Mississippi River - St. Cloud

May 2024

Draft Mississippi River - St. Cloud Watershed Restoration and Protection Strategy Report Update 2024

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

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Document number: wq-ws4-99a

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Key terms and abbreviations

Assessment Unit Identifier (AUID): The unique water body identifier for each river reach comprised of the U.S. Geological Survey (USGS) eight-digit HUC plus a three-character code unique within each HUC.

Aquatic life impairment: The presence and vitality of aquatic life is indicative of the overall water quality of a stream. A stream is considered impaired for impacts to aquatic life if the fish Index of Biotic Integrity (IBI), macroinvertebrate IBI, dissolved oxygen, turbidity, or certain chemical standards are not met.

Aquatic recreation impairment: Streams are considered impaired for impacts to aquatic recreation if fecal bacteria standards are not met. Lakes are considered impaired for impacts to aquatic recreation if total phosphorus and either chlorophyll-*a* or Secchi disc depth standards are not met.

Hydrologic Unit Code (HUC): A HUC is assigned by the USGS for each watershed. HUCs are organized in a nested hierarchy by size. For example, the Minnesota River Basin is assigned a HUC-4 of 0702 and the Pomme de Terre River Watershed is assigned a HUC-8 of 07020002.

Impairment: Water bodies are listed as impaired if water quality standards are not met for designated uses including aquatic life, aquatic recreation, and aquatic consumption.

Index of Biotic Integrity (IBI): A method for describing water quality using characteristics of aquatic communities, such as the types of fish and invertebrates found in the water body. It is expressed as a numerical value between 0 (lowest quality) to 100 (highest quality).

Protection: This term is used to characterize actions taken in watersheds of waters not known to be impaired to maintain conditions and beneficial uses of the water bodies.

Restoration: This term is used to characterize actions taken in watersheds of impaired waters to improve conditions, eventually to meet water quality standards and achieve beneficial uses of the water bodies.

Source (or pollutant source): This term is distinguished from 'stressor' to mean only those actions, places or entities that deliver/discharge pollutants (e.g., sediment, phosphorus, nitrogen, pathogens).

Stressor (or biological stressor): This is a broad term that includes both pollutant sources and nonpollutant sources or factors (e.g., altered hydrology, dams preventing fish passage) that adversely impact aquatic life.

Total maximum daily load (TMDL): A calculation of the maximum amount of a pollutant that may be introduced into a surface water and still ensure that applicable water quality standards for that water are met. A TMDL is the sum of the wasteload allocation for point sources, a load allocation for nonpoint sources and natural background, an allocation for future growth (i.e., reserve capacity), and a margin of safety as defined in the Code of Federal Regulations.

Acronyms

1W1P	One Watershed, One Plan
AQL	Aquatic Life
AQR	Aquatic Recreation
BWSR	Minnesota Board of Water and Soil Resources
BMP	Best management practice
CAFO	Concentrated Animal Feeding Operation
Chl-*a*	Chlorophyll-a
DNR	Minnesota Department of Natural Resources
DO	Dissolved oxygen
DWSMA	Drinking Water Supply Management Area
E. coli	*Escherichia coli*
EJ	Environmental Justice
EPA	United States Environmental Protection Agency
FIBI	Fish Index of Biological Integrity
FWMC	Flow Weighted Mean Concentrations
HSPF	Hydrologic Simulation Program-Fortran
HUC	Hydrologic unit code
IBI	Index of Biological Integrity
IWM	Intensive watershed monitoring
MCL	Maximum Contaminant Level
MIBI	Macroinvertebrate Index of Biological Integrity
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
MRSCW	Mississippi River - St. Cloud Watershed
M	Meters
µg/L	Micrograms per Liter
N	Nitrogen
NCHF	North Central Hardwood Forests
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service

SDS	State Disposal System
SID	Stressor Identification
SWCD	Soil and Water Conservation District
TN	Total Nitrogen
TMDL	Total maximum daily load
TP	Total phosphorus
TSS	Total suspended solids
UMRB	Upper Mississippi River Basin
USDA	United States Department of Agriculture
WHAF	Watershed Health Assessment Framework
WPLMN	Watershed Pollutant Load Monitoring Network
WRAPS	Watershed Restoration and Protection Strategy
WWTF	Wastewater Treatment Facilities

Minnesota's Watershed Approach

The State of Minnesota developed a watershed approach to focus holistically on each watershed's condition as the scientific basis of permitting, planning, implementation, and measurement of results. This process looks strategically at the drainage area as a whole instead of focusing on lakes and stream sections one at a time, thus increasing effectiveness and efficiency.

The arrow emphasizes the important connection between state water programs and local water management. Local partners are involved – and often lead – in each stage of this framework.

Every 10 years, each of Minnesota's 80 major watersheds are evaluated through monitoring/data collection and assessed against water quality standards to show trends in water quality and the impact of permitting requirements, as well as any restoration, or protection actions. A watershed restoration and protection strategies (WRAPS) report is then updated to provide technical information to support the implementation of restoration and protection projects by local partners through their One Watershed, One Plan (1W1P) comprehensive local water plan. The Minnesota Pollution Control Agency's (MPCA's) watershed work is tailored to meet local conditions and needs, based on factors such as watershed size, landscape diversity, and geographic complexity.

To identify and address threats to water quality in each watershed, WRAPS reports address both strategies for restoration for impaired waters, and strategies for protection for waters that are not impaired. Waters not meeting state standards are listed as impaired and total maximum daily load (TMDL) studies are developed for them. The TMDLs are incorporated into the WRAPS reports.

Key aspects of the MPCA's watershed work are to develop and utilize watershed-scale computer models, perform biological stressor identification (SID), conduct problem investigation monitoring, and use other tools to identify strategies for addressing point and nonpoint-source pollution that will cumulatively achieve water quality targets. Point-source pollution comes from sources such as wastewater treatment plants or industrial facilities; nonpoint-source pollution is the result of runoff or containments not being absorbed in the soil. For nonpoint source pollution, the WRAPS report informs local planning efforts, but ultimately the local partners decide what work will be included in their local plans.

Minn. Stat. § 114D, also known as the Clean Water Legacy Act, sets out the policy framework for the Watershed Approach, including requiring the development and updating of WRAPS for all watersheds of the state. The Clean Water, Land, and Legacy Amendment approved by Minnesota voters in 2008 directs dollars from an increase in sales tax to a Clean Water Fund, which is overseen by the Clean Water Council. The Clean Water Fund provides resources to implement the Clean Water Legacy Act to achieve and maintain water quality standards in Minnesota through activities such as monitoring, watershed characterization and scientific study, planning, research, and on-the-ground restoration and protection activities.

