 2012 Cycle data from February 15, 2012

The POC is Doug Hansen at 651-757-2406 or douglas.hansen@state.mn.us.

Water Quality Trends for Minnesota Rivers and Streams

The longest period of record for information on pollutant trends in rivers and streams comes from "Minnesota Milestone" sites. These are a series of 80 monitoring sites across the state with high-quality, long-term data, in some cases going back to the 1950's. While the sites are not necessarily representative of Minnesota's rivers and streams, as a whole they do provide a valuable historical record for many of the state's waters.

Statistical trends analysis for the milestone sites, done in 2000, showed significant reductions across the state for bio-chemical oxygen demand (BOD), total suspended solids (TSS)s, phosphorus (P), ammonia and fecal coliform bacteria. The following table shows the percentage of the 80 milestone sites which had decreasing, increasing or no trends for various pollutants.

Table I-10. Water Quality Trends in Minnesota Rivers

	Biochemical Oxygen Demand	Total Suspended Solids	Total Phosphorus	Nitrite/ Nitrate	Unionized Ammonia	Fecal Coliforms
Decreasing Pollutant Trend	89%	41%	78%	1%	83%	82%
Increasing Pollutant Trend	1%	4%	1%	75%	4%	0%
No Trend	10%	54%	21%	23%	13%	18%

These results reflect the considerable progress made during that time primarily in controlling municipal and industrial point sources of pollution. Nitrogen levels, on the other hand, showed increases at many of the sites, perhaps reflecting continuing nonpoint-source problems.

In 2010, the Minnesota Milestones effort was replaced by the Watershed Pollutant Load Monitoring Network, which consists of permanent flow and chemistry monitoring sites at the outlets of each of Minnesota's major watersheds, as well as main stem large river sites. A number of the load monitoring sites are located at former Minnesota Milestones sites. More information about the Milestone Program, the trends that have been identified using these long-term data is available at: http://www.pca.state.mn.us/0agxaf7. Information about the Watershed Pollutant Load Monitoring Network is available at: http://www.pca.state.mn.us/veize01.

The POC is Dave Christopherson at 651-757-2849 or david.christopherson@state.mn.us.

Trend analysis of stream water clarity data has also recently been done using transparency-tube measurements collected by volunteers through the Citizen Stream Monitoring Program (CSMP). Of the 408 stream sites with sufficient data, 10 exhibited a statistically significant improvement in transparency over time. In contrast, seven exhibited a statistically significant decline in transparency. No clear Water Quality (WQ) trend was exhibited in 391 of the assessed stream sites.

Table I-11. Trends in Minnesota Stream Water Clarity

Description	Number of Streams
Assessed for Trends	**408**
Improving	**10**
Declining	**7**
No Clear Trend	**391**

The POC is Laurie Sovell at 651-757-2750 or laurie.sovell@state.mn.us.

The MPCA received support from the USEPA to conduct a probabilistic survey of its flowing waters as part of the National Flowing Waters survey in 2008. The MPCA has embraced probabilistic surveys as an important surface water monitoring tool in conjunction with its Intensive Watershed Monitoring design.

These surveys are important to scope the extent and magnitude of key existing and emerging water quality indicators. This data will also be a helpful tool in determining time trend information in regards to water conditions. The information from these probabilistic surveys can guide Minnesota's water protection and restoration policies.

The MPCA used state support funds from the project to intensify the geographic distribution of sites with a focus on Level 2 Omernick ecoregions. This was done because the conditions of Minnesota's waters are known to be significantly different from the relatively undeveloped northeast forested areas of the state to the highly developed agricultural areas in the southwestern part of the state. It was felt that a state-wide survey would not be as useful as the ecoregion based approach. Therefore, USEPA statisticians were enlisted to provide a sample draw of sites so that approximately 50 sites per each of the three level 2 ecoregions could be sampled by MPCA staff for a total of 150 sites statewide (see Figure III-9).

Sampling began in the summer of 2010, running from June until September, but was completed in the summer of 2011 due to persistently high flows in 2010. A total of 151 sites were sampled state-wide by the end of the sampling season of 2011. Most sites sampled by the MPCA included biological sampling for fish and aquatic macroinvertebrates, as well as habitat and water chemistry samples. The protocols used can be found on the biological monitoring section of the MPCA website at: http://www.pca.state.mn.us/sbiz8cc.

The POC is April Lueck at 218-316-3909 or april lueck@state.mn.us.

Water Quality Trends for Minnesota Lakes

Detecting trends requires many measurements each summer and several years' worth of data. A variety of statistical tests can be used to perform trend analysis on historical Secchi readings. Kendall's tau-b is a statistical test that has been used in previous MPCA 305(b) reports to Congress (MPCA, 1990 and 1992) for assessing trends in Secchi transparency over time. The seasonal Kendall test is the current method used to determine whether the historic Secchi data for each lake in Minnesota exhibited increasing or decreasing trends. All Secchi readings are assigned a 'season' based on their ecoregion and the date they were taken. Medians are calculated for the readings in each season/year. The statistical software package R is used to run the seasonal Kendall test on these seasonal medians. The trend analysis code requires at least eight years of data to calculate a statistical result.

There were 1,330 lakes in Minnesota that met the minimum requirements for trend analysis in 2010. Of the 1,330 assessed lakes, 324 of them exhibited a statistically significant improvement in transparency over time. In contrast, only 124 lakes exhibited a statistically significant decline in transparency. Of the lakes with sufficient data for trend analysis in 2010, the majority, 882, exhibited no clear WQ trend.

Table I-12. Trends in Minnesota Lake Water Quality

Description	Number of Lakes
Assessed for Trends	**330**
Improving	**324**
Declining	**124**
No Clear Trend	**882**

The POC is Louise Hotka at 651-757-2450 or louise.hotka@state.mn.us.

In addition, the recently established (2008) Sentinel Lakes Monitoring Program will provide a body of data that can be used to calculate trends over time in lakes. More information about the Sentinel Lakes Monitoring Program is available here: http://www.pca.state.mn.us/0agxaf7.

Probabilistic (or random) surveys have become an important tool for monitoring the condition of Minnesota's water resources. These surveys provide data sets that yield statistically sound, unbiased estimates of the condition of the state's water bodies, and are very helpful in determining trends in water resource condition over time.

The MPCA participated in the USEPA's 2007 National Lake Assessment (NLA) survey. Minnesota received 41 lakes as a part of the original draw of lakes for the national survey, and added nine lakes to the survey to yield the 50 lakes needed for a statistically-based statewide estimates of condition. In addition to the 50 lakes, 14 reference lakes were later selected and sampled by EPA as a part of the overall NLA effort. Data from the reference lakes provide an additional basis for assessing lake condition as a part of NLA. While the 2007 data are not sufficient for broad, state-scale, assessment of temporal trends, they are valuable for assessing spatial trends (patterns) and provide valuable insight on a variety of lake management issues. Two examples are provided in Part C.5.2, and further details may be found at http://www.pca.state.mn.us/nwqhae1. The NLA survey was repeated in 2012; data and results from that effort are pending.

Public Participation

A description of the public participation process and a copy of all letters, e-mails, etc. received from the public and a responsiveness summary were included along with the draft TMDL List (see Appendix C.1) sent to USEPA in September 2012.

The draft 2012 TMDL List can be found on the MPCA TMDL Assessment and Listing website at: http://www.pca.state.mn.us/enzq94b.

The POC is Howard Markus at 651-757-2551 or howard.markus@state.mn.us.

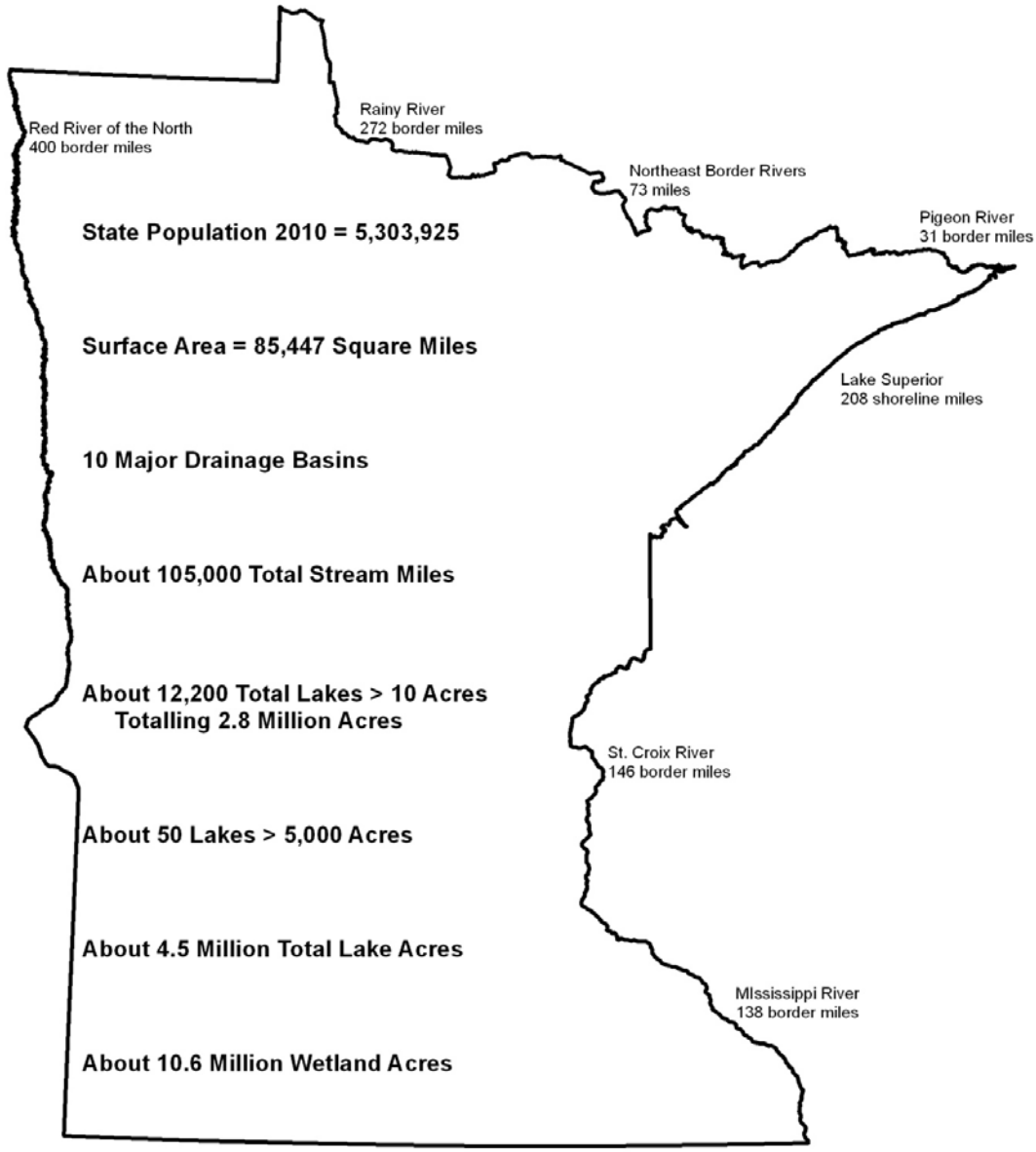
Part B. Background Information

B.1. Total Waters

State Background Information

The estimates of background information (in Figure II-1) for water bodies were developed from 1:24,000 scale National Hydrography Dataset (NHD), with the exception of the estimate for wetland acres. The total lake acres estimate includes the Minnesota portion of border lakes and Lake Superior. Wetland acres estimates were obtained from the NWI dataset, which is not derived from 1:24,000 source data; rather it was interpreted from aerial imagery at a resolution that makes it appropriate for use at 1:24,000 or smaller.

Figure II-1. Minnesota Background Information and Border Waters



Watershed Approach

Minnesota's Clean Water Legacy Act (CWLA), passed in 2006, provides a policy framework and resources to state and local governments to accelerate efforts to monitor, assess, and restore impaired waters, and to protect unimpaired waters. The MPCA primarily follows a 10-year rotation for monitoring and assessing waters of the state on the level of Minnesota's 81 major watersheds. Some monitoring – namely monitoring of toxic parameters – continues to occur on a statewide basis. Assessment of those parameters is done statewide every two years, to reflect the monitoring design.

The watershed approach provides a unifying focus on the water resource as the starting point for WQ assessment, planning, and results measures. It provides a predictable schedule to monitor all of the state's major watersheds while accomplishing the following:

- Provides advance notice to interested stakeholders, local governments and volunteers participating in monitoring plans.
- Allows local groups to conduct monitoring efforts in conjunction with or in-between agency monitoring efforts.
- Informs stakeholders when TMDL study or protection strategy work will begin in their area.
- Insures that comprehensive information on the status of WQ and WQ management efforts is collected, evaluated and provided to state and local partners at least once each decade.

This approach may be modified to meet local conditions, based on factors such as watershed size, landscape diversity and geographic complexity (e.g. Twin Cities metro area).

For more detail on MPCA's watershed approach including the 10-year Intensive Watershed Monitoring Schedule see the Watershed Approach webpage at: http://www.pca.state.mn.us/irypabf.

The POC for this is Cathy O'Dell at 651-757-2621 or catherine.odell@state.mn.us.

B.2. Water Program Areas

B.2.1. Wastewater Overview

Background

The overall goal of the wastewater programs to assure that discharge of treated wastewater to surface waters and groundwater is protective of public health and the environment, and that the following two MPCA Strategic Plan objectives are met:

W3b) Wastewater NPDES facilities do not contribute to the impairment or degradation of state waters.

W3c) By January 1, 2014, strengthen local programs to reduce the percentage of subsurface sewage treatment systems (SSTS) characterized as failing or imminent threats to public health and safety from 39 percent to less than five percent.

Find the MPCA Strategic Plan at this link: http://www.pca.state.mn.us/tchy3da. To meet these overall goals, the MPCA and its partners conduct technical assistance, develop rules and policy, permitting, land application approvals, limits determination, environmental reviews, technical reviews, compliance and enforcement, financial assistance, training, certification and licensing. The MPCA conducts this work with partners that include the municipal wastewater, water treatment, industrial wastewater and

industrial stormwater facilities; local units of government (LGU), USEPA, other funding agencies and pumpers, installers, and inspectors of individual sewage treatment systems (ISTS).

The POC is Wendy Turri at 507-206-2651 or wendy.turri@state.mn.us.

2011 Accomplishments

TMDLs

- As of April 2012, the Agency has completed 31 TMDL projects that contain wastewater Waste Load Allocations (WLA) that cover a total of 235 industrial and municipal dischargers. The agency places those WLA into its NPDES/SDS permits during reissuance. There are multiple individual TMDLs associated with each TMDL project.

Pretreatment

- The pretreatment rulemaking has been completed and the rules have been fully implemented.
- Routine program oversight, including review of annual reports, and annual inspections of the delegated publicly owned treatment plants and two audits.
- Four reissued wastewater treatment permits have included compliance schedules for the development of delegated pretreatment programs.
- Enforcement support.

Large (10,000 gallons per day) (gpd) Subsurface Treatment Systems

- Design guidance update
- Implementing the previously developed reduced permit monitoring policy
- Reduced permit monitoring policy

Hydrologists

- Permit technical support
- Enforcement support
- Training support

Training and Certification

- Continued success with the Need-to-Know (N2K) Certification Implementation. The SSTS Business License Expiration Notification process was also implemented.
- Successful Collection System Operators and Wastewater Treatment Plant (WWTP) Operation Annual Conferences had a combined attendance of almost 800 people.
- The Wastewater Training Team conducted approximately 28 learning events, which trained over 1200 operators, and led our annual conferences.
- The Wastewater Training Advisory Committee continues to review current courses and complete a needs assessment for new wastewater courses.
- The unit continues to work to establish better systems, processes and procedures to do more with fewer resources. We are working hard to reach out to new customers and reaffirm and strengthen relationships with established partners and customers.

- Formal training is offered in the Wastewater, Solid Waste and ISTS programs, the unit also provides much needed one-to-one consulting with city, wastewater facility, and small business personnel.
- The Wastewater Training Team has reviewed and updated the Wastewater Collection System Operator Exams (SA, SB, SC, SD). This review will be conducted again as the Wastewater N2K is completed.

Financial Assistance Program and Policy Development/Implementation

- Continued to manage the funds associated with the American Recovery and Relief Act of 2009 (Federal Stimulus) which provided a significant amount of new wastewater and stormwater infrastructure funding assistance and related project activity.
- Completed 2012 Project Priority List to the satisfaction of our Clean Water Revolving Fund partner, the Public Facilities Authority.
- Completed required legislative report on Future Wastewater Infrastructure Needs and Capital Costs. Completed required legislative report on New Wastewater Treatment Facilities.

Subsurface Sewage Treatment System Program and Policy Development/Implementation

- Completed annual activities and reporting for the "Unsewered (small community needs) Strategy", the SSTS Annual Report, and the Tank Fee Program. Statistics are compiled and used to evaluate program effectiveness and highlight areas where additional activity is needed.
- Continued SSTS rule implementation by developing new programs like Product Registration and the Septic Tank program, assisting LGUs as they update local ordinances, providing design guidance; rule interpretations and fact sheets; communication through websites, the SSTS e-newsletter, and newsletters from other organizations.
- Provided assistance in the certification and licensing of SSTS Professionals including application reviews, participating with the SSTS Advisory Committee and other partners, providing technical assistance, and by assisting in the On-site Training Program offered by the University of Minnesota, as well as other training events.
- Updated SSTS prescriptive design guidance as required by Statute 115.56 for systems up to 5,000 gpd. This work, with both internal and external partners, is to resolve long standing issues relating to the design of SSTS and the need for professional licenses and/or certifications.
- Provided 2010-11 legislative session assistance for budget and other program needs as they impact the MPCA, LGUs and the SSTS industry. This includes working with the Clean Water Council, the body that advises the legislature on spending relating to the Clean Water Legacy funds.

Inspection Numbers and Other Accomplishments

- Continued implementation of regional teams for the Unsewered (small community needs) Strategy
- Continued work on DELTA inspections team to improve usefulness of DELTA for inspection activities
- Completed all Biosolids and Pretreatment Annual Report Reviews
- Enhanced use and of a new Biosolids Inspection Checklist
- In the process of requiring the development of seven delegated pretreatment programs as individual permits are reissued
- Regulated point source WQ program (2010-2011):
  - Completed 18 Biosolids compliance and/or land application inspections
  - Completed 16 Pretreatment compliance inspections and/or audits

- Completed 482 Compliance evaluation inspections
- Industrial – 61
- Municipal – 421
- Completed 78 Compliance actions (formal with penalty and schedule of compliance)
  - Industrial – 41
  - Municipal – 37

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B.2.2. Nonpoint Source Pollution Control

Introduction

Minnesota is fortunate to have many water bodies that are in good condition because their terrestrial watersheds still have minimal development, although all surface waters are affected by atmospheric pollutants such as mercury (Hg). It is important to protect the good condition of many water bodies, while also addressing degraded water resources.