Executive summary

The State of Minnesota has adopted a Watershed approach to water quality for each of the 80 major (8 - digit Hydrologic Unit Code [HUC-8]) watersheds in the state. It is planned that every 10 years, each major watershed is cycled into the Watershed Lake and Stream Monitoring Schedule, a comprehensive monitoring and assessment process known as the intensive watershed monitoring (IWM), which intensively evaluates the overall health of the watershed's surface water resources. The information gathered though the IWM is summarized in a series of reports (e.g., Monitoring and Assessment) and subsequent processes (e.g., SID, TMDLs) leading to the opportunity for the development of a Watershed Restoration and Protection Strategy (WRAPS) Update Report, led by the MPCA.

The first IWM cycle began in the Mississippi River - St. Cloud Watershed (MRSCW) – 07010203 in 2009, with the initial WRAPS report approved in 2015. This Mississippi River - St. Cloud WRAPS Report Update 2024 is an update of the 2015 WRAPS Report. This WRAPS report update summarizes water quality findings and provides recommendations from the second round of IWM and the associated water quality restoration and protection related processes. The goals of this updated WRAPS report are to:

- Highlight differences and trends in the MRSCW conditions since the first IWM Cycle, which was completed in 2009 – 2010. This includes summarizing key findings from the associated MRSCW monitoring and assessment along with SID processes.
- Serve as a companion document to the MRSC TMDL Report, which is being developed concurrently with the WRAPS Update Report. This TMDL Report addresses several water quality impairments within the MRSCW. These impairments include high levels of bacteria *Escherichia coli* (*E. coli*), total suspended solids (TSS), and total phosphorus (TP), affecting aquatic recreation (AQR) and aquatic life (AQL) designated uses. Seventeen TMDLs were developed through the project: 10 *E. coli* stream TMDLs, 1 TSS stream TMDL and 6 TP lake TMDLs.
- Provide water quality information and recommendations in the effort to help support the ongoing and future comprehensive local water planning efforts (e.g., MRSCW 1W1P), which is currently under development and is planned for completion in the fall of 2024.
- Serve as an informational and educational resource to help inform readers and stakeholders of various water quality resources and tools available to support MRSCW water quality restoration and protection efforts.
- Spotlight some of the ongoing water quality implementation and public outreach activities occurring over the past decade, including some noteworthy water quality success stories.

From its multitude of available natural resources, diverse land uses and its thriving communities, the MRSCW is a highly dynamic watershed, one of which provides great recreational and essential environmental assets to the residents of the MRSCW and beyond. Overall, significant progress in surface water quality has occurred within the MRSCW over the past decade. These assessments are supported statistically through improvements in AQL communities, positive water quality trends on 17 lakes and 8 delistings from Minnesota's Impaired Waters List. Two of these delistings, which are specifically highlighted in this report; Plum Creek (bacteria) and Lake George (nutrients), are featured as Success

Stories on the United States Environmental Protection Agency (EPA) Nonpoint Source Pollution website (see Section 2 for more information and links to websites). However, ongoing problems and challenges such as loss of shoreland habitat due to development, excess nutrients, elevated levels of bacteria, and low dissolved oxygen (DO) levels continue to exist and expand in some areas of the MRSCW (MPCA 2022a). The following describes some of the key findings, the overall general watershed conditions and planning considerations for the MRSCW surface water and related resources.

Condition of Lakes

Sunset on Clearwater Lake – Photo Credit CRWD

One lake (Eagle/71-0067-00) was added to the 2022 impaired waters list for AQR - Nutrients.

Seven lakes (Betty/47-0042-00, Mitchell/71-0067-00, Big/71-0082-00, Briggs/71-0146-00, Eagle/86-0148-00, Mary/86-0156-00, Locke/86-0168-00) were added to the 2022 impaired waters list for AQL - Fish Bioassessments.

Six lakes (2 Fully Supporting – Cedar/86-0227-00 and Bass/86-0234-00, and 4 Inconclusive – Augusta/86-0284-00, Elk/71-0055-00, Louisa/86-0282-00, Pleasant/86-0251-00) were determined to be vulnerable to future impairment based on Fish Index of Biological Integrity (FIBI) scores near the impairment threshold.

There are 34 lakes in the MRSCW that have water quality trend data. Of this total, 20 lakes had improving trends, 13 lakes indicated no change and 1 (Albion/86-0212-00) had a declining trend.

The water quality for Lake Julia/71-0145-00 has significantly improved since the first Cycle of IWM (2009 – 2010). It is still listed as impaired by nutrients, but recent data and associated trends suggest it is near the nutrient threshold (barely impaired).

Sugar Lake scored above the Exceptional Level for FIBI and may warrant additional protection measures.

Rice Lake/71-0142-00 (2020) and Clearwater Lake (West)/86-0252-02 (draft 2024) have been added to the impaired waters list due to sulfate levels that may impact Wild Rice Production.

Four Lakes (George/73-0611-00, Augusta/86-0284-00, Union/86-0298-00, Birch/71-0057-00) were Delisted from the impaired waters list for AQR – Nutrients.

Condition of Rivers and Streams

Between the first round and second round of IWM in the MRSCW, the MPCA adopted new rules to provide reasonable AQL protections for water bodies that were legally altered prior to the Federal Clean Water Act (1972). These rules based on Tiered Aquatic Life Uses (TALU) resulted in 12 biological impairments (carried over from Cycle 1 IWM) being listed on the 2020 Impaired Waters List. These impairments included: seven fish bioassessments, four benthic macroinvertebrates bioassessments, and one for low DO.

Six stream segments were added to the 2022 Impaired Waters List for the MRSCW (0701203). The last three digits of the Assessment Unit Identification number (AUID) for the reaches are noted. These listings included: Clearwater River/549 – Fish bioassessments, Snake River/529 – Fish bioassessments, Snake River/558 – Fish bioassessments, Threemile Creek/545 – Fish Bioassessments, Threemile Creek/564 – Fish and Benthic macroinvertebrates bioassessments. Most of these AQL impairments existed on coldwater tributaries, which could support coldwater fish species (e.g., brook and brown trout), but poor habitat is limiting factor. Additionally, a segment of Johnson Creek/633 was determined to be impaired by *E. coli* bacteria, thus failing the AQR standard.

Of the 25 MRSCW stream reaches assessed in the Cycle 2 IWM for AQL standards, 60% (15) were found in nonsupport status, while 94% (16) of the 17 reaches evaluated for the AQR standards were determined to be in nonsupport status.

Successful restoration of the biological community was observed on Unnamed Creek/684 where a culvert replacement project significantly improved overall stream connectivity. This stream was sampled for fish and macroinvertebrates in 2009, and then repeated in 2019. After the 2019 sampling, the fish and macroinvertebrate IBI scores vastly improved, which prompted a delisting for both communities.

Bacteria impaired streams/rivers continue to be prevalent and present a significant issue in the MRSCW with 20 reaches (17 listed for *E. coli* and 3 for fecal coliform) currently on the draft 2024 Impaired Waters list. Of these 20 reaches, 9 have approved TMDL plans and 10 are included in the 2024 MRSC TMDL project.

Plum Creek/572 was delisted from the Impaired Waters List for *E. coli* bacteria in 2020. This reach along with Lake George (one of the lake delistings noted above) are two of the highlighted Success Stories in the MRSCW, which are featured in this report and on EPA's Nonpoint Source Pollution website. Links to both EPA stories are provided within the report.

Recreating on the Mississippi River near Clearwater MN. Photo Credit – Clearwater Outfitters and Northwest Canoe

The city of St. Cloud is the furthest city upstream in the United States to obtain its drinking water supply from the Mississippi River. The Mississippi River serves as the drinking water supply for the St. Cloud Water Treatment Facility and the Minneapolis Water Treatment and Distribution Services. Additionally, the Mississippi River is also one of the main water supplies for the St. Paul Regional Water Services. The approximate population being served by these water facilities as of 2023 is St. Cloud (67,344), Minneapolis (425,300) and St. Paul (397,797) for a total of 890,441 users.

TMDL studies were developed concurrently to the MRSC WRAPS Update effort for 10 *E. coli* impaired stream reaches, 6 nutrient impaired lakes, and 1 stream impairment for fish and benthic macroinvertebrate bioassessments. These studies identify known and likely sources of pollutants and reductions needed to bring these water bodies back into compliance with state standards. Over the past 15 years several previous TMDLs have been developed for waters within the MRSCW including: the

Mississippi River (St. Cloud) Watershed TMDL (2015), Upper Mississippi River Watershed TMDL and Protection Plan (2014), Elk River Watershed TMDL (2012) and several TMDLs completed for waters within the Clearwater River Watershed District (CRWD) dating back to 2009.

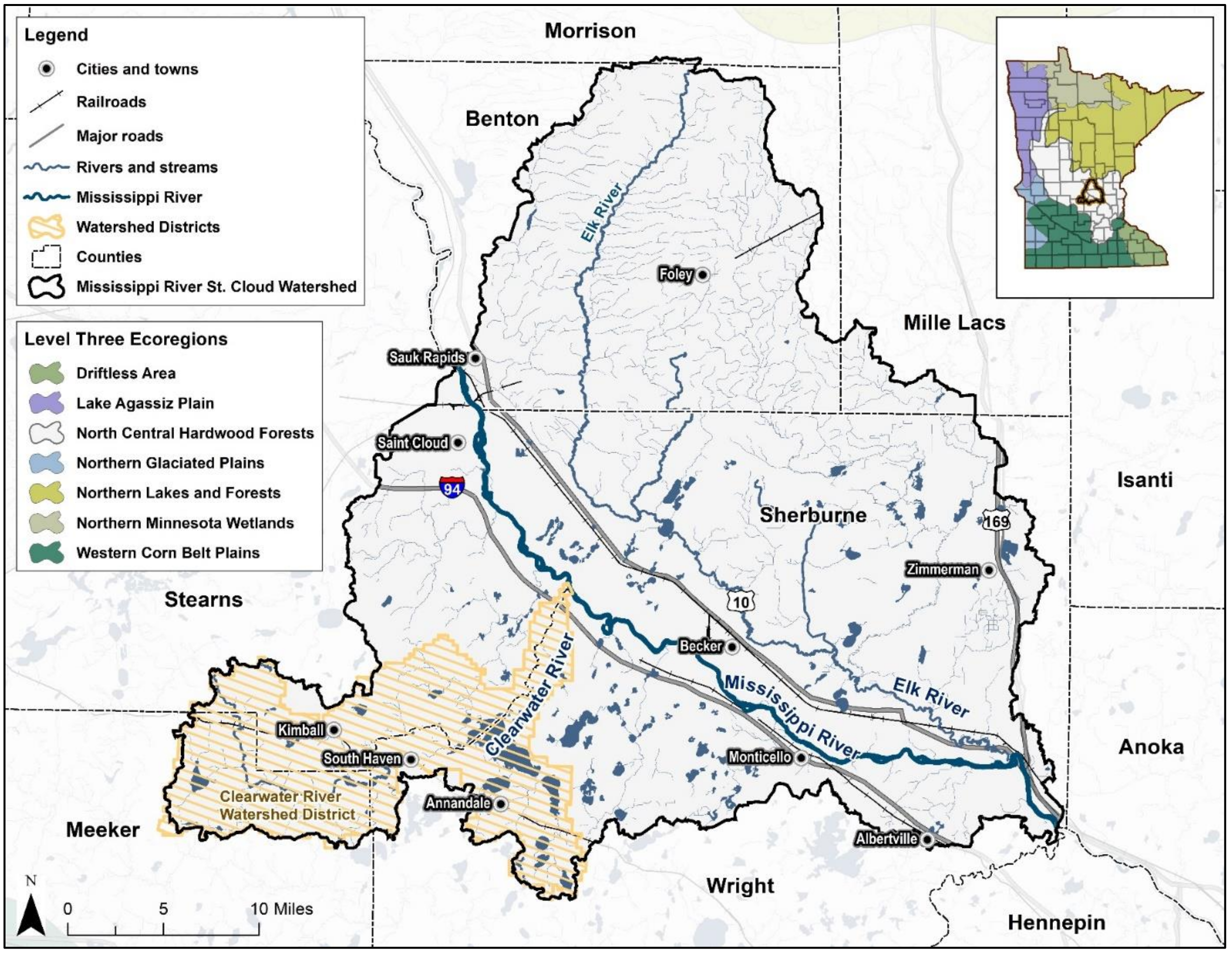
To investigate the causes of AQL impairments in the assessed streams, a SID study was completed by the MPCA in 2022 (MPCA 2022b). The study noted potential stressors found throughout the MRSCW. These stressors included altered hydrology, habitat degradation, connectivity and flow issues. Practices to exclude cattle, maintaining healthy riparian buffers and efforts towards restoring the natural hydrology and/or stream channel are commonly noted as practice alternatives to consider for restoration strategies to biologically impaired waters. The 2022 SID study identified systemic issues (e.g., altered hydrology/geomorphology) within the MRSCW, which factored into nearly all of the biological impairments identified with the MRSCW.

Several important MRSCW environmental planning processes are ongoing and occurring concurrently with the WRAPS Update and TMDL processes completed subsequent to the Cycle 2 IWM effort. This includes the development of the MRSCW 1W1P, which will serve as the local comprehensive local water planning strategy for guiding implementation efforts in the MRSCW for years to come. It is the goal of this WRAPS Update to provide information to best support these key partnering efforts. Situated on the fringe of a rapidly expanding Twin Cities metro region, the MRSCW is a highly complex watershed, one of which presents challenges to local and state water planners. However, the strong MRSCW partner network is continuously working to meet these challenges head on, which has resulted in significant water quality achievements throughout the MRSCW over the years. It is through such collaborative partner networks, combined with the ongoing successful engagement of its residents MRSCW and users, that will help ensure that the MRSCW and its wonderful surface water and associated natural resources will remain a healthy Minnesota treasure now and for generations to come.