Most of the pollution originating from point sources (municipal and industrial facilities discharging to a state water) has been controlled. Water quality is mainly degraded by the pollutants entering surface waters from nonpoint sources (NPS)s derived from both air pollution and runoff from land, particularly from watersheds dominated by agricultural and urban land use. The NPS pollution is the major cause of degradation of Minnesota's surface and groundwater, impairing recreation, fish consumption, drinking water use, and aquatic life.

The state restoration plans follow a 'resource management system' concept on a watershed basis, selecting and applying a set of site-specific Best Management Practices (BMPs) within a watershed unit.

Updated Nonpoint Source Assessment

The Updated NPS Assessment in the 2008 Nonpoint Source Management Program Plan (NSMPP) reports the following steps have been taken since 2001 to improve the assessments

- Incorporate biological assessment information, where available, into the process including development of biocriteria for watersheds where none had existed before
- Increased coordination of monitoring and assessment activities among local, state and federal agencies
- Included atmospheric deposition as a source of pollutant loading in the assessment
- Developed assessments using an increasing number of credible sources of information
- All contributing monitoring entities are reviewing assessment data for adequacy, relevance and validity
- Reporting different use supports to reflect adequacy of WQ for various uses, rather than simply reporting an 'overall use'

2008 Nonpoint Source Management Program Plan

Minnesota's 2008 NSMPP was approved by the USEPA on March 14, 2008. Developing this Plan was a statewide effort. Seventeen technical committees comprised of more than 200 representatives of 50

federal, state and local governmental agencies, and public and private environmental organizations, worked to develop the NSMPP. The MPCA coordinated overall development of the NSMPP. The 17 chapters/strategies of the NSMPP examine sources contributing to NPS water pollution. Most of the chapters/strategies include action plans recommending implementation of NPS pollution control measures.

The state of Minnesota NSMPP is a requirement for Minnesota to remain eligible to receive NPS grant funds from the USEPA under Section 319 of the CWA. Any actions to be undertaken by a NPS water pollution control project must be cited in this document to be eligible for a Section 319 Grant Award.

The website for Minnesota's 2008 NSMPP is: http://www.pca.state.mn.us/tchyb3c.

MPCA will lead efforts to develop Minnesota's revised 2013-2017 NSMPP.

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Federal Clean Water Act - Section 319

Section 319 of the CWA requires each state to assess NPSs of pollution within its boundaries. State investigations must identify NPSs of pollution that contribute to WQ problems, as well as waters or stream segments unlikely to meet WQSs without additional NPS controls. State management programs must:

- run for a specific number of years
- identify the NPS controls necessary
- specify the programs that will apply the controls
- certify that the state has adequate authority to implement these measures
- identify all sources of funding for these programs
- establish a schedule for implementation

Section 319 NPS funds are made available to assist LGUs and organizations in Minnesota to implement NPS measures that reduce water pollution to lakes, rivers, wetlands and groundwater resources.

Investment in education must be considered an essential and integral part of every step in the 2008 NSMPP. In almost every chapter of this management plan, education is recognized as an important means for effecting change with respect to NPS water pollution problems.

Through twenty-four annual funding cycles of the Federal Section 319 Program (1989 through 2012) the MPCA has awarded $55,979,611 for 514 NPS projects.

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Clean Water Partnership Financial Assistance

The program, established in 1987, relies upon LGUs and other partners to submit proposals to MPCA for watershed projects. The MPCA scores the projects based on a set of scoring criteria established in state rules. The highest-scored projects are then eligible for financial and technical assistance from the state. Clean Water Partnership (CWP) projects involve the following:

- Completing a comprehensive diagnostic study of a water body and its watershed by identifying the pollutants that cause a reduction of WQ and the origin of the pollutants
- Developing an implementation plan that identifies the BMPs needed to restore and protect WQ
- Implementing the BMP

Through twenty-four annual CWP funding cycles (1989 through 2012) the MPCA has awarded $39,333,613 in grant funding to 111 resource investigation projects, 76 implementation projects and 83 continuation projects.

Through eighteen annual CWP funding cycles for loans (1995 through 2012), the MPCA has awarded $53,081,538 in low-interest loans to 210 implementation and continuation projects.

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Statewide Information and Education

Good information about the condition of waters and the health of aquatic systems on a watershed scale is absolutely critical. This is especially important as Minnesota's clean water program continues moving to a watershed approach with a commitment to identify and address remaining WQ problems. The MPCA addresses impaired waters through TMDL studies. The CWA's impaired waters provisions call for taking measures to mitigate NPS pollution, but neither state nor federal agencies have the authority to regulate much of the activity that causes such pollution. Many of the needed mitigation measures will consist of education and pollution reduction incentives. This makes it all the more important to have in place sound Information and Education (I&E) approaches and strategies for NPS issues.

The MPCA set five major I&E goals to address NPS water pollution in the 2008 through 2012 version of the NSMPP. They are:

- Build and improve capacity to deliver NPS-related I&E at state and local level
- Raise the general public's awareness about the nature of NPS pollution, how communities and individuals contribute to it, and what governmental organizations and individuals are doing about it
- Foster coordination and cooperation between governmental agencies and private, nonprofit and other organizations to carry out I&E efforts
- Include NPS I&E in formal and informal educational curricula
- Effectively measure impact of NPS I&E activities

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B.2.3. Stormwater Program

Section 402 of the CWA established the NPDES permit program to specifically control the discharge of pollutants from point source dischargers to waters of the US. A 1987 amendment to the CWA required stormwater discharges from municipal, construction, and industrial sources to be permitted under the NPDES permit program. The amendment was to be implemented in two phases, Phase I in the early 1990's and Phase II in March 2003.

The Phase I federal regulations required NPDES permits for two broad categories of stormwater discharges: 1) medium and large municipal separate storm sewer systems (MS4s) serving populations of

100,000 or more, and 2) eleven categories of industrial activity, including larger construction activities disturbing five or more acres of land. The Phase II federal regulations expanded the scope of the existing NPDES permitting program to include discharges of stormwater from smaller MS4s in urbanized areas, from construction activities that disturb between one and five acres, and from smaller municipally owned industrial activities.

The MPCA is the delegated NPDES authority to implement the stormwater regulatory program in Minnesota. The MPCA issues general and individual NPDES permits for each program area: municipal, construction, and industrial. These permits require permittees to control discharges of polluted stormwater runoff by implementing BMPs which are incorporated in the permittees Stormwater Pollution Prevention Program or Plan (SWPPP). The MPCA's stormwater webpage is available at: http://www.pca.state.mn.us/nwqha90.

In implementing the Phase II requirements, the MPCA was directed by the Minnesota Court of Appeals to address Minnesota nondegradation rules stemming from federal anti-degradation policy (see http://www.epa.gov/lawsregs/regulations/); and to conduct review and provide opportunity for public comment and hearing on permittee's individual SWPPPs in a general permit setting. Together these have presented a considerable challenge and burden on MPCA resources.

In 2004, the Minnesota Stormwater Steering Committee (SSC) was formed; a team of public and private organizations committed to improving stormwater management in Minnesota. With various groups and entities involved in stormwater management, the SSC provides a forum for communication between different governmental units and stakeholders, and seeks to improve the effectiveness and coordination of groups involved in stormwater management. The SSC webpage is available at: http://www.pca.state.mn.us/wfhya76.

The SSC forms work groups for specific tasks to provide technical expertise and recommendations on their specific issues to the SSC. Various SSC work groups have completed the following products: 1) the Minnesota Stormwater Manual, 2) the Recommended Solutions to Enhance Compliance with the NPDES Construction Permit (report) and study conclusions, and 3) recommendations on Integrating Stormwater Permitting and Watershed Management (which examines the feasibility of a watershed-based permitting approach for MS4s in Minnesota).

The minimal impact design standards (MIDS) work group was most recently formed with a diverse group of partners. The MIDS work was funded by the 2009 Legislature to 'develop performance standards, design standards or other tools to enable and promote the implementation of low impact development and other stormwater management techniques.' The MIDS webpage is available at: http://www.pca.state.mn.us/veiza8e.

The MPCA received legislative funding in 2011 to update and append the Minnesota Stormwater Manual. Since the last Manual update in 2008, the MPCA and MIDS technical teams have identified several additional areas where new information and/or updates are needed if the Manual is to continue to be a primary resource for Minnesota's stormwater practitioners. The MIDS work group efforts will be coordinated with and inform the Manual update effort.

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Municipal Stormwater

The MPCA issued the original small MS4 general permit in June of 2002. The permit was appealed and the Minnesota Court of Appeals remanded the permit to the MPCA requiring the MPCA to provide opportunity for public comment on each permittees SWPPP, and to address anti-degradation and several other issues. The MS4 general permit was revised to meet the court remanded issues and became effective June 2006. In September 2009, the MPCA completed meaningful review and public notice of all individual SWPPPs and applications under the 2006 MS4 general permit. Permit coverage was issued to all 233 permit applicants.

In 2010, the municipal stormwater program shifted more work activity into technical assistance and adaptive management for stormwater systems, evaluating compliance with rules, TMDLs, and the permit conditions. Randomly selected and targeted MS4s received an audit evaluation of parts or all of their stormwater programs. With limited staff resources, the MPCA goal was to conduct a combination of audits and inspections on 24 MS4s during 2010; 15 audits were conducted due in large part to the loss of one staff person. The municipal program is currently conducting an evaluation of the existing audit process and will look for ways to achieve audit goals in a more efficient and effective manner through completion of a process improvement project.

The existing MS4 general permit expired in May 2011. Internal work on reissuance of the permit began in 2009. Staff focused on the highest priority issues for permit revision and began to obtain stakeholder input in the permit revision process in early 2010. The draft MS4 general permit was first placed on public notice May 31, 2011, for a 45 day comment period. The public notice comment period for the draft permit was extended in August 2011, due in part to the state government shutdown which occurred in July. Multiple large group meetings with stakeholders were held to discuss key issues identified in their comments submitted. A revised draft permit was public noticed in the summer of 2012. The MPCA is currently making final revisions to the draft permit based on comments received; with early 2013 targeted for final permit reissuance.

The MPCA is trying to manage new competing demands for staff resources associated with several projects in 2012 that will carry over into 2013. These include project management of the previously identified MIDS project and the Stormwater Manual update effort, as well as the State Revolving Fund (SRF). Stormwater staff assisted in review and processing of 40 applications for SRF projects in 2011; one of those projects, for the City of Minneapolis, has been funded. The rules for wastewater and stormwater treatment assistance (Minn. R. ch. 7077) are in the process of being amended to allow for funding of more stormwater projects in the future; stormwater staff is assisting with this rulemaking. Completion of these rule amendments is targeted for June 2012. Also included are tasks mandated in 2009 Legislation on polyaromatic hydrocarbons (PAHs) in stormwater ponds, including pond inventory, and development of BMPs for treatment. Information on the restriction of coal tar-based sealants which contain PAHs, and completed work efforts to date which include a model ordinance, and grants to help municipalities clean out PAH-contaminated sediment in stormwater ponds is available at: http://www.pca.state.mn.us/ktqha7e. In addition, Minnesota, Wisconsin, and Michigan are joint recipients of USEPA grant funding for work on interstate consistency on managing pollution prevention activities related to PAHs. Also, integration of impaired waters and TMDL implementation with the MS4 general permit requires additional staff resources for planning, communication, and compliance work with MS4 permittees.

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Construction Stormwater

The Phase I rules regulated large construction activities that disturb five or more acres of land. The Phase II rules required small construction activities disturbing one to five acres, including construction that is part of a common plan of development or sale disturbing one acre or more, to have NPDES permit coverage. In August 2003, the MPCA issued a revised construction stormwater general permit for construction activity over one acre of disturbance, incorporating both the Phase I and Phase II regulations for stormwater discharges associated with construction activity. The 2003 permit provided additional environmental protection for the state's ORVWs and wetlands, better regulated construction activity within subdivisions, and provided more options for post-construction BMPs than previous permits. In August 2008, the MPCA re-issued the construction stormwater general permit with revisions that included new requirements for impaired waters covered by a USEPA approved TMDL, revised requirements for change of permit coverage, and training.

The MPCA plans to refine and reissue the construction stormwater general permit before the current permit expires in August 2013. Work on this permit reissuance began in the fall of 2011. The MPCA will need to comply with the USEPA final rule on Effluent Guidelines for Discharges from Construction and Development Sites (December 2009) with the 2013 permit reissuance.

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Industrial Stormwater

In fall 2006, an industrial work group was formed to work with the MPCA to develop Minnesota's Industrial Stormwater Multi-Sector General Permit and permit program. USEPA's permit (issued September 2008) was used as a model for Minnesota's permit. The draft Permit was placed on public notice in July 2009. The permit was finalized and became effective on April 5, 2010. Benchmark monitoring began after April 2011; the "year two" monitoring starts one year after the permittee's authorization date for permit coverage. Since permit issuance, the Industrial Stormwater Program has shifted focus from permit guidance development to: 1) education and outreach, 2) local partnership development, 3) sampling data for measures, and 4) compliance and enforcement. The Industrial Stormwater Program will continue to collaborate with the University of Minnesota to provide training on the new permit requirements, including monitoring training workshops. Several training events were held during 2009-2012.

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Stormwater Rules

Minnesota State Stormwater Rules, Minn. R. ch. 7090, were enacted August 15, 2005, combining the Phase I and Phase II Rules in one place. The Rules designated 43 additional small MS4s for permit coverage, as well as the entire jurisdiction of cities and townships that are located partially within an urbanized area. Federal stormwater rulemaking is currently underway with final action on the rules expected in late 2012. The MPCA will need to comply with the new federal rules according to the applicable schedules identified in the rules.

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B.3. Cost/Benefit Analysis

Underlying the nation's water pollution control efforts is the assumption that the overall cost of those efforts, while considerable, is outweighed by the resulting benefit.

Cost-benefit analysis is an attempt to make this assumption explicit and testable. However, estimating the benefits associated with environmental programs (and, to an extent, even the costs) is challenging. While the influence of environmental factors on market prices and the positive value that people place on environmental improvements is at this point fairly well established, it remains extremely difficult to estimate environmental values with precision. As a result, environmental policy decisions continue to be made through the political process, rather than through the strict application of a quantitative cost-benefit analysis, which would be incomplete and of debatable accuracy.

Nevertheless, the underlying purpose of cost-benefit analysis – the assurance that the public's dollars are well spent – lies at the heart of the MPCA's considerable efforts at cost control and program effectiveness. In a time of decreased funding countered by increased demand for environmental services, the MPCA has done a great deal to ensure that its programs are directed towards the most important environmental problems and that those programs are conducted as cost-effectively as possible. Ongoing process-improvement efforts addressing the efficiency of various agency programs, and the *Environmental Information Report – An Assessment of Stressors Facing Minnesota's Environment*, a tool used by the MPCA to help prioritize the environmental problems currently faced by Minnesota, are only two examples of this continuing effort.

A partial accounting – partly quantitative, partly descriptive – of some of the costs and benefits associated with Minnesota's water quality program is given below.

Costs

The primary water quality programs at the state level are those of the MPCA, DNR, MDA, MDH and the BWSR. Including local assistance, the WQ budget of the MPCA is approximately $55 million per year and of BWSR approximately $71 million per year. Other costs are incurred at the local level in the regulation of land use, feedlots, and on-site sewage disposal systems. It should be noted also that other environmental programs, such as air quality, solid waste, hazardous waste, and agricultural pesticide regulation have direct effects on the quality of the state's surface and groundwaters. The MPCA, which has primary jurisdiction for the first three of these, has an overall budget of approximately $170 million per year.

Regarding the actual implementation of point source water pollution controls, approximately $2 billion in federal, state, and local funds have been spent since the enactment of the CWA for the construction of municipal wastewater treatment facilities in the state, including the separation of combined sewers. Operating costs for Minnesota municipal sewer utilities for 2009 are estimated by the Office of the State Auditor for 2009 at $567 million, while an incomplete estimate of industrial water pollution control costs derived from the federal survey of Pollution Abatement and Control Expenditures for 2005 in (estimated) equivalent 2009 dollars is $135 million. Note, however, that municipal facilities treat industrial as well as municipal wastes and that industrial contributions represent a significant portion of the above figures.

Regarding the implementation of NPS water pollution controls, the overall costs are both more diffuse and more difficult to calculate than are those for point source programs. Current estimates, however,

are that it will take as much as $3 billion to restore Minnesota waters on the current 303(d) list that are impaired by NPSs. Details on these estimated costs can be found at http://www.pca.state.mn.us/yhiz926.

Benefits

If the comprehensive costs of water pollution control efforts are not fully calculated, the benefits are even less well measured. Theoretical models for translating water quality improvement into economically measured benefits do exist but no attempts have been made to do this for the state as a whole.

For point source programs, even if dollar figures are not readily available, benefits can be illustrated in descriptive terms. Significant improvements in state water quality have occurred over the past several decades, especially since the passage of the CWA. While only 20 percent of the state's sewered population was served by facilities capable of at least secondary treatment in 1952, fully 99.9 percent are so served at present. In a similar vein, rates of regulatory compliance for municipal and industrial facilities are at a high level, with more than 95 percent of major permittees meeting their effluent limits.

Even more striking are the indications of water quality improvements associated with improvements in specific major wastewater treatment facilities. On the Mississippi River below the Twin Cities, both the elimination of floating mats of sludge and the return of the mayfly are evidence of cleaner water conditions that followed massive treatment facility construction and stormwater separation. Parks are being developed up and down the river's shores and recreational boat use has increased significantly. In the St. Louis River Bay, while sediment and fish tissue contamination problems remain, facility construction by the Western Lake Superior Sanitary District has led to noticeably cleaner water and return to use of the river as a walleye fishery. Similar results have been achieved on the Rainy River below International Falls. While the NPS program is considerably younger than that for point sources, similar benefits are beginning to be shown. The water quality projects implemented through local cooperators have led to significant improvements in specifically targeted problem areas. Improved water quality in Lake Bemidji and Lake Shokatan are examples of this. Perhaps even more impressive is the water quality improvements for the Minnesota River, with a 25 percent reduction since 1998 in sediment carried by the river during typical flow conditions. Increased use of agricultural soil conservation practices in recent years appear to be the main reason behind the reductions, and is a large step towards meeting the ultimate goal of a 40 percent reduction in sediment originating from cropland in the basin. Similar improvements have been seen for Phosphorous and BOD concentrations in the river. A map of impaired waterbodies that have been restored to meeting water quality standards is found at http://www.pca.state.mn.us/index.php/view-document.html?gid=15339.