1. Watershed background and description

The MRSCW covers approximately 691,200 acres (1,080 square miles) in the south-central part of the Upper Mississippi River Basin (UMRB; Figure 1). Located entirely within the North Central Hardwood Forests ecoregion, the MRSCW includes all or parts of the counties of Benton, Meeker, Mille Lacs, Morrison, Sherburne, Stearns, and Wright. Communities located in the watershed include Sauk Rapids, Elk River, Big Lake, Monticello, and parts of St. Cloud. This watershed has approximately 907 total river miles and contains 374 lakes with a total acreage of covering 23,728 acres.

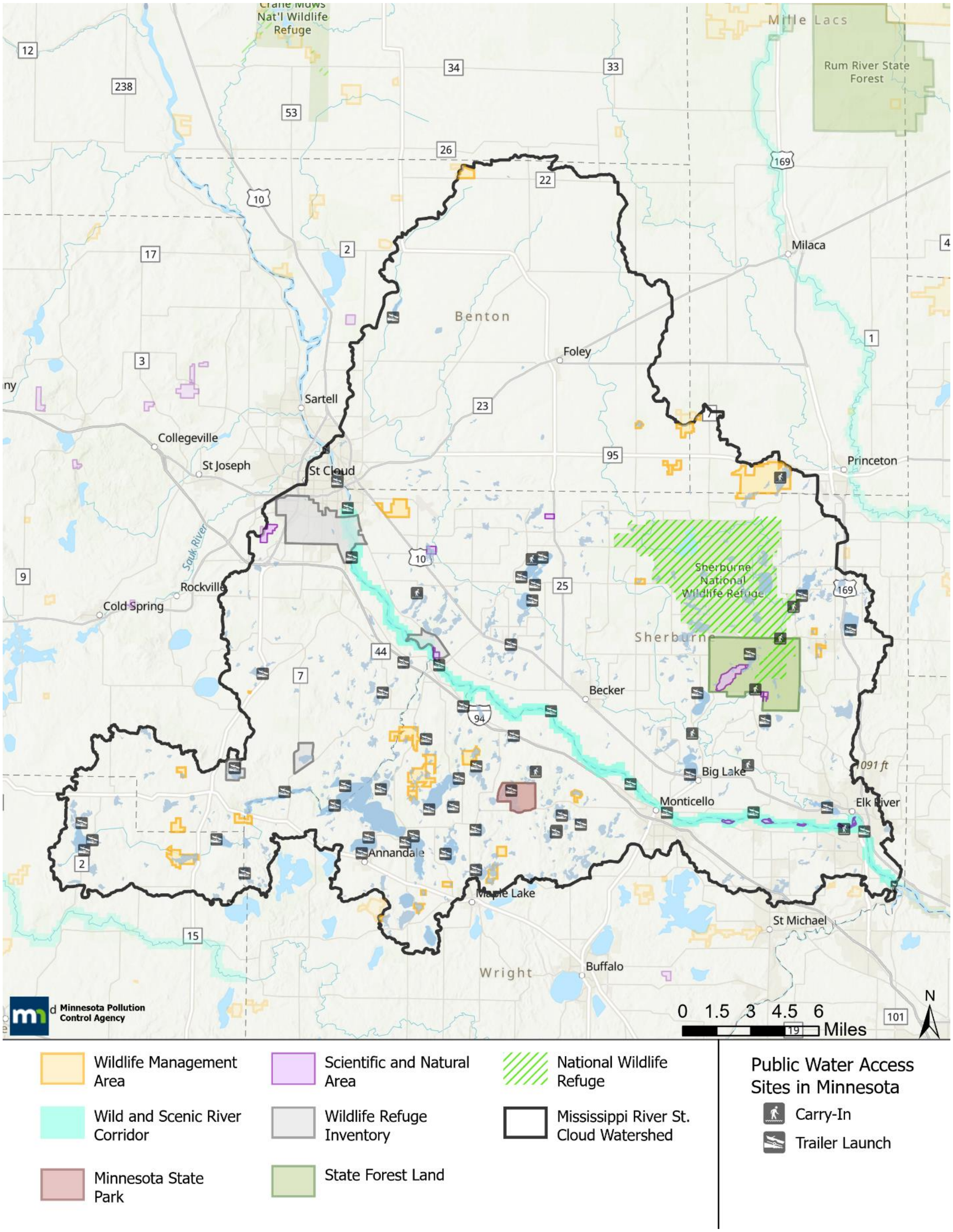
Figure 1. Mississippi River – St. Cloud Watershed.



The MRSCW is a metro fringe watershed, one of which has experienced and continues to see expanding development growth. The close proximity to the Twin Cities metro area, existing important state and interstate travel corridors and favorable natural attributes makes it an ideal watershed for residential and municipal expansion. This in turn has resulted in some of the fastest growing communities in the state as of 2023 either located within (e.g., Otsego) or on the edge (e.g., Dayton, Rogers, Sartell) of the watershed.

Within this watershed, the Mississippi River serves a multitude of uses. St. Cloud is the first city along the Mississippi River to obtain its drinking water from this resource. The downstream municipalities of Minneapolis and St. Paul also utilize the river as their primary source water resource, which further emphasizes the vital importance of protecting the drinking water beneficial use of the Mississippi River within the MRSCW. In 1976, this stretch of the Mississippi River was added to Minnesota's Wild and Scenic Rivers Program; it is the only reach of the Mississippi River in Minnesota to have this designation. The rolling forested bluffs, numerous public accesses and rest areas, along with abundant wildlife make this segment of the Mississippi River a popular route for day-long canoe trips. This portion of the river also provides excellent recreational fishing opportunities and continues to be recognized for its high-quality smallmouth bass fishing. Along with several public accesses to water resources, county and city parks, several areas of interest highlighting the natural resources of the MRSCW exist, offering a variety of recreational opportunities to the public (Figure 2).

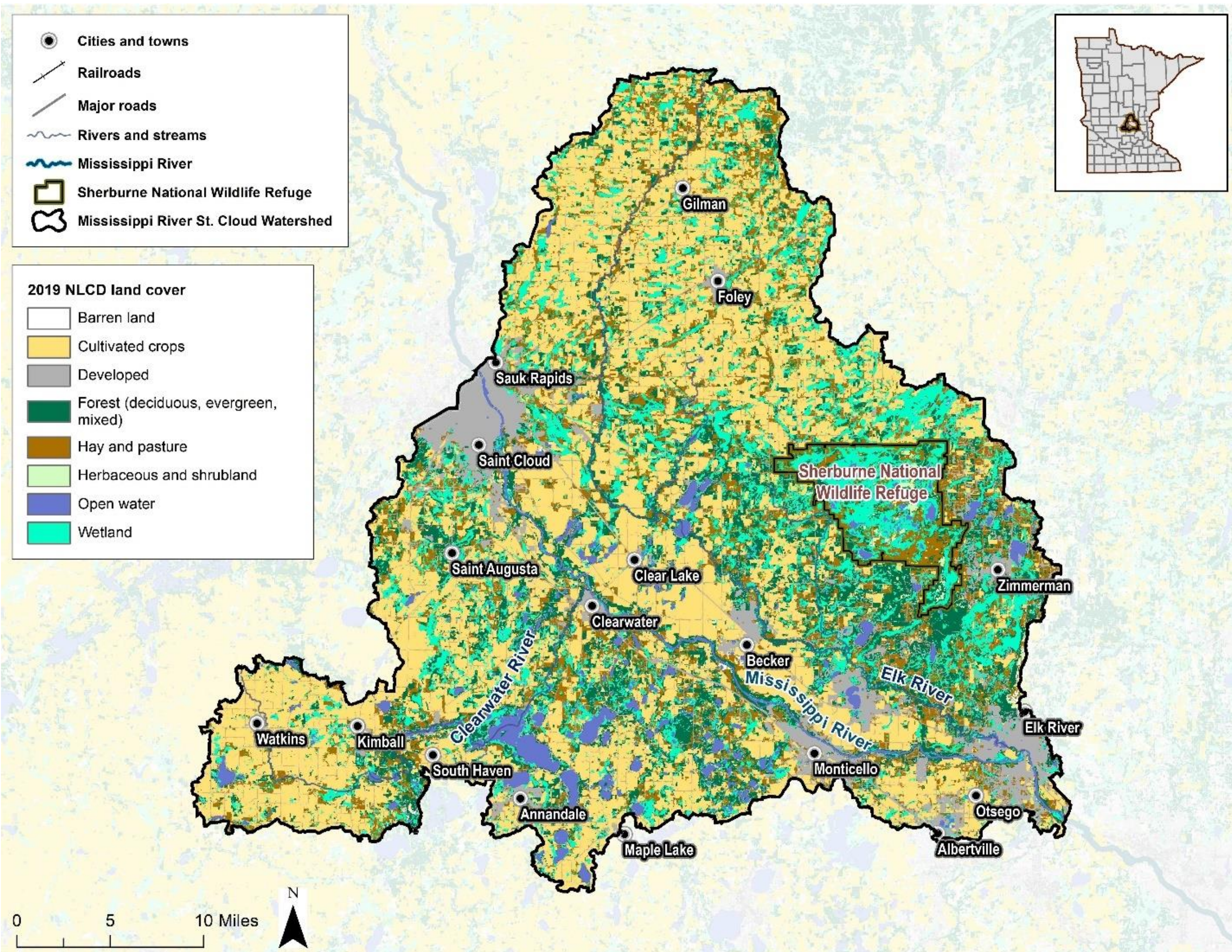
Figure 2. Natural Resource areas of interest within the MRSCW



Land use in the MRSCW is primarily agricultural (40%), primarily cultivated corn and soybeans (NLCD 2019). Pockets of development are scattered throughout the watershed, particularly around the cities of Sartell and St. Cloud to the west and Albertville and Otsego to the east (Figure 3). Other significant land use types are pastureland (14%) and forested lands (14%). The Sherburne National Wildlife Refuge holds 30,700 acres of oak savanna, prairie opening, forest, wetland, and riverine habitats in the eastern portion of the watershed (Fish and Wildlife Service 2022). Land cover within the refuge and nearby areas, is primarily comprised of forestland, wetlands and natural areas.

Prior to European settlement, the MRSCW was heavily forested, with patches of prairie and bog/swamps. Oak stands, prairies, and barren lands were dominant in riparian areas along the Mississippi River, transitioning into denser, hardwood forests in upstream areas. European settlement in the 1800s resulted in loss of many ecosystems including prairie systems, oak openings, and oak savannas in the MRSCW. In addition, many hardwood forest species were cleared to create new agricultural fields.

Figure 3. Land use in the MRSCW (NLCD 2019).



Additional Mississippi River – St. Cloud Watershed resources

Minnesota Department of Natural Resources (DNR) Watershed Context Report for the Mississippi River – St. Cloud Watershed: Watershed Context Report (state.mn.us)

DNR Watershed Report Card for the Mississippi River – St. Cloud Watershed: Watershed Health Report Card: Miss R - St. Cloud (state.mn.us)

MPCA Mississippi River – St. Cloud Watershed Mississippi River - St. Cloud | Minnesota Pollution Control Agency (state.mn.us)

Table 1. MRSCW Land cover (2019 NLCD)

Class	Percent of MRSC HUC-8
Open Water	4.0%
Developed, Open Space	4.3%
Developed, Low Intensity	3.8%
Developed, Medium Intensity	2.8%
Developed, High Intensity	1.1%
Barren Land	0.1%
Deciduous Forest	12.6%
Evergreen Forest	0.9%
Mixed Forest	0.5%
Shrub/Scrub	0.2%
Grassland/Herbaceous	0.9%
Pasture/Hay	14.0%
Cultivated Crops	39.8%
Woody Wetlands	3.9%
Emergent Herbaceous Wetlands	11.1%
TOTAL	100%

WRAPS Update process

The first WRAPS cycle for the MRSCW began with water quality monitoring in 2009-2010 and was completed with the MRSC WRAPS in 2015. The WRAPS included assessments and identification of stressors for many water bodies in the watershed, TMDLs, and strategies recommended to achieve reductions for various pollutants in the watershed.

The MPCA returned to conduct a second round of IWM in 2019 and 2020 to reevaluate the water resources of the MRSCW. Impaired waters based on this monitoring were added to Minnesota's impaired waters list | Minnesota Pollution Control Agency (state.mn.us) (303d list) in 2022. It is the goal of the subsequent WRAPS Update and the MRSCW TMDL processes to help inform local water panning efforts, including the ongoing development between local watershed partners of the comprehensive MRSCW 1W1P and subsequent CWMP implementation efforts.

2. Watershed conditions

Assessed and impaired waterbodies in the MRSCW are shown in Figure 34 and Figure 45. These figures illustrate the HUC-12 subwatersheds within the MRSCW to best align with local water planning efforts to help develop a targeted approach to better assess watershed conditions as they relate to regional land uses and stressors.

In this WRAPS report, "nutrients" refers chemically to both phosphorus and nitrogen. In Minnesota waters, reducing phosphorus will generally reduce algae growth; however, reducing nitrogen (especially nitrate) is important in protecting drinking water, which is sourced from surface water and groundwater, and for protecting AQL that is sensitive to nitrogen.