As a result of both point source and NPS programs, water quality improvements in the state have been significant. Over the last three decades, the large majority of regularly monitored streams show a decreasing pollutant trend for BOD (89 percent of sites), fecal coliform bacteria (82 percent), ammonia (83 percent), and TP (78 percent). (On the other hand, only 42 percent of the sites show a decreasing trend for TSSs, and fully 75 percent of the sites show an increasing trend for nitrite/nitrate (NO_2/NO_3)).

Indicative of both the value of clean water and the success of Minnesota's clean water programs is the large total revenue of the state's tourism industry. At approximately $10 billion per year, the economic importance to the state is considerable; water is one of the state's greatest attractions and plays a critical role in those dollars. Similarly, a recent study by Bemidji State University on the socio-economic value of Minnesota lakes found a strong relationship between water clarity and lake property values,

with an increase (or decrease) of one meter in clarity leading to changes of tens or even hundreds of millions of dollars for given individual lakes. This matches with the results of studies elsewhere in the US demonstrating and quantifying the benefits of WQ protection and improvement.

An accounting of some of the key results regarding the MPCA's environmental programs can be found at http://www.pca.state.mn.us/gp0r10bb.

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B.4. Special State Concerns and Recommendations

B.4.1. Restoring Impaired Waters and Protecting Unimpaired Waters

Impaired waters continue to be a special and growing concern. When a water body fails to meet WQSs because of one or more pollutants, it is considered 'impaired'. The 2012 Draft Inventory contains 3638 impairments; the 2010 Inventory had 3050 impairments. For context, the 2008 Inventory had 2575 impairments. The largest sources of the increases include additional waterbodies with excess bacteria, additional waterbodies with eutrophication excesses, and additional waterbodies with excess Hg in fish.

These pollution problems are caused by a combination of point and NPSs. (For more information see Appendix C.1., Impaired Waters List).

To help accelerate Minnesota's efforts to address impaired waters as well as protect and improve unimpaired waters, two critical developments have occurred over the past three years. First, the Minnesota Legislature adopted the CWLA in 2006. The Act provided a policy framework and additional funding for monitoring and assessment, TMDL development, and restoration activities.

Then, in November of 2008, the voters of Minnesota approved an amendment to the state's constitution to raise the sales and use tax rate by three-eighths of one percent on taxable sales, starting July 1, 2009, and continuing through 2034. Of those funds, approximately 33 percent will be dedicated to a Clean Water Fund (CWF) to protect, enhance, and restore WQ in lakes, rivers, streams, and groundwater, with at least five percent of the fund targeted to protect drinking water sources. Revenues appropriated from the CWF will vary depending on the economy, but estimates range from $150-$200 million per biennium.

The majority of CWF appropriations will be allocated to point and nonpoint-related programs governed by several state agencies, including the MPCA, the BWSR, the Minnesota Department of Agriculture (MDA), the Minnesota Department of Natural Resources (MDNR) and the Minnesota Department of Health (MDH).

These agencies are coordinating closely with LGUs to implement water programs. This will be a critical boost to Minnesota's efforts. For more information, see http://www.pca.state.mn.us/dm0r92d.

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B.4.2. Other Contaminants of Concern in Minnesota's Environment

The MPCA is attempting to stay abreast of newly recognized environmental contaminants and other issues that have the potential to cause known or suspected adverse ecological and/or human health

effects but are not well understood. These newly recognized contaminants of concern are not routinely addressed by traditional environmental protection programs in Minnesota or elsewhere.

Newly recognized environmental contaminants include pharmaceuticals, household and industrial-use products; endocrine disrupting compounds (EDCs); brominated flame retardants; and perfluorinated chemicals (PFCs). These chemicals can enter the environment through consumer products, solid waste disposal, agricultural and urban runoff, residential and industrial wastewater, and long-range atmospheric transport. Many newly recognized environmental contaminants have been identified because of advances in analytical chemistry that make it possible to analyze complex chemicals and detect these chemicals at extremely low concentrations, such as parts per trillion.

Studies conducted since 2000 demonstrate that some newly identified environmental contaminants have the ability to cause adverse effects on fish and wildlife, such as the feminization of male fish by chemicals that affect the endocrine system (i.e. EDCs). This effect can occur at the tiny concentrations that have been documented in the environment. However, the risks posed to humans from exposure to these contaminants at similarly low concentrations are not well understood.

Newly identified environmental contaminants currently being investigated in Minnesota include:

- Pharmaceuticals, household and industrial-use products
- Endocrine-disrupting compounds
- Perfluorinated chemicals (PFCs)

Pharmaceuticals, Household and Industrial-use Products

The MPCA has been collaborating on an on-going basis with researchers from the United States Geological Survey (USGS) to monitor the presence of pharmaceuticals, personal care products, and other wastewater-associated chemicals in Minnesota's groundwater, lakes, and flowing waters. In general, these studies show that industrial and household-use compounds and pharmaceuticals are present in streams, groundwater, wastewater, and landfill effluents. Steroidal hormones, prescription and non-prescription drugs, insect repellent, detergents and detergent degradates, and plasticizers are widespread at low concentrations in Minnesota’s rivers, lakes, and streams. Though most often associated with obvious sources such as WWTPs, contamination is also found in more remote surface water where the source of these chemicals is not clear. The results of this work were published by the USGS in 2004 and are available in full at the USGS’ website: http://water.usgs.gov/pubs/sir/2004/5138/.

Endocrine disrupting chemicals

Building on the results of the study referenced above and other surveys of pharmaceuticals, household, and industrial products in the aquatic environment, scientists from the USGS, St. Cloud State University (SCSU), the University of Minnesota, the University of St. Thomas, and the MPCA have conducted a series of investigations into the significance, sources, and occurrence of compounds with endocrine-disrupting activity in Minnesota’s waste streams and waters. Endocrine disruption is a broad term referring to the adverse effects caused in humans, fish, or wildlife by both natural and synthetic chemicals through their alteration or mimicking of the organism’s endocrine signaling systems. Many of the pharmaceuticals, personal care products, and other wastewater-associated chemicals monitored as part of the 2004 study are considered EDCs.

Two studies of EDCs in Minnesota waters that were recently completed focused on gaining further information about the presence of EDCs in: 1) Minnesota lakes and rivers (http://www.pca.state.mn.us/iryp8f4), and 2) in the vicinity of wastewater treatment plants (http://www.pca.state.mn.us/index.php/view-document.html?gid=15610). The studies show that endocrine active chemicals - such as alkylphenols (breakdown products of detergents) or bisphenol A (a chemical used to make polycarbonate plastic) - are commonly found in surface water at low concentrations, even in lakes and rivers that do not receive effluent from WWTPs. In addition, fish from surface waters both with and without WWTPs showed evidence of exposure to estrogenic compounds (i.e. EDCs), indicating that endocrine disruption in fish is surprisingly widespread in Minnesota's lakes and rivers. It is not generally known if these chemicals pose a risk to human health at the low concentrations being detected.

The MPCA, USGS and SCSU also collaborated on a study that examined in more detail the presence and effects of EDCs on a single Minnesota lake from a variety of point and nonpoint sources. In addition, surface water from very remote Minnesota lakes was analyzed to understand the extent of contamination by personal care products, pharmaceuticals, and endocrine disrupting chemicals. Results of this study can be found at: http://www.pca.state.mn.us/index.php/view-document.html?gid=17685.

Beginning in 2010, the MPCA began collecting groundwater samples from its Ambient Groundwater Monitoring Network for analysis of over 100 contaminants of emerging concern, which included EDCs. The primary objective of the first year of sampling was to determine the magnitude of contamination in the groundwater; consequently, the sampling focused on areas with a high relative potential for groundwater contamination. The results from the 2010 survey are available here http://www.pca.state.mn.us/index.php/view-document.html?gid=17244.The 2010 results were used to inform the design of the groundwater survey for EDCs that was conducted in 2011. The MPCA is planning to continue monitoring Minnesota groundwater for EDCs and potentially other emerging contaminants for the foreseeable future.

The MPCA is continuing to monitor for EDCs and other emerging contaminants in Minnesota surface waters in conjunction with statewide and nationally-based probabilistic surveys to build trend information over time. These include the 2010 large streams study funded by the USEPA as part of the National Aquatic Resource Survey (NARS), for which the MPCA sampled 150 stream locations for about 25 pharmaceuticals and personal care product related compounds. Analysis of these samples (which were extracted and frozen) was performed by the MDH laboratory in spring of 2011. The MPCA also collected samples from 50 Minnesota lakes for analysis of pharmaceuticals and personal care product-related compounds as part of the 2012 NARS lake study.

Perfluorinated chemicals

Perfluorinated chemicals (PFCs) such as perfluorooctanesulfonic acid (PFOS), perfluorooctanic acid (PFOA), perfluorobutyric acid (PFBA) and others, are manmade chemicals used to manufacture products that are heat and stain resistant and repel water. The PFCs used in emulsifier and surfactant applications are found in fabric, carpet and paper coatings, floor polish, shampoos, fire-fighting foam and certain insecticides. The PFCs are used to make fluoropolymers, which then are used in the production of many personal care products, textiles, non-stick surfaces and fire-fighting foam. The PFCs are widespread and persistent in the environment and they have been found in animals and people all over the globe. Past local manufacture and disposal of these chemicals in Minnesota has led to groundwater and surface water contamination issues.

Initial work by the MPCA and MDH focused on identifying contaminated drinking water wells in the eastern Twin Cities suburbs, and making sure residents had access both in the short and long term to safe drinking water.

The MPCA investigations also detected PFOS at elevated concentrations in fish taken from Pool 2 of the Mississippi River and downstream, as well as in metro area lakes with no known connection to manufacturing or waste disposal. Mississippi River Pool 2, which received effluent during the years of PFOS and PFOA manufacturing, is listed as an impaired water, due to PFOS. Preliminary work in advance of a PFOS TMDL for Pool 2 also is underway, and TMDLs will be needed for the PFOS-impaired lakes.

The MPCA has investigated the broader presence of PFCs in the ambient environment and a number of studies have been completed. In addition to fish tissue, PFCs have been found in some shallow groundwater wells, in the influent, effluent and sludge of WWTPs, in ambient air, in blood of bald eagles, in tree swallows, and in landfill leachate and gas. Several findings of elevated PFOS concentrations have been traced to chrome platers using PFOS-containing products in plating or for chrome mist suppression. The MPCA and the MDH continue to examine potential sources of exposure to PFCs.

An extensive description of all MPCA and MDH activities, and links too many PFC-related reports and studies are available on the following website: http://www.pca.state.mn.us/bkzq82b.

A public health assessment of PFCs in the east metro area was published in February 2012 by the MDH, and is available at this link: MDH Public Health Assessment_01-05-2012.pdf.

Much remains to be learned about the origins, fate and mechanisms of PFC contamination in the environment. However, the results of investigations to date have begun to move PFCs beyond the realm of the emerging issue of concern and into the MPCA's prevention and regulatory work. Some examples include PFC effluent limits for WWTPs, monitoring at solid waste landfills, and development of TMDLs for impaired waters.

The MPCA is continuing to partner with state and federal agencies, academic researchers, and stakeholders to identify and address emerging issues of concern to Minnesota.

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Part C. Monitoring and Assessment Strategy

C.1. Water Quality Standards Development

Introduction

At the center of the assessment process are the beneficial uses we derive from our water resources and the water quality standards that protect these uses. The water quality standards are the fundamental tool by which the quality of groundwater and surface waters is measured. The water quality standards listed in Minn. R. chs. 7050 and 7052 consist of three elements:

- Classifying waters with designated beneficial uses
- Narrative and numeric standards to protect those uses
- Nondegradation (antidegradation) policies to maintain and protect existing uses and high quality waters

For a full discussion on water quality standards, see MPCA's *Water Quality Standards* webpage at http://www.pca.state.mn.us/gp0r909.

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C.2. Monitoring Strategy

A. Minnesota's Water Quality Monitoring Strategy

The *Minnesota's Water Quality Monitoring Strategy, 2011-2021* (Monitoring Strategy), describes elements of the state's surface water and groundwater monitoring programs. The Monitoring Strategy satisfies the USEPA monitoring program strategy requirement and serves as the guide to MPCA monitoring programs.

Minnesota's WQ monitoring strategy is available at: http://www.pca.state.mn.us/index.php/view-document.html?gid=10228.

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B. Condition Monitoring Strategy: Watershed Approach

In recent years, the MPCA has organized components of stream and lake condition monitoring into the watershed framework at the major watershed level. An average of eight to ten watersheds are intensively monitored annually and assessed in a yearly rotation expected to complete a statewide assessment every 10-years. This approach coordinates with the Minnesota's impaired waters program, local groups, and citizens by laying out future work and impairment listings well in advance. For a full discussion of the benefits and components of the watershed approach, refer to http://www.pca.state.mn.us/irypabf and (http://www.pca.state.mn.us/index.php/view-document.html?gid=3887).

C. Stressor Identification Strategy

Minnesota addresses impaired biota by examining the interactions of numerous physical, chemical, and biological processes that define community composition. Biological impairments can be driven by natural or unnatural changes to one or many components of these systems. Biological impairments differ from some traditional WQ impairments in that the impaired biotic communities are indicators of disturbance rather than causes of disturbance.

Biological impairments are commonly caused by stressors that are not considered conventional pollutants within our WQ rules. These include stressors such as degraded habitat or altered hydrology. Minnesota utilizes the process of stressor identification developed by the USEPA to identify the dominant stressors.

The process of stressor identification draws upon a broad variety of disciplines such as aquatic ecology, biology, geology, geomorphology, statistics, chemistry, environmental risk assessment, and toxicology.

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D. Effectiveness Monitoring Strategy

Much like problem investigation monitoring, the state's effectiveness monitoring strategy relies on monitoring activities by a variety of parties. On a project scale, regulated parties, local implementers, MPCA contractors, other organizations and the MPCA conduct effectiveness monitoring to evaluate specific management practices or groups of practices in a specific area. With the MPCA's adoption of the watershed approach, the condition monitoring conducted in the first two years of the 10-year cycle becomes dual purpose monitoring in cycles following the first 10-year cycle, since at this point the Major Watershed Restoration and Protection Plan developed for the watershed is in on-going implementation. Thus, the condition monitoring conducted in years one and two in the second, and subsequent, 10-year cycles is an indication of the effectiveness of the implemented measures from the previous cycle.

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E. Surface Water Monitoring Purposes, Designs and Indicators

The MPCA's current Condition, Problem Investigation and Effectiveness Monitoring activities are described in detail in Section 2.4 of the Monitoring Strategy, from pages 33 - 44. The information provided includes monitoring activity start date, purpose, and description, including the type of monitoring design that is used to meet the specific monitoring purpose, and indicators. The Monitoring Strategy is available here: http://www.pca.state.mn.us/index.php/view-document.html?gid=10228.

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F. Drinking Water Assessments

The MPCA does not assess groundwater (Class 1A) for potential impairment of the drinking water use. However, the MPCA is assessing Class 1B and Class 1C listed surface waters for potential impairment by nitrate nitrogen (NO_3-N). This step was taken in recognition of the trend of increasing nitrate concentrations in Minnesota streams and the public health and economic impact arising from elevated nitrate concentration in drinking water (a particular concern in southeast Minnesota's karst region, where many Class 1B and 1C waters are located). More information about the assessment of Class 1B and 1C waters for nitrate nitrogen (NO_3-N) is available in Section VI., Part C, on page 39 of the 2012 Guidance Manual http://www.pca.state.mn.us/index.php/view-document.html?gid=16988.

The MPCA and the MDH staff have discussed assessing the drinking water use more broadly. Both agencies are investigating the possibility of making such assessments. Staff of both agencies are interested in the implementation of Source Water Protection Plans (http://www.umrswpp.com/) that have been developed by the municipal water suppliers for the major metropolitan cities of Minneapolis, St. Paul, and St. Cloud, Minnesota. These three cities all use surface waters in their municipal supplies and provide drinking water to a large portion of the state's population. They have identified priority areas for implementation and the contaminants of concern in intake waters that presently fall within current monitoring strategies of the state and others which are not currently being monitored.

G. Source Water

The MDH is the lead agency in Minnesota working on source water protection with USEPA. For groundwater-based public water supplies, source water protection is the state's wellhead protection program. For surface water supplies, source water assessment is being approached in various ways,

depending on the size and circumstances of each source water and watershed. Where possible, these assessments and MPCA's Watershed Assessment Teams (WAT) are being coordinated.

In the past, the MPCA has worked closely with the MDH on source water protection, through a Memorandum of Agreement. As part of this effort, the MPCA provides data on potential contaminant sources in source water protection areas and provides technical assistance to the MDH, and public water suppliers on managing contaminant sources. The MDH and the MPCA continue to coordinate on special projects that involve both source water protection, and basin and watershed management. The MDH can now electronically access some of the MPCA's electronic databases to obtain information on potential contaminant sources, and the MPCA is continuing to work on the expansion of data access. The MPCA also has a representative on the MDH Ad Hoc Committee on Source Water Protection for Surface Water Systems.

C.3. 1. Assessment Methodology and Summary Data

Assessment Units

Assessments of use support in Minnesota are made for individual waterbodies. The waterbody unit used for river systems, lakes, and wetlands is called the "assessment unit". A river assessment unit usually extends from one significant tributary to another or from the headwaters to the first significant tributary and is typically less than 20 miles in length. The river may be further divided into two or more assessment units when there is a change in the use classification (as defined in Minn. R. ch. 7050), or when there is a significant morphological feature such as a dam, or a lake within the river.

The MPCA uses the 1:24,000 scale high resolutions NHD to create geospatial data to represent stream and lake assessment units. All of our assessment units are indexed to the NHD, or have had custom shapes created for addition to the NHD. The high resolution NHD was created from 1:24,000 scale USGS DLG's (United States Geological Survey Digital Line Graphs) and MDNR stream and lake data.

Each waterbody is identified by a unique waterbody identifier code called an assessment unit identification (AUID). For streams, the code is comprised of the USGS eight digit subbasin code plus a three character code that is unique within each subbasin. It is for these specific reaches that the data are evaluated for potential use impairment. The MPCA consults with border states during the assessment process and documents reasons for any discrepancies in assessment determination between Minnesota and the specific border state.