Figure 4. Aquatic Recreation Impairments – MRSCW

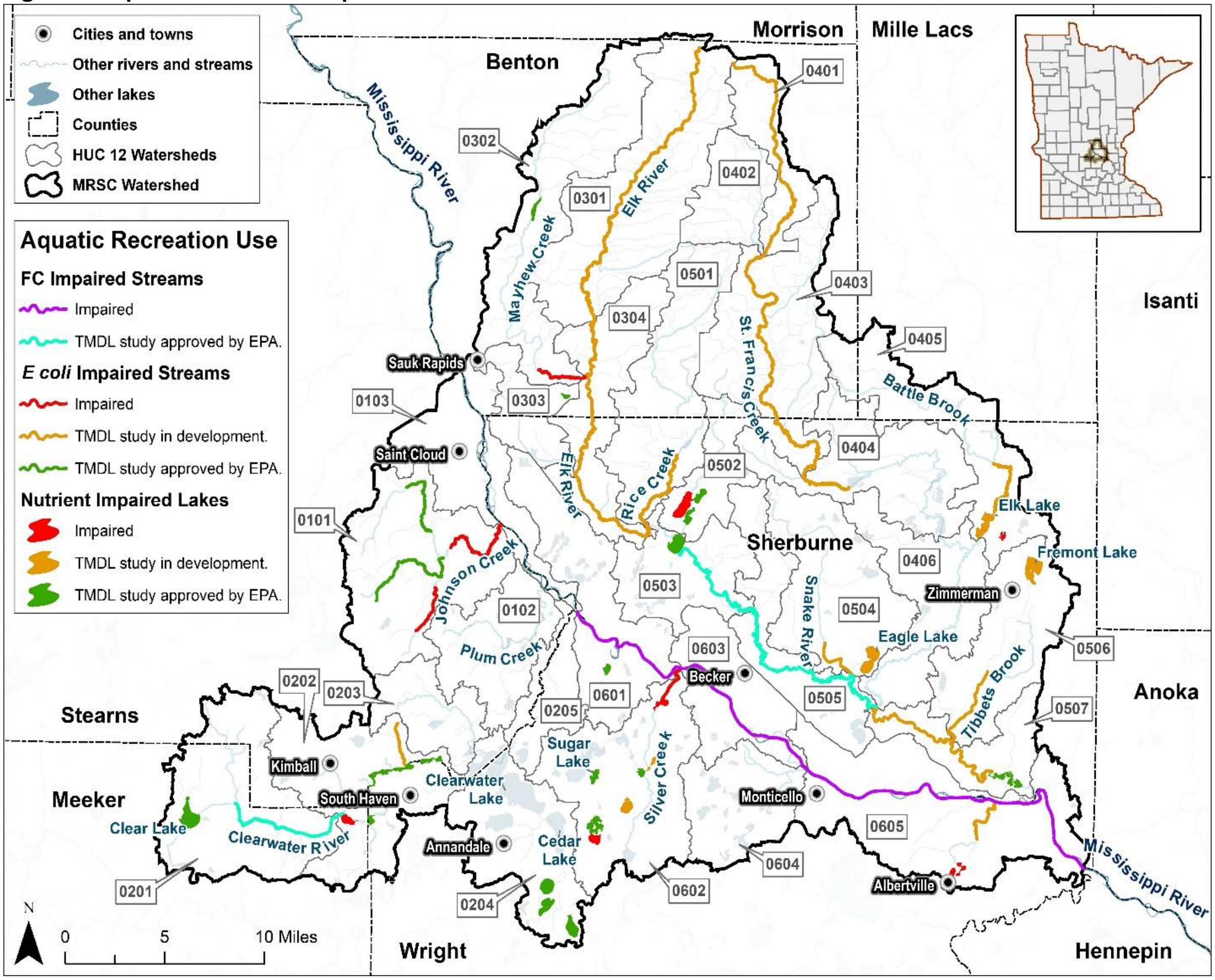
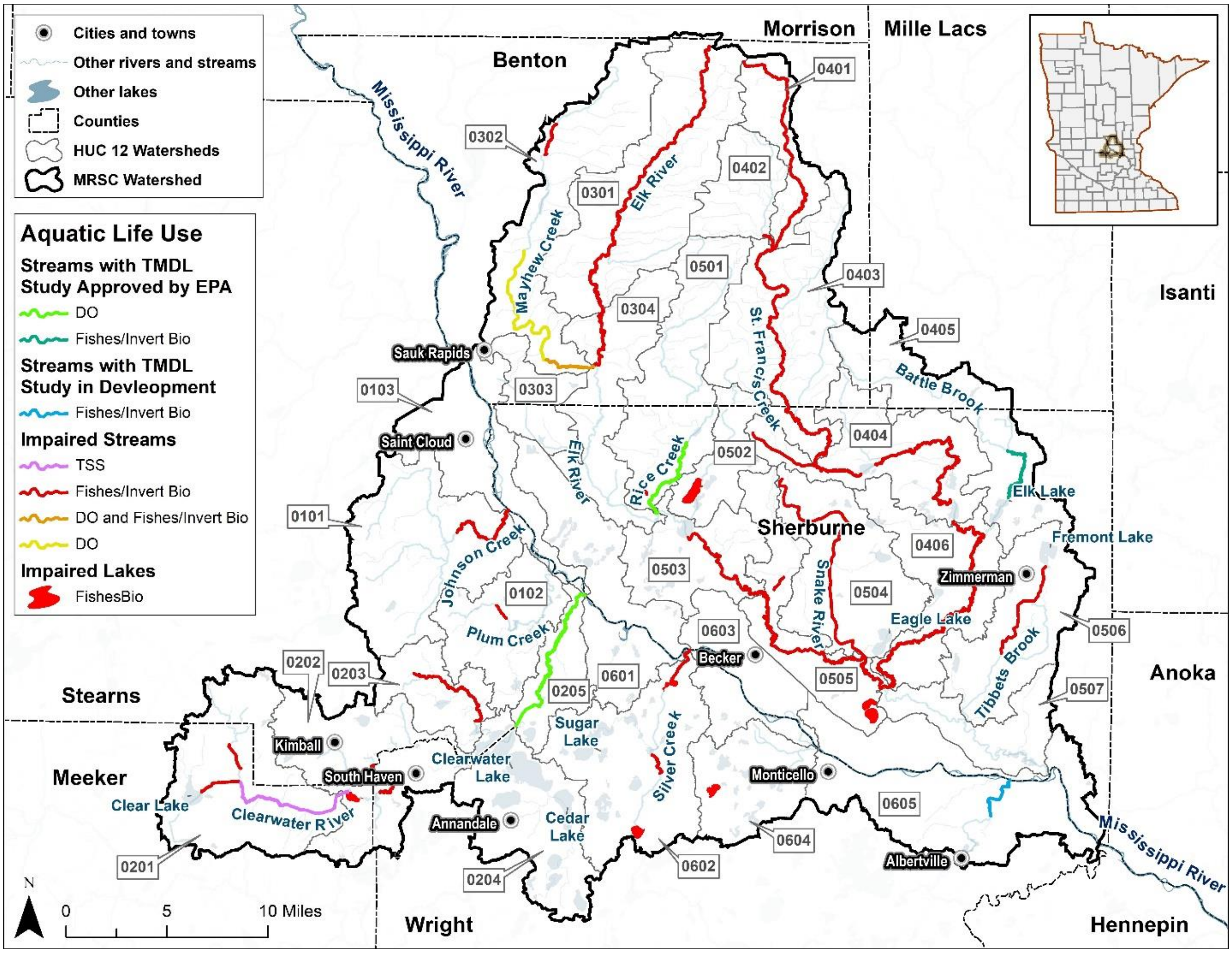


Figure 5. Aquatic Life Impairments - MRSCW



2.1 Condition status

The MPCA conducted its IWM efforts in 2009 - 2010 and again in 2019 - 2020 for the MRSCW lakes and streams.

2009 to 2010 IWM

Lakes - Of the 79 MRSCW lakes possessing assessment level data, 35 were determined to be nonsupporting of recreational use. Of the 10 lakes that had insufficient data to complete an assessment, 8 indicated improving water conditions. The MRSCW had 34 lakes that were determined to be fully supporting of recreational use. Several potential stressors for impaired lakes were noted for consideration for the subsequent TMDL study processes. During this IWM cycle, it was typically noticed that MRSCW lakes within catchment areas primarily consisting of undisturbed forested or rangeland land uses were determined to be fully supporting their beneficial uses. In contrast, lakes that were already receiving high nutrient contributions from large catchment areas also appeared to be influenced by a variety of anthropogenic activities contributing to their impairment status. See Water Quality Assessments of Select lakes within the Mississippi River (St. Cloud) Watershed Report (MPCA 2012b) and *Appendix A* for additional information on lakes during the first IWM round for the MRSCW.

Streams - The Mississippi River – St. Cloud Watershed Monitoring and Assessment Report (MPCA 2012a) and *Appendix B* summarizes the results of 32 stream reaches that were monitored and assessed through this effort. Twenty-three of the stream reaches were classified as impaired for impacts to AQR and/or impacts to AQL, five were classified as supporting of AQL, and four had insufficient data to make a determination. The assessed stream reaches were organized in the report by HUC-11, subwatersheds.

2019 to 2020 IWM

To measure the AQL health in streams community, fish and macroinvertebrates were sampled as well as the general water chemistry. These aquatic communities provide an excellent reflection of the cumulative effects of natural and human-caused influences on surface water resources. Fish and macroinvertebrate samples were used to generate the Index of Biological Integrity scores for fish (FIBI) and for macroinvertebrates (MIBI). The index scores for a sampled monitored point were compared to their respective thresholds to determine if the stream supported AQL. Statistically significant positive increases were noticed between 2009 and 2019 sampling cycles with the average MIBI score increasing by 12.0 points, while FIBI scores across the MRSCW increased by 8.2 points. Water chemistry results help evaluate the causes of a biological impairment if present. Similar to streams, water quality and biological sampling were conducted on select lakes across the MRSCW.

Twenty-nine lakes were assessed for AQL for the first time using a fish based IBI developed for lakes. Twenty-two of these lakes had sufficient date for an assessment of AQL with 15 fully supporting and 7 did not support AQL use. One lake (Sugar – Wright County) was noted as containing an exceptional fish community. Sufficient data were available to assess AQR in 40 lakes, 21 of which were in full support (7 were noted as vulnerable) and 19 nonsupporting. Through strategic water quality efforts led by local partner organizations, four lakes (George, Augusta, Union, Birch) have been successfully restored to AQR standards and thus been removed from Minnesota's Impaired Waters List (MPCA 2023d).

Comparing the two rounds of IWM

The MRSCW assessment and trends update (MPCA 2022a) notes significant progress in the water quality within the MRSCW over the past decade, with the overall health of the fish and macroinvertebrate communities improving. These assessments are supported statistically through improvements in AQL communities, positive water quality trends on 17 lakes and eight delistings from Minnesota's Impaired Waters List. However, ongoing problems and challenges such as loss of shoreland habitat due to development, excess nutrients, elevated levels of bacteria and low DO levels continue to exist and expand in some areas of the MRSCW. The MRSCW has within and is near some of the fastest growing communities in Minnesota. The continued demand and increasing pressure on the water resources and their surrounding habitats in the MRSCW presents significant challenges. It is through these challenges which truly emphasizes the importance of strong partnerships in working cooperatively together to protect and restore the water resources of the MRSCW. The MRSCW local organizations and their partners realize this importance and have taken the needed steps over the past decade to achieve excellence in their ongoing water quality collaboration efforts. See Table 2, Figure 6, and Figure 7 and Appendices A and B for more information on monitoring locations and assessment comparisons between the Cycle 1 vs Cycle 2 rounds of IWM in the MRSCW.

Table 2. Number of assessed reaches and lakes with sufficient data and impairment status.

MPCA	Beneficial Use	2011			2021		
		Assessed with Sufficient Data	Fully Supporting	Impaired	Assessed with Sufficient Data	Fully Supporting	Impaired
Reaches	Aquatic Life	21	6 (29%)	15 (71%)	25	10 (40%)	15 (60%)
	Aquatic Recreation	20	2 (10%)	18 (90%)	17	1 (6%)	16 (94%)
	Aquatic Consumption	6 (mercury)	0	6	N/A	N/A	N/A
Lakes	Aquatic Life	N/A	N/A	N/A	22	15 (68%)	7 (32%)
	Aquatic Recreation	70	34 (49%)	36 (51%)	40	21 (53%)	19 (49%)
	Aquatic Consumption	15 (mercury)	6 (40%)	9 (60%)	N/A	N/A	N/A

Some of the waterbodies in the MRSCW are impaired by mercury; however, this WRAPS report update does not specifically cover mercury and most other non-conventional water quality parameters. These pollutants are managed via other programs or methods. For more information on mercury impairments, see the statewide mercury TMDL information on the MPCA website at: https://www.pca.state.mn.us/business-with-us/statewide-mercury-tmdl