The Protected Waters Inventory (MDNR) is the source for lake and wetland identifiers. The MDNR uses an 8-digit identifier for waterbodies, consisting of a 2-digit prefix that represents county, 4-digit number identifying a lake, and a 2-digit suffix that represents either a whole lake (-00) or representing a specific bay of a lake (-01, -02, etc.). This 8-digit identifier is used by MPCA to represent an assessment unit for lakes and wetlands. Waterbodies determined to be wetlands will not be assessed using the eutrophication factors discussed in the Water Quality Trends for Minnesota Lakes section in this report factors used to identify wetlands can be found in Appendix C.2.

Typically, the listing of impaired waters is by individual assessment unit. The major exception to this is the listing of rivers for contaminants in fish tissue. Over the time it takes fish, particularly game fish, to grow to "catchable" size and accumulate pollutants to unacceptable levels there is a good chance they have moved considerable distance to the site where they were sampled. The impaired reach is defined by the location of significant barriers to fish movement such as dams upstream and downstream of the

sampled reach. Thus, the impaired reaches often include several assessment units, and for lakes, will include all bays on the lake (may be listed under the -00 suffix, representing the entire waterbody).

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C.3.2. Data Management

The MPCA stores surface water monitoring data in an Environmental Quality Information System (EQuIS) database management system, which was selected to replace the state's Storage and Retrieval Information System (STORET) database, which USEPA stopped supporting in the fall of 2009. More information about EQuIS is available on the MPCA's website: Surface Water Data Submittal, Review and Reports - Minnesota Pollution Control Agency.

It is the MPCA policy that all WQ monitoring data required or paid for by the MPCA be entered into EQuIS. This includes projects funded by the MPCA such as Section 319 projects, CWP projects, and more recently, TMDL projects.

It is also the MPCA policy to use all credible and relevant monitoring data collected by others for its assessment activities. For example, the MDA is storing their data in EQuIS and their monitoring report can be found at http://www.mda.state.mn.us/~/media/Files/chemicals/maace/2010wqmreport.ashx Because of this policy many local projects not funded by the MPCA choose to submit data to the MPCA in EQuIS-ready format. These projects then also have their data accessible to a variety of users through the MPCA's Environmental Data Access Initiative http://www.pca.state.mn.us/foyp675.

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C.3.3. Integrated Assessment Process

Integrated Assessment Methodology

Until 2010, the MPCA assessed the condition of the state's waters via a biennial, statewide assessment process. With the advent of the intensive watershed monitoring approach, which was piloted in 2006 and adopted in earnest beginning in 2007, the MPCA faced a need to revise the assessment process to align with the watershed monitoring approach, including the 10-year schedule and the increased volume of data generated during watershed monitoring.

An annual assessment process has been designed to keep up with the monitoring work and reflect the more detailed monitoring data available in the watersheds where intensive watershed monitoring has been completed. The development of an annual assessment process has been critical to the MPCA's implementation of the overall watershed approach. With assessments taking place immediately following completion of intensive watershed monitoring, the entire process of monitoring-assessment-restoration-protection can be completed within ten years, at which time the watershed comes up for monitoring again as part of the next scheduled 10-year rotation. In addition, the revised process encourages earlier and more meaningful local involvement in assessment.

Some monitoring – namely monitoring of toxic parameters – continues to occur on a statewide basis. Assessment of those parameters is done statewide every two years, to reflect the monitoring design. Watershed assessments focus primarily on the aquatic life and recreation beneficial uses. Statewide assessments focus primarily on aquatic consumption and aquatic life toxicity. The redesigned process

expands upon the data analysis steps of the previous assessment process. While this new process focused on the aquatic life use assessments in rivers and streams, concepts of the redesigned process have also influenced how other designated uses (e.g., aquatic recreation) are assessed. Additional reviews at the parameter level and the addition of an internal comprehensive review, prior to the professional judgment group meeting, are the largest changes. These changes reflect the increased volume and complexity of the data gathered during the intensive watershed monitoring effort, and help ensure a robust decision about the appropriate management actions to be pursued for each assessment unit (waterbody, or AUID) in the planning and implementation phases of the watershed approach (i.e. restoration for impaired waters, and protection for unimpaired waters). Further detail on the specific steps in the process is included below. A note should be made that the aquatic consumption (fish) assessment at this time utilizes only the first two steps in the process.

1. **Data Compilation (pre-assessments)**
   The initial step in the process is a computerized screening that identifies monitoring results collected on AUIDs over the appropriate period of record and compares each data point to WQ criteria, summarizes the number of data points that exceed the criteria, the total number of data points, and the number of years of data. This step produces a parameter-specific pre-assessment (e.g.,Dissolved Oxygen (DO), Fish Index of Biotic Integrity (IBI), and Escherichia Coli (E. coli)).

2. **Expert review**
   This stage involves a review of automated pre-assessments for quality assurance that the computerized screening captured the appropriate data and is properly calculating the pre-assessments (particularly important when new assessment methods or new parameters are added). Also included in this stage are additional analysis and review steps required for several parameters (e.g. E. coli, chloride, un-ionized ammonia, nitrate) prior to the calculation of the pre-assessment.

3. **Desktop Assessment**
   The desktop assessment involves a review of pre-assessments by resource-specific staff (e.g. WQ staff review chemistry data, biologists review biological data) for waterbodies within a specific 8-digit hydrologic unit code watershed (HUC-8). This review considers multiple lines of evidence – review of flow conditions, precipitation, land use, habitat, etc. – in addition to the pre-assessment to ascertain the quality of the dataset (temporal and spatial completeness, etc.) and whether the parameter is meeting or exceeding the criterion. During this process any candidates for delisting or natural background review are identified and work begins to determine if those AUIDs meet the criteria to be removed from the TMDL List.

4. **Watershed Assessment Team**
   Joint internal meeting of the MPCA personnel involved in the individual desktop assessments, the regional watershed project manager and stressor identification staff for a specific HUC-8. In this meeting each AUID is reviewed, considering comments and parameter-level evaluations from the desktop assessment as well as supplemental information, to reach an overall use-support decision. Delisting and natural background candidates may also be identified at this time.

5. **Professional Judgment Group**
   The Professional Judgment Group (PJG) meeting is a joint meeting of WAT and external parties (local data collectors, local government units, etc. as determined by the MPCA regional watershed project manager) to discuss the results of the WAT meeting for a specific HUC-8. Prior to the PJG meeting, the results of the WAT meeting are distributed to all invitees, including parameter-level evaluations, overall use-support recommendations and all comments (Figure III-1). Invitees are asked to identify

AUIDs they wish to discuss; an agenda is developed based on these submissions. The format of this meeting, instead of an exhaustive review of each AUID, is an overview of the process, a general discussion of the watershed and major subwatersheds and a review of requested AUIDs, delisting and natural background candidates. The results of this meeting are the final use-support determinations.

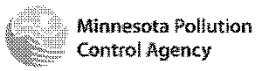
The analyses and recommendations for each AUID are documented in a transparency database that is archived following the completion of the assessments. Throughout the annual assessment process, care is taken to maintain consistency among the HUC-8 assessment meetings and decisions. This is accomplished via internal training and quality control, the assignment of individual staff to multiple HUC-8 data sets for the expert review and desktop assessments, "cross-pollination" of WATs, and the oversight and guidance provided by a Technical Team and management team charged with ensuring quality data analysis and consistency among watershed assessment discussions and decisions.

For more detail, consult the Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List, 2012 Assessment Cycle (see http://www.pca.state.mn.us/index.php/view-document.html?gid=16988).

Each water body is assigned to an integrated assessment report category, as shown here in the flow chart in Figure III-2. The State of Minnesota elects to not only use the USEPA categories in this flow chart, but also assigns sub-categories to better identify waters with insufficient information to make an assessment. The state categories may be found on page 47 of Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List, 2012 Assessment Cycle.

The POC is Pam Anderson at 651-757-2190 or pam.anderson@state.mn.us.

Figure III-1 Example of Assessment Documentation



Stream Assessment Transparency Documentation

Basin: Red River
Assessment Year: 2012

AUID: 09020101-515 **Use_Class:** 2B, 3C **Name:** Unnamed creek **HUC 8:** 09020101

Length(mi): 2.4 **Description:** Unnamed cr to Rabbit R **Name:** Bois de Sioux River

Final Assessments

Aquatic Life Use Support (ALUS): Not Supporting **Aquatic Recreation Use Support (ARUS):** Not Assessed

Preliminary Assessments

Reviewed Pre-assessment

Use Support	Summary String
	DO12 EX 10/31[8]
	DO5_9am MTS 0/1[1]
	DO5_All EX 10/20[7]
	DO7 MTS 0/11[6]
AL	EXS !!!DO Final EX[0]
	=TSS MTN 0/2[1]
AL	EXP !!!Turbid TT TSS EX 7/31[8](7/31[8] 0/25[6] --/--[--])
AL	MT <>pH MTS 0/25[5]

Comments:

WAT 3/14/12: Aquatic life impairments for turbidity and dissolved oxygen.
--
Chem Desktop Comments: P Anderson 2/17/12: Data collected monthly over 4 years. One station on AUID. Number of mid morning and early afternoon exceedances. The most severe being in May 2011 with complains of a chemical odor/possible spill of some sort. Turbidity exceedances paired with transparency tube readings less than 20 cm. Exceedances were quite high - over 100 on several occassions. Recommend not support for aquatic life based on low dissolved oxygen levels and high turbidity levels.

Existing impairments

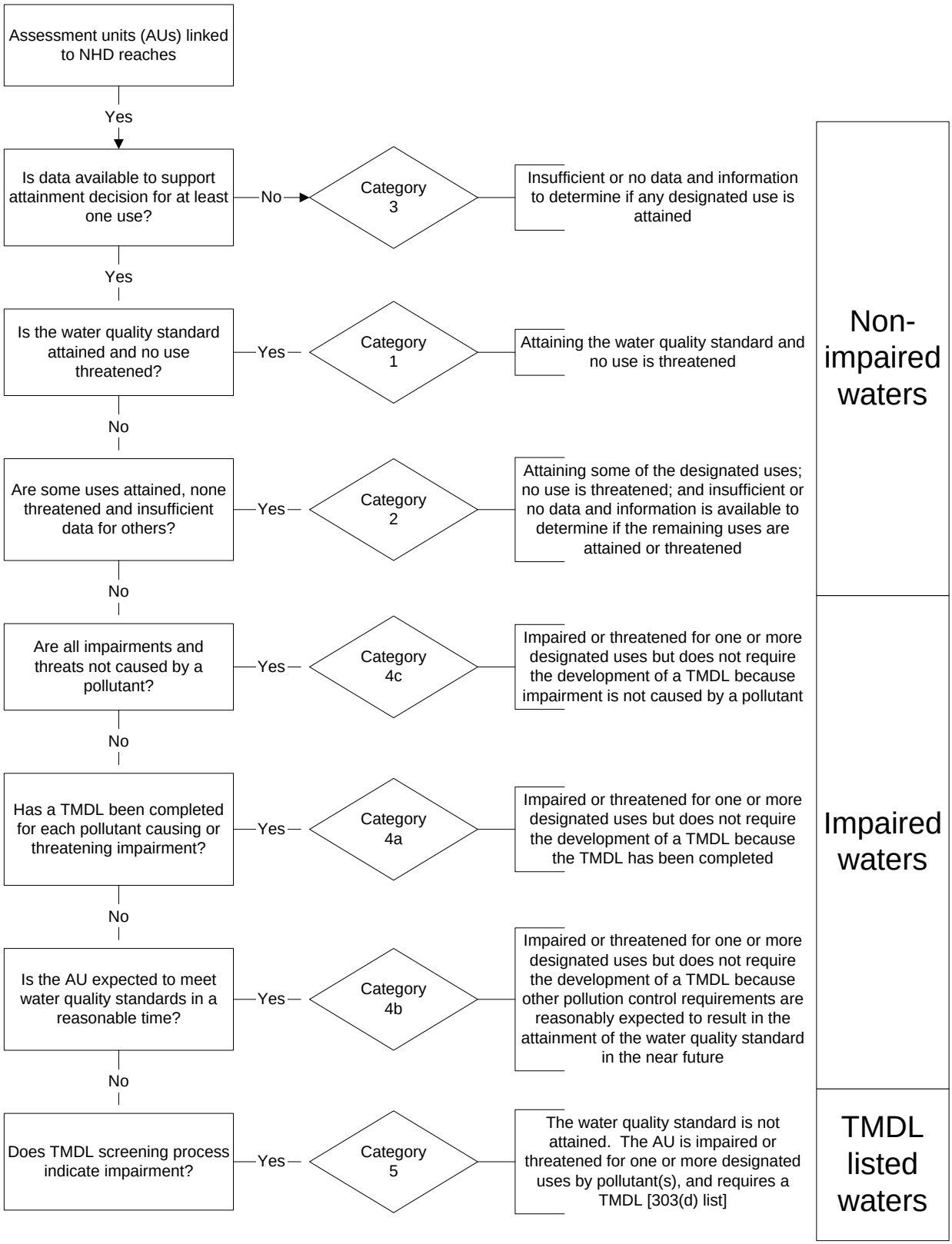
Use	Attainment	Cycle First Listed Impairment	TMDL ID (A number indicates a TMDL plan approved by the EPA.)
Class 2B Warm Water Aquatic Consumption	Not Assessed		
Class 2B Aquatic Recreation	Not Assessed		
Class 2B Warm Water Aquatic Life	Insufficient Infor		

AUID History

AUID	Date Retired

Professional Judgment Group "Transparency" Form

Figure III-2 Flowchart of Non-Impaired Waters, Impaired Waters and TMDL Listed Waters



C.3.4. Data Analysis Procedures - Lakes

Data Age and Quality for Assessments

Assessed Data

Lakes with summer data (defined as the time period from June through September) collected between calendar years 2000 and 2010 were considered for this assessment. Summer data are required for assessments to better represent the maximum productivity of a lake and yield the best agreement among trophic variables.

Data Quality

Data used to make assessments are generally of good or excellent quality. Requirements for different quality datasets can be found in the Guidance Manual for Assessing Minnesota Surface Waters at: http://www.pca.state.mn.us/index.php/view-document.html?gid=16988.

Procedures

Lakes in the Red River Valley Driftless Area- and Northern Minnesota Wetlands ecoregions were assessed using the North Central Hardwood Forest and Northern Lakes and Forests standards, respectively, since there were too few lakes to establish reference conditions and standards in the Red River Valley, Driftless Area or North Central Hardwood Forest ecoregions. In transitional areas near ecoregion boundaries, watershed drainage and land use was considered to determine the appropriate ecoregion standards for the lake to be assessed against.

Candidates for non-support assessment required the minimum eight paired samples over a minimum of two years for TP, Chlorophyll-a (chl-a), and Secchi.

Candidates for full support assessment could meet the full data set requirements of non-support waters or a reduced dataset of 4 TP, chl-a, and Secchi and an extended Secchi record.

The remainder of reviewed waters were placed in the insufficient data category.

More detailed information on the process used to assess lakes for the 2012 cycle can be found in the Guidance Manual for Assessing Minnesota Surface Waters at: http://www.pca.state.mn.us/index.php/view-document.html?gid=16988.

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C.4.1. Impaired Waters List

Current Status

Pollutants listed in the MPCA's draft 2012 TMDL List are in the first column of Table III-1. These are the number of impairments, caused by each, in streams and lakes.

Bioaccumulative toxics include polychlorinated biphenyls (PCBs), Dieldrin, dioxin, PFOS, dichlorodiphenyltrichloroethane, and toxaphene. Impairments due to Hg in water and fish tissues account for 64 percent of the bioaccumulative total and 26 percent of all the impairments on the draft 2012 TMDL List.

Table III-1 Flowchart of Non-Impaired Waters, Impaired Waters and TMDL Listed Waters

Pollutant	2012 Draft List #Impairments	2010 Final List # Impairments
Ammonia	**6**	**7**
Bioaccumulative toxics & Mercury	**564**	**525**
Chlorides	**18**	**18**
Excess nutrients	**456**	**418**
Bacteria	**307**	**190**
Impaired biotic communities	**384**	**171**
Low dissolved oxygen	**104**	**97**
pH	**7**	**8**
Temperature	**1**	**1**
Turbidity	**324**	**321**
TOTAL	**2171**	**1756**

A separate 303(d) impaired waters list is being submitted to USEPA, but it is MPCA's intent to use Version 2.3.1 of the USEPA ADB for integrated reporting. The Category 5 Assessment Units in the ADB will match with the submitted impaired waters list.

C.4.2. Total Maximum Daily Loads and Impaired Waters

For each pollutant that causes a water body to fail to meet applicable WQSs, the CWA requires the states to conduct a study called a TMDL Study.

A TMDL study determines the assimilative capacity of a water body, and identifies both point and NPSs of each pollutant that violates standards. Water Quality sampling and computer modeling determine how much each pollutant source is contributing to the problem. An allocation process involving stakeholders determines how much each source must reduce its contribution to assure the standards are again met.

An impaired water body may have several TMDL studies, each one determining reductions for a different pollutant. After a TMDL study is written, a detailed implementation plan is developed to meet the TMDL's pollutant load allocation and achieve the needed reductions to restore WQ. Depending on the severity and scale of the impairment, restoration may require many years and millions of dollars.

Minnesota has completed TMDLs on 1,328 impairments – 1,102 for Hg and 226 for conventional pollutants – out of the more than 3,000 lakes, river and stream segments that are currently impaired. The state is currently on schedule to complete TMDL studies by their target dates. To date, 15 previously impaired waters are now meeting WQ standards due to corrective actions.

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C.4.2.1. Strategies the MPCA Employs in the Impaired Waters Restoration Process

State Funding

CWLA funding that began in FY07 and continued in the FY08-09 biennium enabled Minnesota to reach its goal for beginning TMDL studies on schedule. However, that funding was not permanent. Appropriations by the Legislature from the CWF (per the Clean Water, Land, and Legacy Constitutional Amendment) began in the FY10-11 biennium. Approximately $21.7 million was appropriated to TMDLs in FY10-11 and $24.6 million in FY12-13. These funds should enable us to keep on track with state goals. For more information on current funding see http://www.pca.state.mn.us/dm0r92d.

Partnering with Local Government

Cities, counties, soil and water conservation districts, and watershed management organizations play a large and growing role in NPS pollution abatement across the state. The MPCA is ultimately responsible for completing and submitting TMDLs to the USEPA. However, these stakeholders play a critical role in the development and implementation of TMDLs. Our first priority is to use ready and qualified local government and watershed organizations with jurisdiction in the impaired watershed to develop TMDLs to lead a project. These entities need to have the expertise to do the work, especially for monitoring, land use inventory, choosing reduction scenarios, developing implementation plans and public outreach.

Locally-driven projects are most likely to succeed in achieving WQ goals because communities often best understand the sources of WQ problems and effective solutions to those problems. Through grant contracts with the MPCA, local governments and watershed organizations are leading over three-fourths of Minnesota's TMDL projects. The remaining projects, particularly the most complex ones, will often be led by MPCA or other state agencies. The MPCA provides oversight, technical assistance, and training to ensure regulatory and scientific requirements are met.

Working with Private Consultants

The MPCA and local government often employ private consultants to perform specific steps of TMDL studies where needed and where they will be most effective. Consultants are helpful in supplementing MPCA and local staff resources, particularly for technical work. In many cases, consultants assist with data collection, modeling and development of draft reports.

The POC is Jeff Risberg at 651-757-2670 or jeff.risberg@state.mn.us.

Strategies for Waters Impaired by Mercury and Other Toxic Pollutants

Mercury can be carried great distances on wind currents before it eventually falls on our land and water bodies. In fact, about 90 percent of the Hg deposited from the air in Minnesota comes from other states and countries. Therefore, the traditional TMDL approach to addressing impairments will not work for Hg, as Minnesota can not control the many sources of this toxic pollutant outside our borders.

The MPCA's statewide Hg TMDL was approved by USEPA in March 2007 and an implementation plan was completed in October 2009. The implementation plan includes measures to reduce Hg from airborne sources such as coal-fire power plants. For more information on the Hg TMDL and implementation plan, go to: http://www.pca.state.mn.us/water/tmdl/tmdl-mercuryplan.html.

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Strategies to Increase the Effectiveness and Efficiency of Total Maximum Daily Load Development and Implementation

Given the growing number of TMDL studies, limited staffing, and available funding, the MPCA has made important strides to increase the efficiency and effectiveness of its impaired waters activities, including:

- Watershed Approach: The MPCA has completed or has underway several TMDL projects that cover multiple impairments within a major watershed (several stream reaches or lakes) or across an entire region (several watersheds or an entire basin). In addition, as noted elsewhere in this report, the MPCA has launched a rotating, comprehensive watershed approach in approximately 10 percent of the 81 major watersheds per year. This includes completing monitoring and assessment activities, and Watershed Restoration and Protection Strategies or (WRAPS) which include TMDLs and protection plans for most waters in a watershed. For more information on the watershed approach, go online at: http://www.pca.state.mn.us/irypabf.

- Protocol Development: The MPCA is working to provide technical expertise to MPCA staff and stakeholders on technical work related to TMDLs and restoration projects. For example, guidance or protocol documents have been written by the MPCA to create more standardized approaches to TMDLs in Minnesota. Guidance documents that are on the agency's website include bacteria, DO, turbidity, excess nutrients in lakes, and biotic impairments. The MPCA is also applying these protocols to TMDL projects through standing technical staff teams called "parameter teams." The MPCA is also making great progress on challenging issues related to stormwater TMDLs and the incorporation of TMDL requirements into stormwater permits.

- Coordination with state and federal agencies: The cornerstone strategies of Minnesota's CWLA is to better fund and utilize existing state and federal programs with WQ programs. On the state level, the MPCA is coordinating closely with the MDNR, BWSR, and the MDA on many of these programs. On the federal level, the MPCA is working with the Natural Resource Conservation Service, the USGS, and other agencies. Finally, the MPCA has worked with the USEPA on direct assistance on some TMDLs.

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Goal Setting and Performance Measurement

As required by the CWLA, the MPCA and six other state agencies released their first collaborative report in February 2012 to help Minnesotans clarify connections between CWF invested, actions taken and outcomes achieved in FY2010-2011. Eighteen measures in the report provide a snapshot of how CWF dollars are being spent and what progress has been made. The measures are organized into three sections: investment, surface water quality, and drinking water protection. Each measure has detailed status ranking and trend information.The report, the summary document and the metadata sheets can be found at: Minnesota's Legacy website. Minnesota's Legacy website.

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C.4.2.2. Relationship of 305(b) Report to 303(d) List

A complete description of the integration of the 305(b) report with the 303(d) listings, the levels of use support, how data are used and data quality are determined may be found in Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List, 2012 Assessment Cycle, Chapter VI Elements of the Integrated Report. This report may be found at http://www.pca.state.mn.us/index.php/view-document.html?gid=16988.

C.4.3. Wetlands Update

Even after nearly 50 percent of its historic wetlands were drained, Minnesota leads the conterminous US in inland (Lacustrine, Palustrine and Riverine) wetland area with over ten million acres of nontidal and non-estuarine wetland. Minnesota's wetland resource is not only large, but also is diverse and regionally very different. Regional differences require consideration in developing the state's regulatory, monitoring, restoration and management practices. In 2006, monitoring wetlands throughout the state in a comprehensive manner was initiated through state-wide probabilistic wetland quantity and quality surveys. The results of these two surveys have just recently been released (see Kloiber 2010, Genet 2012, & Section C.4.4).

C.4.4. Wetland Regulatory Program

The WCA continues to be the principle wetland protection and regulatory program in Minnesota. Central to the WCA is the enactment of state policy to achieve a 'no net loss' and to increase the "quantity, quality and biological diversity of wetlands in the state" (Minn. Stats. 103A.201). Several non-wetland specific regulatory programs including the 404/401 certification permit program, the MDNR Public Waters Permit Program and the NPDES Permit Program (including stormwater) align with the WCA and the Federal Food Security Act "Swampbuster", to provide broad oversight of most types of direct and indirect physical alteration to Minnesota wetlands.

Minnesota actively implements Section 401 of the federal CWA (401 certification) based on state water quality standards (Minn. Rules ch. 7050), including the wetland WQ standards. Many, though not all, of the Section 401 certification actions, in Minnesota, involve wetland waters.

Figure III-3 Minnesota Section 401 water quality certifications by category between 2006 to 2011

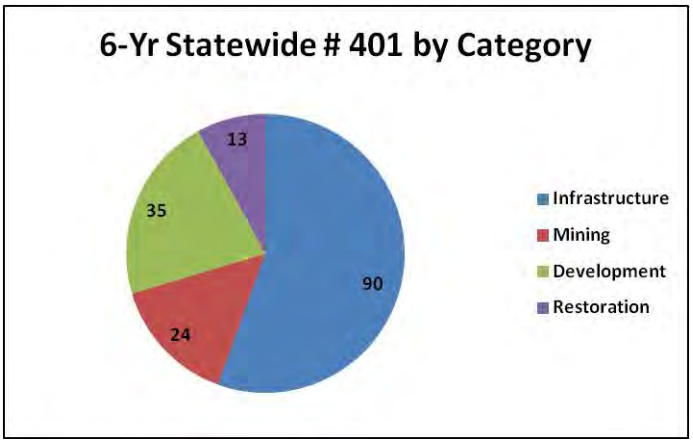


Figure III-4 Minnesota Section 401 water quality certification by action between 2006 to 2011

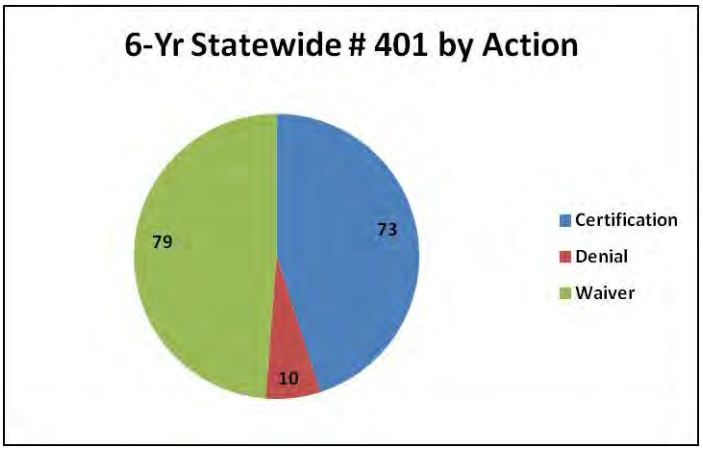


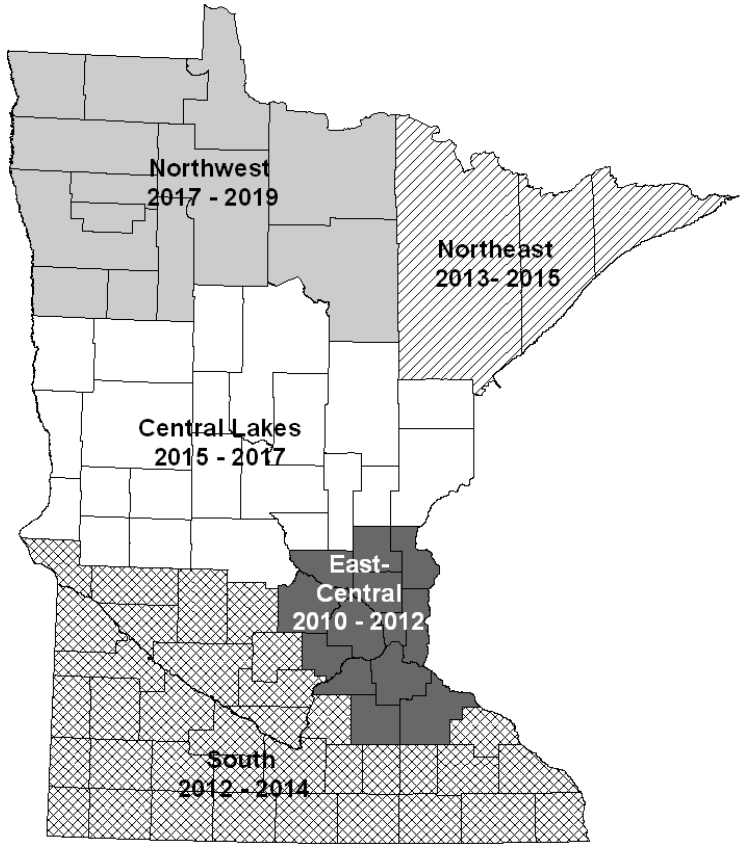
Figure III-3 illustrates the number of MPCA individual Section 401 certifications by industry category from 2006 – 2011. Infrastructure projects, such as road construction, trails, airports, pipelines, waste management, and stormwater and power lines represent the most common project type affecting wetlands. These data generally do not include agricultural land improvement projects. Figure III-4 presents the number of statewide Section 401 WQ certifications by the type of determination action; certify, deny and wave. During this time period the MPCA issued slightly more waivers than certifications. The MPCA recognizes that 401 WQ Certification as an important regulatory tool which has contributed measurable protection to Minnesota's valuable wetlands and watersheds.

C.4.5. Wetland Mapping, Monitoring and Assessment.

C.4.5.1. Updating State National Wetland Inventory Coverage

The original Minnesota NWI is based on aerial photographs taken in the late 70's and early 80's. As a result of changes in land use and various land management actions since that time, the original wetland maps have become inaccurate. The MDNR, in collaboration with the BWSR, the MPCA, the US Fish and Wildlife Service, the Minnesota Geospatial Information Office and the University of Minnesota, has received funding from the Minnesota Environment and Resources Trust Fund for the first two phases of five planned mapping phases (Figure III-5) to update Minnesota's NWI. Contingent on continued funding, Minnesota expects to have the statewide NWI update completed by 2019. The NWI updates will be publicly available as they are completed.

Figure III-5 Provisional mapping phases for updating the Minnesota National Wetland Inventory



A detailed comprehensive plan and quality assurance plan for the NWI update process is available at http://www.dnr.state.mn.us/eco/wetlands/nwi_proj.html.

C.4.5.2 .Indicator Development – Floristic Quality Assessment and Remote Sensing

The MPCA has devoted significant resources to developing field sampling protocols and assessment criteria to enable the agency to assess depressional wetlands using invertebrate and plant IBIs. Though IBIs are robust assessment indicators, the development process is time intensive. Floristic Quality Assessment (FQA) provides another robust approach to assessing plant community integrity. The use of FQA assessment derives from standard assigned coefficients of conservatism values (C-values) which have been developed for Minnesota's wetland flora (Milburn, Bourdaghs and Husveth 2007). The *C*-values are available at: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/wetlands/floristic-quality-assessment-for-minnesota-wetlands.html. MPCA's Biological Monitoring Program has committed significant resources toward developing standardized FQA sampling protocols and science derived, defensible FQA assessment criteria suitable for use in all 14 of Minnesota's common wetland plant communities.

C.4.5.3. Minnesota Wetland Status and Trends Monitoring Program-First Cycle

In 2006, Minnesota initiated a comprehensive status and trends Minnesota Wetland Status and Trends Monitoring Program (MWSTMP) survey of wetland quantity and quality. Implementation of the status and trends program is accomplished using two actual surveys, one for quantity (acres) and one for

wetland quality (condition). Vital assistance with survey design and sample selection was provided by the USEPA Western Ecology Division of the Office of Research and Development. A report on the first cycle of the wetland quantity survey was completed by the MDNR (Kloiber 2010) and is available at http://files.dnr.state.mn.us/eco/wetlands/wstmp_report_final_121410.pdf. Baseline results from this survey confirmed that Minnesota currently supports an estimated 10.62 million acres of wetland. This is similar to the 1990's estimate of wetland area reported by the current (original) Minnesota NWI coverage.

Minnesota also implemented a statewide wetland condition survey designed to collect wetland quality data state-wide in a rotating ecoregion schedule similar to wetland quantity. The wetland condition survey began as a three-year schedule to cover the three Level II "Omernick Ecoregions" (Figure III-6). Beginning in 2011 this survey is expected to be completed in a single field season, using FQA plant indicators, as an intensification of USEPAs NWCA which is scheduled to be repeated in 2016. A separate Minnesota depressional wetland survey using invertebrate and plant-based IBI protocols is planned to occur in years following the NWCA. The depressional wetland condition survey will only occur in the Mixed Wood Plains Ecoregion and the Temperate Prairies Ecoregion since depressional wetlands are not very common in the Mixed Wood Shield Ecoregion of Northeastern (NE) Minnesota.

Figure III-6. Level II Ecoregion boundaries (Omernick 2005) in Minnesota with county boundaries in the background

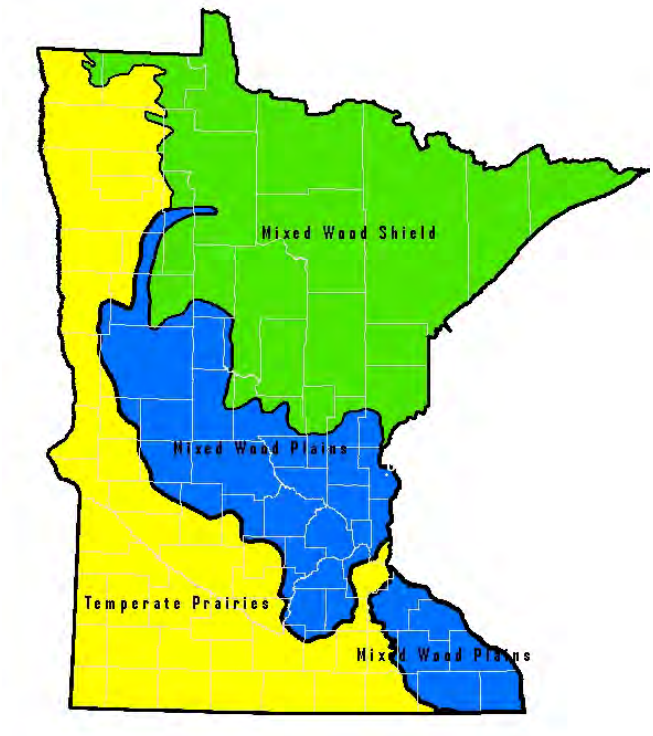
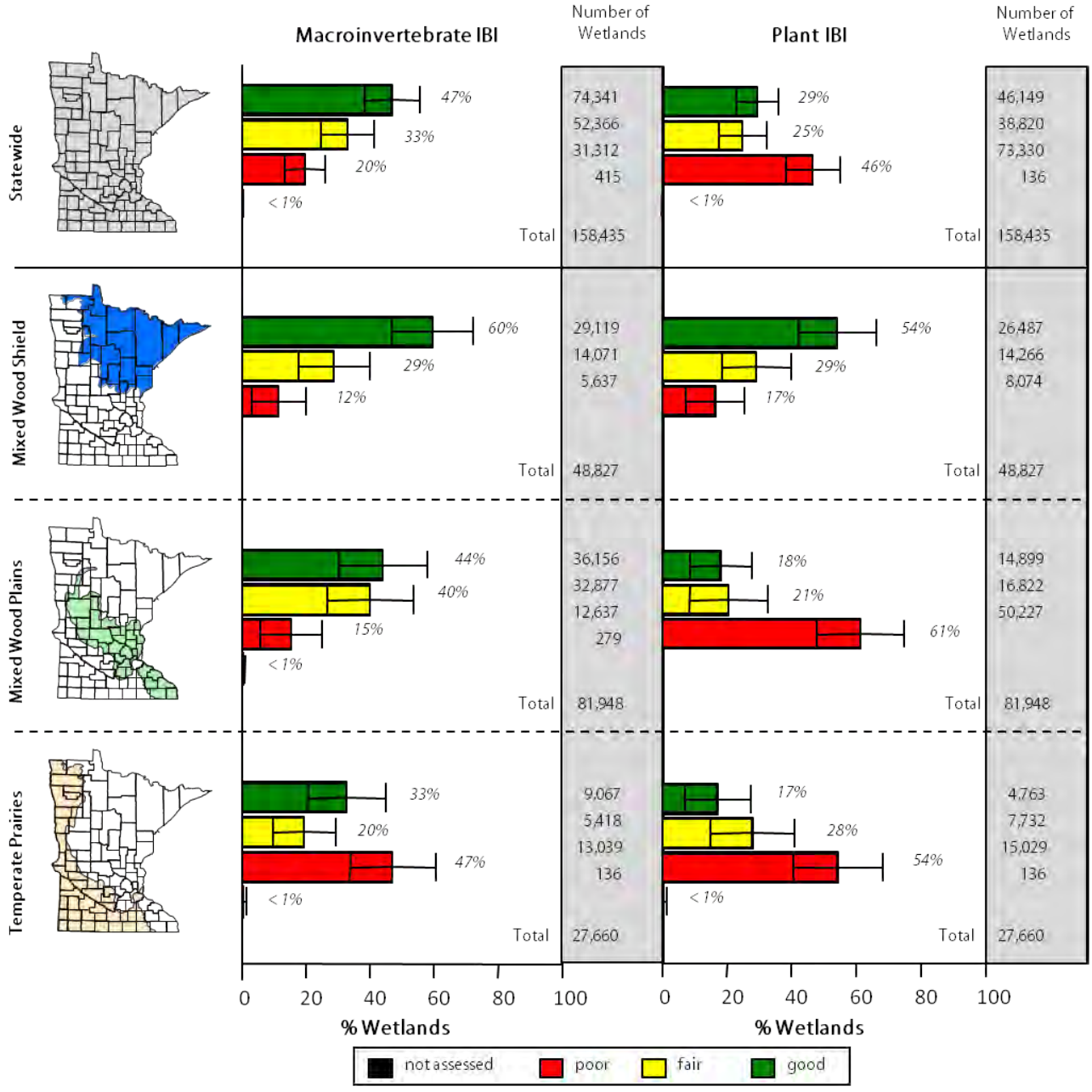


Figure III-7 Biological condition of Minnesota's depressional wetlands and ponds according to macroinvertebrate and plant IBIs, including the estimated number of wetlands within each condition category. Bracketed lines represent the width of the 95 percent confidence interval associated with each estimate. Percentages may not add up to 100 percent due to rounding.



The MPCA recently released the first baseline status and trends report (Genet 2012) on the condition of Minnesota depressional wetlands http://www.pca.state.mn.us/index.php/view-document.html?gid=17741.

Results from this report include a statewide summary of depressional wetland condition and separate summaries for each Level II Ecoregion (Figure III-7). Estimates of condition categories for good, fair, and poor quality wetlands were established for each indicator, invertebrates and plants, relative to least or

minimally disturbed reference sites within each of the three ecoregions. Because the depressional wetland survey treated wetlands as a discrete resource estimates can be made of either their number or area. The wetland quality survey estimated 158,435 depressional wetlands and ponds occur in the state of Minnesota, the majority of which are located on private property. Plant communities are in good condition in 29 percent of Minnesota's depressional wetlands and ponds, while 25 percent are in fair condition and 46 percent are in poor condition. The macroinvertebrate communities (including insects, snails, crustaceans, and leeches) inhabiting these waterbodies are in better condition with estimates of 47 percent good, 33 percent fair, and 20 percent poor. Macroinvertebrate community condition varied depending on whether the wetland or pond was natural or man-made in origin; 57 percentof the natural basins were in good condition compared to only 27 percent of the man-made basins. Plant community condition did not exhibit a substantial difference between these two categories.

The condition of plant and macroinvertebrate communities both varied among the three ecoregions, however a different pattern was exhibited by each community. Both plant and macroinvertebrate IBIs indicated that the Mixed Wood Shield ecoregion has the largest proportion of depressional wetlands in good condition, 54 percent and 60 percent, respectively. Compared to the Mixed Wood Shield, wetland plant communities are significantly worse, almost equally so, in the Mixed Wood Plains and Temperate Prairies ecoregions. Macroinvertebrate communities, on the other hand, demonstrated a pattern of decreasing condition: Mixed Wood Shield > Mixed Wood Plains > Temperate Prairies. Invasive wetland plant species and the differential impact they have on plant and macroinvertebrate communities may partially explain these observed patterns.

The POC is Mark Gernes, mark.gernes@state.mn.us, 651-757-2387 or John Genet, john.genet@state.mn.us, 651-757-2386.

Wetland Literature Cited:

Genet, John. 2012. Status and Trends of Wetlands in Minnesota: Depressional Wetland Quality Baseline. MN Pollution Control Agency, St. Paul, MN. 74 pp. http://www.pca.state.mn.us/index.php/view-document.html?gid=17741.

Kloiber, Steven M. 2010. Status and Trends of Wetlands in Minnesota: Wetland Quantity Baseline. MN Department of Natural Resources, Division of Ecological and Water Resources, St. Paul, MN. 26pp. http://files.dnr.state.mn.us/eco/wetlands/wstmp_report_final_121410.pdf.

Milburn, S.A., M. Bourdaghs, J.J. Husveth. 2007. Floristic quality assessments for Minnesota wetlands. Publ. wq-bwm2-01, Minnesota Pollution Control Agency, St. Paul, MN 55155, pp 197. http://www.pca.state.mn.us/oxpgaff.

C.5. Trends Analysis

C.5.1. Water Quality Trends for Minnesota Rivers and Streams

The best available long-term information on pollutant trends in rivers and streams comes from "Minnesota Milestone" sites. These are a series of 80 monitoring sites across the state with high-quality, long-term data, in some cases going back to the 1950's. While the sites are not necessarily representative of Minnesota's rivers and streams, as a whole they do provide a valuable historical record for many of the state's waters.

Statistical trends analysis for the milestone sites, done in 2000, showed significant reductions across the state for bio-chemical oxygen demand (BOD), total suspended solids (TSS)s, phosphorus (P), ammonia and fecal coliform bacteria. The following table shows the percentage of the 80 milestone sites which had decreasing, increasing or no trends for various pollutants.

Table III-2. Water Quality Trends in Minnesota Rivers

	Biochemical Oxygen Demand	Total Suspended Solids	Total Phosphorus	Nitrite/ Nitrate	Unionized Ammonia	Fecal Coliforms
Decreasing Pollutant Trend	89%	41%	78%	1%	83%	82%
Increasing Pollutant Trend	1%	4%	1%	75%	4%	0%
No Trend	10%	54%	21%	23%	13%	18%

These results reflect the considerable progress made during that time primarily in controlling municipal and industrial point sources of pollution. Nitrogen levels, on the other hand, showed increases at many of the sites, perhaps reflecting continuing nonpoint-source problems.

More information about the Milestone Program and the trends that have been identified using these long-term data is available at: http://www.pca.state.mn.us/0agxaf7.

The POC is Dave Christopherson at 651-757-2849 or david.christopherson@state.mn.us.

At the end of the 2010 field monitoring season, the Milestone Program was discontinued. Instead, the Major Watershed Load Monitoring Network now provides a well-distributed set of monitoring sites from which data will be collected on an on-going basis; the load monitoring stations will, in the future, be used to provide information about long-term Water Quality (WQ) trends in Minnesota rivers.

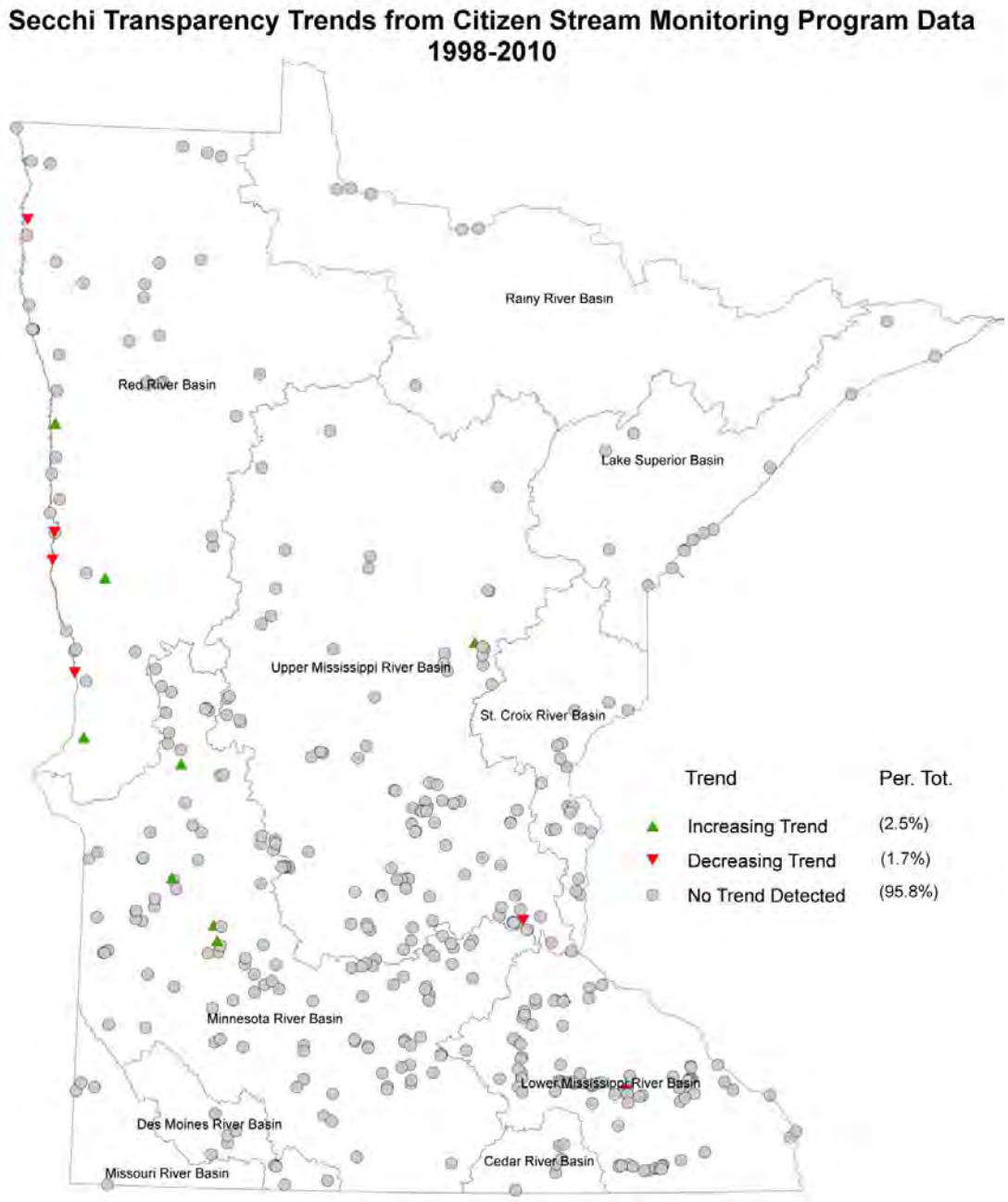
Trend analysis of stream water clarity data has also recently been done using transparency-tube measurements collected by volunteers through the Citizen Stream Monitoring Program (CSMP). Of the 408 stream sites with sufficient data, 10 exhibited a statistically significant improvement in transparency over time. In contrast, seven exhibited a statistically significant decline in transparency. No clear WQ trend was exhibited in 391 of the assessed stream sites.

Table III-3. Trends in Minnesota Stream Water Clarity

Description	Number of Streams
Assessed for Trends	**408**
Improving	**10**
Declining	**7**
No Clear Trend	**391**

The POC is Laurie Sovell at 651-757-2750 or laurie.sovell@state.mn.us.

Figure III-8. Secchi Transparency Trends 1998 - 2010



Results in Figure III-8 are minimal due to:

1. The program is much younger (less data) than the surface water chemistry programs.
2. Issues with the two tranparency-tubes (60 and 100) compromise the quality of the data, resulting in fewer usable data points (again, less data).

The MPCA received support from the USEPA to conduct a probabilistic survey of its flowing waters as part of the National Flowing Waters survey in 2008. The MPCA has embraced probabilistic surveys as an

important surface water monitoring tool in conjunction with its Intensive Watershed Monitoring program.

These surveys are important to scope the extent and magnitude of key existing and emerging WQ indicators. This data will also be a helpful tool in determining time trend information in regards to water conditions. The information from these probabilistic surveys can guide Minnesota's water protection and restoration policies.

The MPCA used state support funds from the project to intensify the geographic distribution of sites with a focus on Level 2 Omernick ecoregions. This was done because the conditions of Minnesota's waters are known to be significantly different from the relatively undeveloped northeast forested areas of the state to the highly developed agricultural areas in the southwestern part of the state. It was felt that a state-wide survey would not be as useful as the ecoregion based approach. Therefore, USEPA statisticians were enlisted to provide a sample draw of sites so that approximately 50 sites per each of the three Level 2 ecoregions could be sampled by MPCA staff for a total of 150 sites statewide (see figure Figure III-9).

Sampling began in the summer of 2010, running from June until September, but was completed in the summer of 2011 due to persistently high flows in 2010. A total of 151 sites were sampled state-wide by the end of the sampling season of 2011. Most sites sampled by the MPCA included biological sampling for fish and aquatic macroinvertebrates, as well as habitat and water chemistry samples. The protocols used can be found on the biological monitoring section of the MPCA website at: http://www.pca.state.mn.us/sbiz8cc.

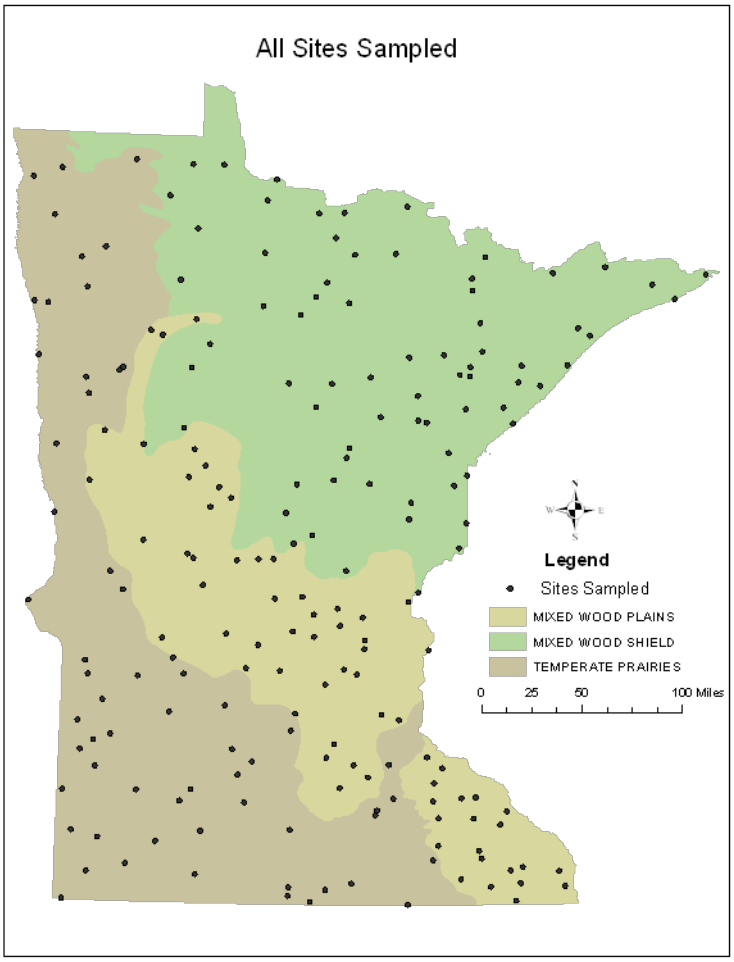


Figure III-9. Map of the Minnesota ecoregions and site location.

Biology

Each site sampled was evaluated using state developed Index of Biotic Integrity (IBI). These IBI scores were compared to thresholds that are developed based on channel condition, location, stream size, and gradient (see Table III-4). There are nine fish and nine invertebrate IBI classes that are in use for assessments by the MPCA. Within five of the fish IBI classes and four of the invertebrate IBI classes there are proposed thresholds for channelized or modified streams. These thresholds are still in development and are not currently used in the TMDL program. They were included in this study because there is a large amount of stream miles that wouldn't have been accounted for otherwise. Each site was then compared to the appropriate threshold in relation to stream classification and channel condition. The results indicated that an average of 47 percent of the stream miles statewide meets the fish IBI river thresholds, and 37 percent meets invertebrate IBI thresholds. These percentages shown in Figures III-10 and III-11 also demonstrate some of the ecoregion dissimilarity; for example the Temperate Prairie region falls below statewide averages, and in comparison the Mixed Wood Shield exceeds the statewide average.

Group	Class	Class Name	General	Modified
Fish	1	Southern Rivers	39	
Fish	2	Southern Streams	45	34
Fish	3	Southern Headwaters	51	44
Fish	4	Northern Rivers	35	
Fish	5	Northern Streams	50	34
Fish	6	Northern Headwaters	40	25
Fish	7	Low Gradient Streams	40	15
Fish	10	Southern Coldwater	45	
Fish	11	Northern Coldwater	37	
Invertebrates	1	Northern Forest Rivers	51	
Invertebrates	2	Prairie Forest Rivers	31	
Invertebrates	3	Northern Forest Streams RR	50	
Invertebrates	4	Northern Forest Streams GP	52	42
Invertebrates	5	Southern Streams RR	36	27
Invertebrates	6	Southern Forest Streams GP	47	34
Invertebrates	7	Prairie Streams GP	38	28
Invertebrates	8	Northern Coldwater	26	
Invertebrates	9	Southern Coldwater	46	

Table III-4. Fish and invertebrate draft IBI thresholds used for natural and modified or channelized conditions

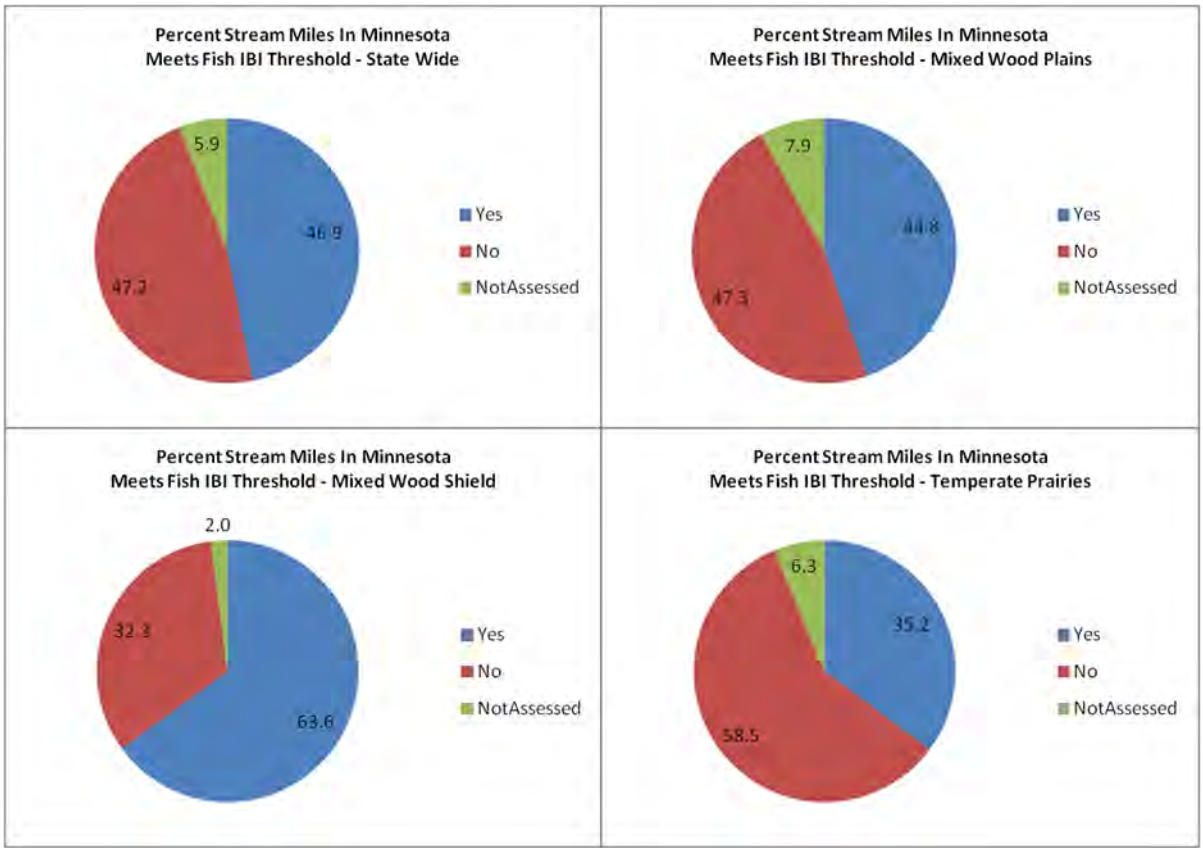


Figure III-10. Estimated percent of stream miles that meet or do not meet fish IBI thresholds

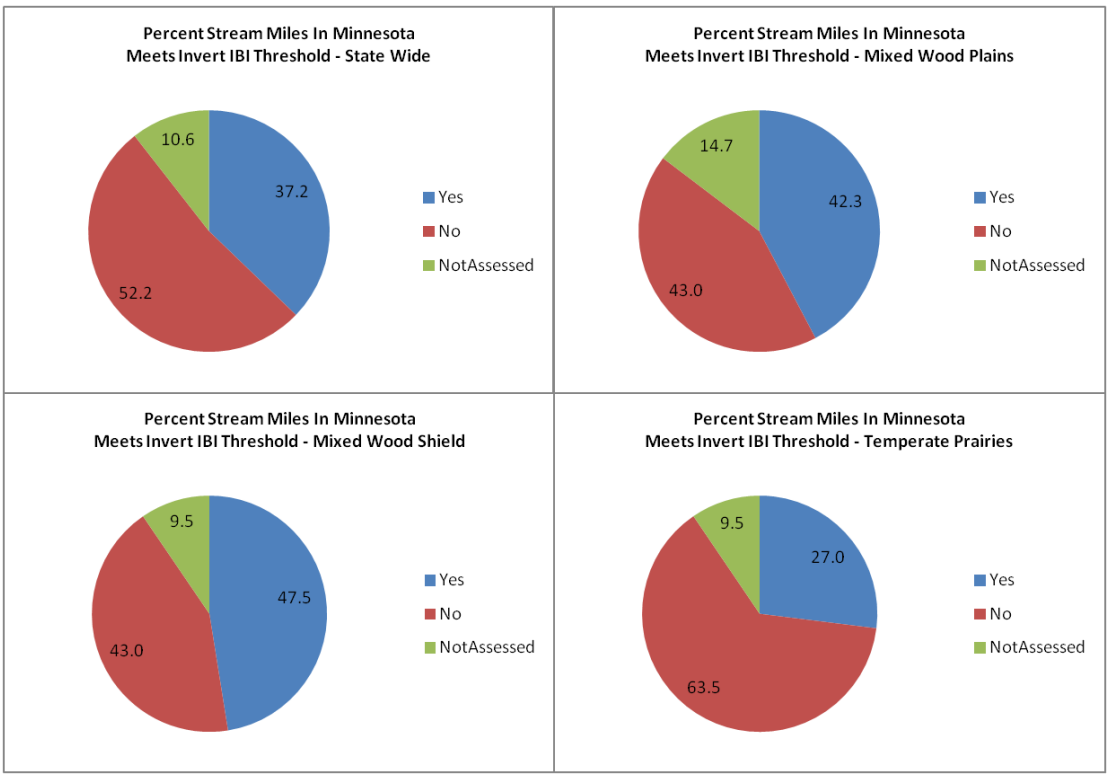


Figure III-11. Estimated percent of stream miles that meet or do not meet macro invertebrate IBI thresholds

C.5.2. Water Quality Trends for Minnesota Lakes

Detecting trends requires many measurements each summer and several years' worth of data. A variety of statistical tests can be used to perform trend analysis on historical Secchi readings. Kendall's tau-b is a statistical test that has been used in previous MPCA 305(b) reports to Congress (MPCA, 1990 and 1992) for assessing trends in Secchi transparency over time. The seasonal Kendall test is the current method used to determine whether the historic Secchi data for each lake in Minnesota exhibited increasing or decreasing trends. All Secchi readings are assigned a 'season' based on their ecoregion and the date they were taken. Medians are calculated for the readings in each season/year. The statistical software package R is used to run the seasonal Kendall test on these seasonal medians. The trend analysis code requires at least eight years of data to calculate a statistical result.

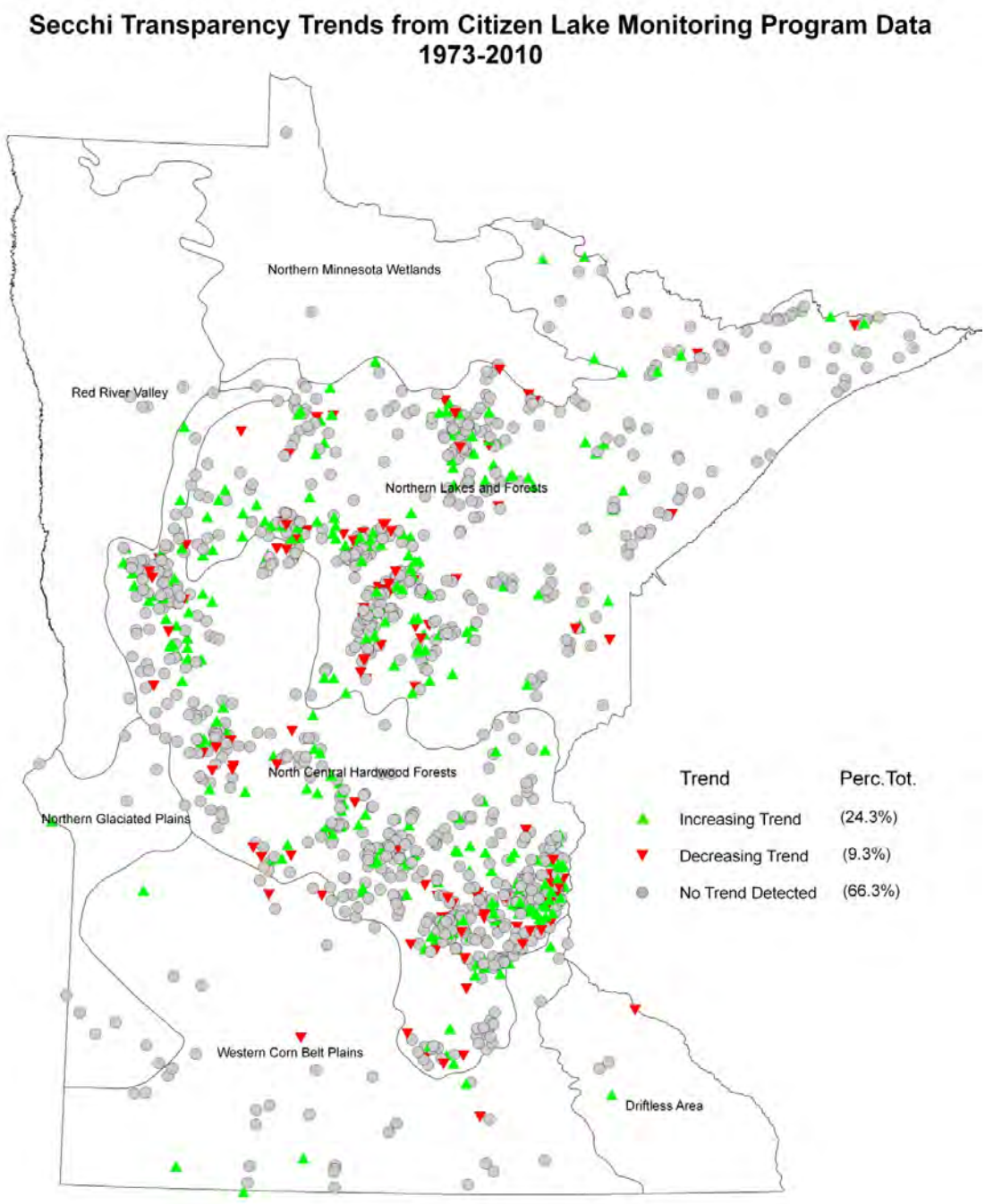
There were 1,330 lakes in Minnesota that met the minimum requirements for trend analysis in 2010. Of the 1,330 assessed lakes, 324 of them exhibited a statistically significant improvement in transparency over time. In contrast, only 124 lakes exhibited a statistically significant decline in transparency. Of the lakes with sufficient data for trend analysis in 2010, the majority, 882, exhibited no clear WQ trend.

Table III-5. Trends in Minnesota Lake Water Quality

Description	Number of Lakes
Assessed for Trends	**330**
Improving	**324**
Declining	**124**
No Clear Trend	**882**

The POC is Louise Hotka at 651-757-2450 or louise.hotka@state.mn.us.

Figure III.12. Secchi Transparency Trends 1973-2010



In addition, the recently established (2008) Sentinel Lakes Monitoring Program will provide a body of data that can be used to calculate trends over time in lakes. More information about the Sentinel Lakes Monitoring Program is available here: http://www.pca.state.mn.us/0agxaf7.

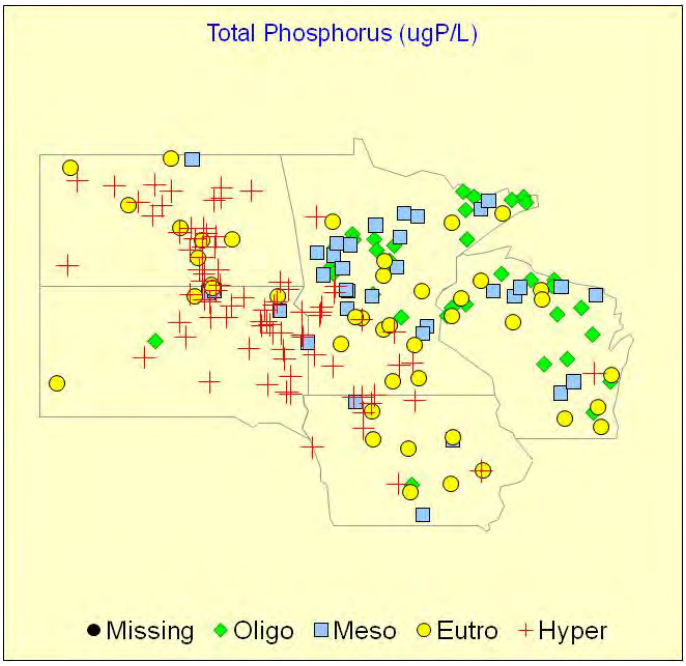
Probabilistic (or random) surveys have become an important tool for monitoring the condition of Minnesota's water resources. These surveys provide data sets that yield statistically sound, unbiased

estimates of the condition of the state's water bodies, and are very helpful in determining trends in water resource condition over time.

The MPCA participated in the USEPA's 2007 National Lake Assessment (NLA) survey. Minnesota received 41 lakes as a part of the original draw of lakes for the national survey, and added nine lakes to the survey to yield the 50 lakes needed for a statistically-based statewide estimates of condition. In addition to the 50 lakes, 14 reference lakes were later selected and sampled by EPA as a part of the overall NLA effort. Data from the reference lakes provide an additional basis for assessing lake condition as a part of NLA. While the 2007 data are not sufficient for broad, state-scale, assessment of temporal trends, they are valuable for assessing spatial trends (patterns) and provide valuable insight on a variety of lake management issues. Two examples are provided below, and further details may be found at http://www.pca.state.mn.us/nwqhae1.

a) NLA data from Minnesota and surrounding states was used to evaluate regional patterns. This can be of use as new assessment issues, e.g. sulfate and chloride arise or to help support long-term assessment efforts, e.g. total phosphorus (TP). An example of the latter is presented in Figure III-16. A distinct northeast to southwest pattern of increasing trophic state across Minnesota and how this pattern extends into adjacent states is evident in Figure III-13. Based on the cumulative distribution function (CDF) about 65 percent of Minnesota's lakes have TP < 30 µg/L, which is the standard for lakes in the Northern Lakes and Forests ecoregion. In contrast, about 20 percent of Minnesota's lakes have TP > 90 µg/L, which is the standard for shallow lakes in the Western Corn Belt and Northern Glaciated Plains ecoregions. These two examples imply that over 65 percent of Minnesota's lakes are estimated to meet the lake TP WQS, while over 20 percent likely will exceed the TP-based WQS. The 2012 NLA, which will have 150 lakes (50 per aggregated ecoregion) will allow for refinement of these figures and provide a basis for beginning to address temporal trends.
b) Minnesota Department of Natural Resources and MPCA are collaborating on the development of biotic indices for assessing the health of lakes. The 2007 NLA provided an opportunity to see how an existing fish IBI corresponded to measures of rooted plant health, lake trophic state, and other factors. While the fish IBI was developed based on specific lake classes and targeted lake surveys, the NLA offered an opportunity to expand to other lake classes and a random set of lakes. Of the 50 NLA lakes, 27 were suitable for IBI sampling and testing. A comparison of fish IBI to lake trophic state re-affirmed the relationship from the original research. Combining NLA-based fish IBI with plant health metrics from the same NLA lakes (Figure III-14), indicated a strong relationship between these important plant metrics and fish IBI. In general, this indicates that lakes with more plant species, higher floristic quality, and deeper maximum depth of plant growth exhibit higher fish IBI. This suggests good correspondence among fish IBI, rooted plant integrity, and lake trophic state – all of which are important as new assessment tools are developed.

Figure III-13. Total phosphorus map for Minnesota and surrounding states: a) trophic status classes and b) CDF a) Trophic status map uses MN-based TP thresholds: Oligo <12 µg/L, Meso 12-30 µg/L, Eutro 30-100 µg/L and Hyper >100 µg/L. Lakes coded as oligotrophic or mesotrophic would meet TP-based WQS, while all hypereutrophic would not meet TP-based WQS. Eutrophic lakes may or may not meet WQS, dependant on ecoregion.



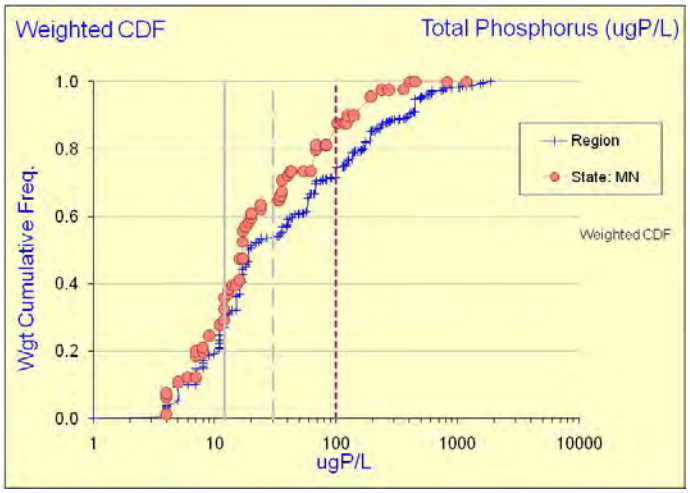
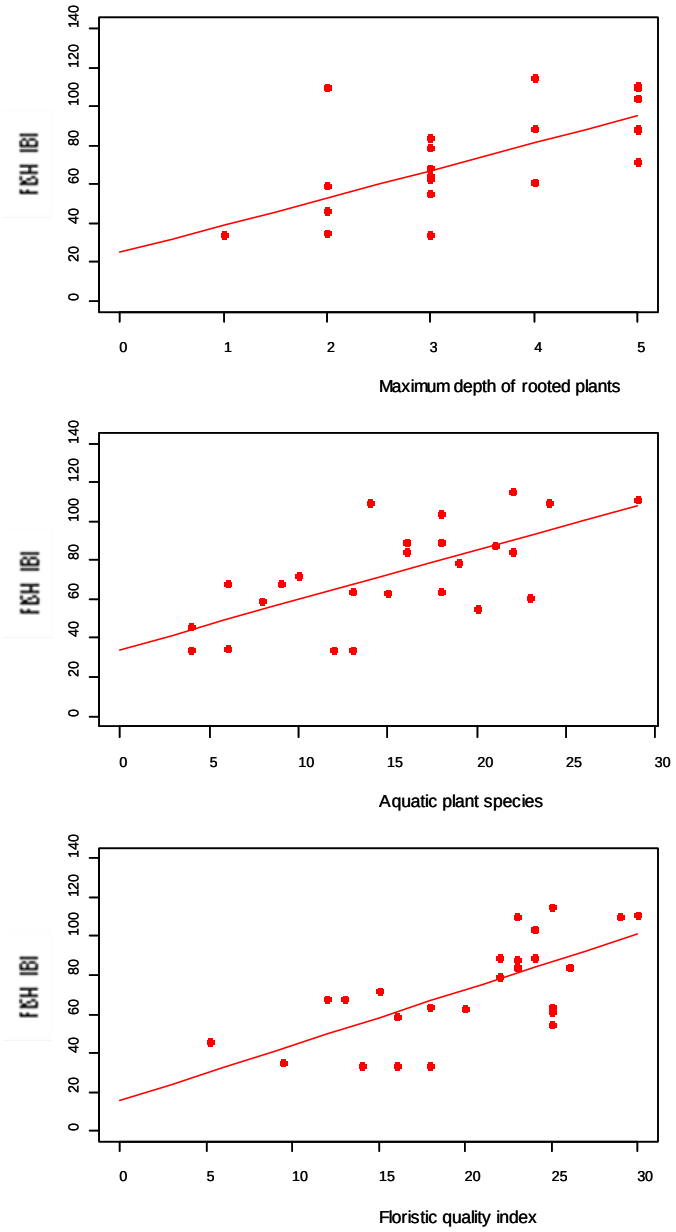


Figure III-14. Relationship between Fish IBI and maximum depth of rooted aquatic plants, number of aquatic plant species, and floristic quality index. A line indicates a significant relationship.



2012 National Lakes Assessment Survey

The MPCA is also participating in the 2012 NLA survey this summer. For this survey, a total of 150 lakes has been randomly selected that will yield national, statewide, and ecoregional assessments of lake condition.

Part D. Groundwater Monitoring and Assessment

The Groundwater Portion of the Integrated Report is included within this submittal as Appendix D and Table D-1.

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Part E. Public Participation

In general, public participation is critical throughout Minnesota's TMDL process. Minnesota expects advisory groups to be involved from the earliest stages of the project. At a minimum, the USEPA requires that the public must be given an opportunity to review and comment on TMDLs before they are formally submitted to USEPA for approval. Every TMDL is formally public-noticed in Minnesota with a minimum 30-day comment period. For more detailed information on the agency's public participation process for the development of TMDLs at: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/minnesotas-impaired-waters-and-tmdls/project-resources/civic-engagement-in-watershed-projects.html.

In addition, the MPCA has a comprehensive effort underway to build civic engagement into watershed projects. The MPCA is trying to build greater civic engagement in watershed planning by encouraging more citizens to become leaders for change in their communities and holding individuals personally responsible for making needed changes that could reduce water pollution. The MPCA is engaged in several activities to promote civic engagement in watershed plans and has developed several civic engagement products and services for use by local partners and citizens. See more information at: http://www.pca.state.mn.us/tchy956.

Finally, in addition to the TMDL development, the MPCA has an active public participation process during the development of biennial updates to the 303(d) List of Impaired Waters, including public meetings throughout the state on the draft List and a 30-day public comment period.

For the draft 2012 Impaired Waters List, the draft List was placed on the MPCA website in December 2011. The public was informed by a state wide MPCA press release and letters to over 500 individuals and groups on the MPCA TMDL mailing list. Seven public meetings were held between September 28 and October 7, 2009. The 30-day formal public comment period was between December 21, 2011 and January 25, 2012.

The draft 2012 TMDL List, the comments received during the public comment period, and the MPCA's Response to Comments can be found on the MPCA website at: http://www.pca.state.mn.us/enzq94b. The final TMDL List is not included here but it will be added as Appendix C.1. once USEPA provides MPCA with final approval.

The POC is Howard Markus at 651-757-2551 or howard.markus@state.mn.us.

Appendices

Appendix C.1.Final 2012 Impaired Waters List and Inventory

The MPCA's 2012 List and Inventory can be found at the following web page; http://www.pca.state.mn.us/enzq94b.

This link also contains the 2012 Guidance Manual and the approved 2010 List, the latter under the Archives Section.

The POC for Impaired Waters List and the Inventory is Howard Markus 651-757-2551 or howard.markus@state.mn.us.

Table C.2. Factors for differentiating among lakes, shallow lakes, and wetlands. For purposes of applying water quality standards and making 303(d) assessments. (July 13, 2009 draft – MPCA Environmental Analysis and Outcomes Division).

Factor	Lakes	Shallow lakes	Wetlands
Protected Waters Inventory Code	Typically coded as "L or LP" in PWI	May be coded as either "L, LP or LW" in PWI	Typically coded as a "LW" in PWI
Depth, maximum	Typically >15 feet	Typically < 15 feet	Typically < 7 feet
Littoral area	Typically <80%	Typically >80%	Typically 100%
Area (minimum)	> 10 acres (Bulletin 25)	> 10 acres (Bulletin 25)	No minimum
Thermal stratification (summer)	Stratification common but dependent upon depth, size and fetch	Typically do not thermally stratify	Typically do not stratify.
Fetch	Significant fetch depending on size & shape	Fetch is variable depending on size & shape	Rarely has a significant fetch
Substrate	Consolidated sand/silt/gravel	Consolidated to mucky	Mucky to unconsolidated
Shoreline features	Generally wave formed, often sand, gravel or rock.	Generally wave formed, often sand, gravel or rock.	Generally dominated by emergent.
Emergent vegetation & relative amount of open water	Shoreline may have ring of emergents; vast majority of basin open water.	Emergents common, may cover much of fringe of lake; basin often has high percentage of open water.	Emergents often dominate much of basin; often minimal open water.
Submergent vegetation	Common in littoral fringe, extent dependent on transparency.	Abundant in clear lakes; however may be lacking in algal-dominated turbid lakes.	Common unless dominated by an emergent like cattail.
Dissolved Oxygen	Aerobic epilimnion; hypolimnion often anoxic by midsummer.	Aerobic epilimnion but wide diurnal flux possible.	Diurnal flux & anaerobic conditions common.
Fishery	Typically managed for a sport/game fishery. May be stocked. MDNR fishery assessments typically available.	May or may not be managed for a sport fishery. If so, fishery assessment should be available. Winter aeration often used to minimize winterkill potential.	Typically not managed for a sport fishery. Little or no MDNR fishery information. Seldom aerated. May be managed to remove fish & promote waterfowl.
Uses	Wide range of uses including boating, swimming, skiing, fishing; boat ramps & beaches common.	Boating, fishing, waterfowl production, hunting, aesthetics; limited swimming; may have boat ramp, beaches uncommon.	Waterfowl & wildlife production, hunting, aesthetics. Unimproved boat ramp if any. No beaches.

Appendix D.1. Groundwater Monitoring and Assessment

The state of Minnesota has a multi-agency approach to monitor and assess its groundwater resources. The state agencies work together to provide a coordinated approach to groundwater monitoring and protection in Minnesota.

1. Minnesota's Groundwater Resources

Minnesota's groundwater is contained within 14 principal aquifers that are composed of unconsolidated sand deposits and a series of bedrock units. The uppermost aquifers in the state are sand and gravel aquifers that are generally of glacial origin. Twelve bedrock aquifers, which generally are composed of sedimentary rocks, underlie the sand and gravel aquifers.

The sand and gravel aquifers are important sources of water supply throughout the state. These aquifers occur throughout Minnesota but are concentrated in the central and western parts. These aquifers primarily were formed by materials deposited during a period of continental glaciation which occurred about 10,000 to 350,000 years ago. The sand and gravel aquifers are found near the land surface or buried within more impermeable materials. The surficial sand and gravel aquifers are most prevalent in the central part of the state. The buried sand and gravel aquifers occur in areas with thick glacial deposits where multiple glaciations occurred. The sand and gravel aquifers yield moderate to good amounts of water in the central and western parts of the state; elsewhere the yields from these aquifers are limited. For example, NE Minnesota has a relatively thin covering of glacial materials overlying crystalline bedrock.

The Prairie du Chien-Jordan, Tunnel City/Wonewoc, and Mount Simon Hinckley are the three main bedrock aquifers used for water supply in Minnesota. These aquifers are composed of limestone, dolostone, and sandstones that generally were deposited when seas covered Minnesota about 500 million years ago. The Prairie du Chien-Jordan is the uppermost of these three aquifers and is highly developed in the Twin Cities Metropolitan Area (TCMA). The Tunnel City/Wonewoc aquifer underlies the Prairie du Chien-Jordan and is an important source of water supply in parts of Southeastern Minnesota where the Prairie du Chien-Jordan aquifer is either near the land surface or not present. The Mount Simon/Hinckley aquifer underlies all of southeastern Minnesota and extends as far north as the city of Duluth, Minnesota. Groundwater withdrawals from the Mount Simon/Hinckley aquifer increase substantially north of the TCMA.

Groundwater resources are limited in southwestern and NE Minnesota. Surficial sand and gravel aquifers that yield moderate amounts of water are the main groundwater resources in Southwestern Minnesota. In this part of the state, the sand and gravel aquifers often are located near streams. Northeastern Minnesota has the most limited groundwater resources in the state because this area is composed of very old crystalline rocks with a thin veneer of glacial materials that yield little water.

2. Groundwater Protection Programs

Minnesota's groundwater protection programs primarily are shared among four state agencies—the MPCA, MDA, MDH, and MDNR (Table D-1), with regional coordination in the Twin Cities area by the Metropolitan Council.The MPCA's programs focus on protecting the state's groundwater from non-agricultural chemical contamination. The MDA's programs protect the groundwater from agricultural chemicals. The MDH is charged with protecting the state's drinking water supplies from

groundwater contamination. The MDNR's manage groundwater quantity by regulating water allocation and withdrawals.

The MPCA administers regulatory and monitoring programs that protect the groundwater from contamination by non-agricultural chemicals. The agency's regulatory programs identify, regulate, and remediate spills of non-agricultural contaminants. These include the state's Brownsfields, Emergency Response, Landfills/Dumps, Petroleum Remediation, Resource Conservation and Rrecovery Act Corrective Action, Superfund, Voluntary Investigation and Cleanup, Subsurface Sewage Treatment System, Feedlot, and Stormwater Programs. The agency also maintains an ambient groundwater monitoring network to determine the presence and distribution of non-agricultural chemicals and identify any trends. This monitoring also includes an "early warning network" of shallow monitoring wells. The main goal of the "early warning network" is to identify trends in groundwater quality early, so BMPs to reduce contamination can be put in place rather than more-costly remediation.

The MDH administers several programs that protect the public's health from waterborne contaminants. The agency administers the state's Well Management Program which regulates the construction of new wells and the proper sealing unused ones. The agency also administers the state's Drinking Water and Source Water Protection Programs and develops human health-based guidance for groundwater.

The MDA is the lead state agency for regulating pesticides and fertilizers in the state and administers programs which protect the groundwater from agricultural chemical contamination. The agency approves new pesticide products for use in the state in cooperation with the USEPA. The agency also monitors the groundwater to determine that pesticides are used properly and do not have a harmful impact on the state's groundwater. The agency also takes enforcement actions when improper disposal or application of pesticides is found. The MDA also develops BMPs for pesticide use and regulates the sale, use, and disposal of pesticides.

The MDNR administers programs related to groundwater appropriations. The agency permits groundwater withdrawals, performs aquifer vulnerability assessments, resolves water use conflicts, and monitors groundwater levels across the state.

Table D-1 Summary of Minnesota groundwater protection programs
Minnesota Department of Agriculture (MDA), Minnesota Department of Health (MDH), Minnesota Department of Natural Resources (MDNR), Minnesota Geological Survey (MGS), Minnesota Pollution Control Agency (MPCA).

Programs or Activities	Check (ü)	Implementation Status	Responsible State Agency
Active Sara Title III Program	ü	Established	MPCA, MN Dept. of Public Safety
Ambient groundwater monitoring system	ü	Continuing Effort	MPCA, MDA
Aquifer vulnerability assessment	ü	Continuing Effort	MDNR
Aquifer mapping	ü	Continuing Effort	MGS
Aquifer characterization	ü	Continuing Effort	MPCA, MDA, MDNR, MGS
Comprehensive data management system	ü	Continuing Effort	MPCA, MDA, MDNR, MDA, MGS
Consolidated cleanup standards	ü	Continuing Effort	MPCA, MDH
Groundwater Best Management Practices	ü	Continuing Effort	MPCA, MDA
Groundwater legislation	ü	Continuing Effort	All agencies
Groundwater classification	ü	Established	MPCA
Groundwater quality standards	ü	Continuing Effort	MDH, MPCA, MDA
Interagency coordination for groundwater protection initiatives	ü	Established	All agencies
Nonpoint source controls	ü	Established	MPCA, MDA
Pesticide State Management Plan	ü	Established	MDA
Resource Conservation and Recovery Act Primacy	ü	Established	MPCA
Source Water Assessment Program	ü	Continuing Effort	MDH
State Property Clean-up Programs	ü	Established	MPCA, MDA
Susceptibility assessment for drinking water/wellhead protection	ü	Established	MDH
State septic system regulations	ü	Established	MPCA
Underground storage tank installation requirements	ü	Established	MPCA
Underground Storage Tank Remediation Fund	ü	Established	MPCA/Dept. of Commerce
Underground Injection Control Program	ü	Established	MDH
Underground Storage Tank Permit Program	ü	Established	MPCA
Well abandonment regulations	ü	Established	MDH
Wellhead Protection Program (EPA-approved)	ü	Established	MDH
Well Installation Regulations	ü	Established	MDH

3. Groundwater Monitoring Programs

Four state agencies jointly conduct groundwater quantity and quality monitoring in Minnesota. The MDNR maintains the state's groundwater level monitoring network (quantity). The MPCA, MDA, and MDH jointly conduct groundwater quality monitoring based on their individual state and federal authorities and requirements. The MPCA monitors non-agricultural chemicals, and the MDA monitors agricultural chemicals such as pesticides and fertilizers. The MDH monitors the groundwater used by the public to ensure any chemicals are below concentrations which present a threat to human health. Further information on this multi-agency approach to groundwater monitoring is contained in Minnesota's Water-Quality Monitoring Strategy document (Minnesota Pollution Control Agency 2011).

Several state agencies recently integrated the storage of their groundwater data into shared data management systems. The MPCA and MDA both store the data collected by their groundwater condition monitoring networks in a data management system called EQuIS, which is maintained by the MPCA. EQuIS is the replacement database for STORET. The MPCA and MDNR also plan to both store their groundwater level data in a time series data management system. These advances in data management will facilitate the analysis and interpretation of groundwater data collected across state agencies.

4. MPCA's Monitoring and Assessment Strategy

The MPCA's monitoring and assessment strategy continues to focus on aquifers that are vulnerable to human contamination and underlie the urban and undeveloped parts of Minnesota. The agency's ambient groundwater network currently focuses on the surficial sand and gravel and the Prairie du Chien-Jordan aquifers. Approximately 200 wells representing conditions underlying non-agricultural areas were sampled in 2010 and 2011. About one half of these wells were located in the shallow part of the surficial aquifer, and the remainder was located in deeper parts of the surficial or Paleozoic aquifers. Water samples generally were collected annually to determine concentrations of over 100 chemicals, including nitrate, chloride, and volatile organic compounds (VOCs).

5. MDA's Monitoring and Assessment Strategy

The MDA continues to monitor groundwater that is vulnerable to anthropogenic contamination underlying agricultural parts of Minnesota. The primary focus of this monitoring is to assess the presence and distribution of pesticides in the groundwater (MDA, 2007). The network typically monitors the upper part of the sand and gravel aquifers and consists of about 150 monitoring wells. Eighty-five of these wells are located in central Minnesota. Approximately 50 wells are located in agricultural areas in other parts of the state. In the southeastern part of the state, approximately 10-15 springs are sampled in lieu of wells since springs integrate water-quality conditions in karstic areas.

6. MDH's Monitoring and Assessment Strategy

The MDH continues to monitor the condition of the state's public water supplies, which often utilize groundwater. The MDH samples the state's finished drinking water in cooperation with the public water supply systems to determine whether contaminant concentrations meet Safe Drinking Water Act regulations. Private drinking water wells are not assessed as part of this effort; however, the MDH reviews nitrate and coliform bacteria data collected by well drillers from newly-installed drinking water wells to determine the potability of the water. The MDH also conducts investigative monitoring to assist the public water suppliers in locating wells in areas with lower concentrations of arsenic, radionuclides, and nitrate. In addition, the MDH measures the tritium values in some wells

to identify locations with recently-recharged groundwater which are very susceptible to contamination. The MDH also administers the state's wellhead protection program to protect the groundwater from contamination.

7. MDNR's Monitoring and Assessment Strategy

The MDNR continues to maintain a groundwater level monitoring network across the state. The network contains approximately 750 wells. The MDNR uses the collected data to assess groundwater resources, determine long term trends in water levels, interpret impacts of pumping and climate, plan for water conservation, and evaluate water conflicts. Water level readings are measured on an approximately monthly schedule in cooperation with soil and water conservation districts or other LGUs.

8. Minnesota's Groundwater Quality

MPCA's 2007 condition monitoring report integrated data on nitrate, chloride, VOCs, and pesticides in the groundwater (O'Dell 2007). This information was collected by several state agencies and national and local monitoring efforts. The monitoring data from the 2007 report indicated elevated nitrate concentrations were common beneath agricultural and urbanized parts of Minnesota. The highest nitrate concentrations generally occurred in the agricultural areas in Central Minnesota. In this part of the state, nitrate concentrations frequently exceeded the standard set for drinking water (10 $mg/_L$ as nitrogen) in the shallow groundwater. The elevated nitrate concentrations which occur throughout Minnesota likely resulted from several sources, including fertilizers applied agricultural fields and urban lawns, animal manure, wastewater discharged to the land, or atmospheric deposition. Pesticides and their degradates also were commonly detected in the shallow groundwater underlying agricultural areas; however, concentrations generally were less than the applicable drinking water standards. The MPCA's monitoring data showed the greatest chloride concentrations generally occurred in the Minneapolis-St. Paul metropolitan area. Work performed in Minnesota and several other states indicated the elevated chloride concentrations likely resulted from road salt applications.

There currently (2012) are a limited number of wells in the MPCA's condition monitoring network that have sufficient data to determine the long term temporal trends in groundwater quality. The MPCA's groundwater monitoring network has not operated for a long enough period of time to establish trends. Sixteen wells in the MPCA's condition monitoring network have been sampled for at least 10 years. Most of these wells are located in the vicinity of the city of St. Cloud or the Minneapolis-St. Paul metropolitan area and generally represent conditions near the water table in the surficial sand and gravel aquifers.

The available condition monitoring data from the MPCA showed few long term temporal trends in nitrate and chloride concentrations in the groundwater underlying urban parts of Minnesota. There was a statistically-significant nitrate trend in six of the 16 wells from about 1993-2010, and a statistically significant trend in chloride concentrations in five of the 16 wells during this same period. Four wells had a significant decreasing trend in nitrate concentrations, and there was a significant increasing trend in nitrate concentrations in two wells tapping bedrock aquifers in the eastern part of the Minneapolis-St. Paul metropolitan area. The two wells within increasing nitrate trends are located in an area that is vulnerable to anthropogenic contamination because the bedrock aquifers are overlain by less than 50 feet of glacial deposits. Three wells had a significant increasing trend in chloride concentrations, and two wells had a significant decreasing trend.

The MPCA began collecting samples from its condition monitoring network for analysis of over 100 contaminants of emerging concern (CECs) in 2009. The resultsfrom the first round of sampling, which was conducted from 2009-2010, showed twenty CECs were detected in about one-third of the 40 sampled wells (Kroening 2012). The most frequently-detected chemicals were the fire retardant tris (dichloroisopropyl) phosphate, the antibiotic sulfamethoxazole, and the plasticizers bisphenol A and tributyl phosphate. The presence of these chemicals in the state's water resources continues to concern the public. The MPCA's monitoring of these chemicals supports work by the MDH to determine what level of these contaminants in drinking water presents a risk to human health. http://www.pca.state.mn.us/index.php/view-document.html?gid=17244.

9. **Groundwater Contamination Sources**

   The 10 highest priority sources of groundwater contamination in Minnesota were listed in the state's Nonpoint Source Management Program Plan (Johnson 2008). These sources of contamination were determined through a survey of federal and state agency staff. The 10 highest priority contamination sources were animal feedlots, fertilizer applications, irrigation practices, pesticide applications, unregulated land application of manure, underground storage tanks, landfills, subsurface sewage treatment systems, hazardous waste sites, and urban runoff.

The POC for groundwater questions is Steve Thompson at 651-757-2788 or stephen.c.thompson@state.mn.us.

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