Figure 6. MRSCW IWM Cycle 1 vs Cycle 2 Stream Monitoring Locations

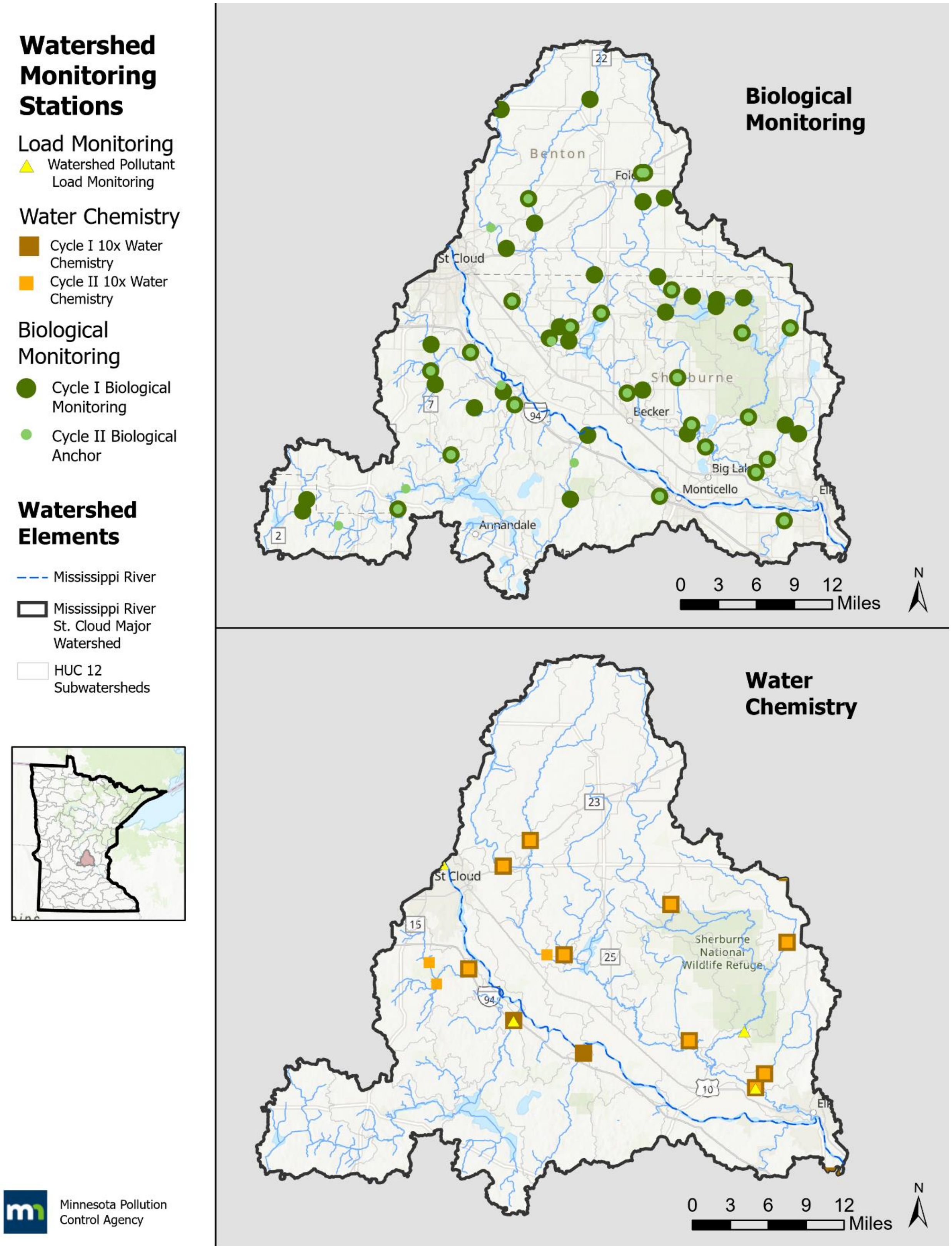


Figure 7. MRSCW IWM Cycle 1 vs Cycle 2 Lake Monitoring Locations

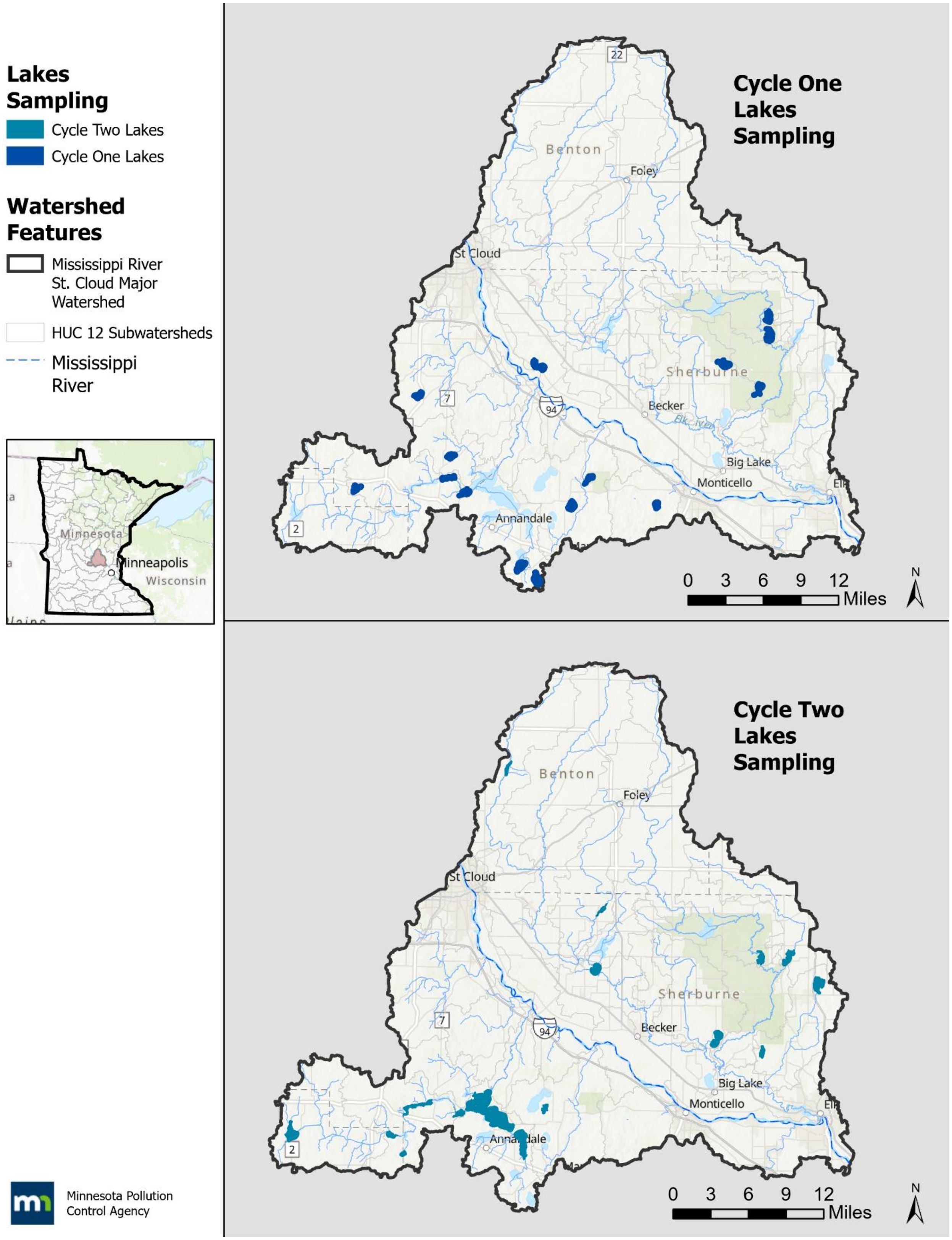
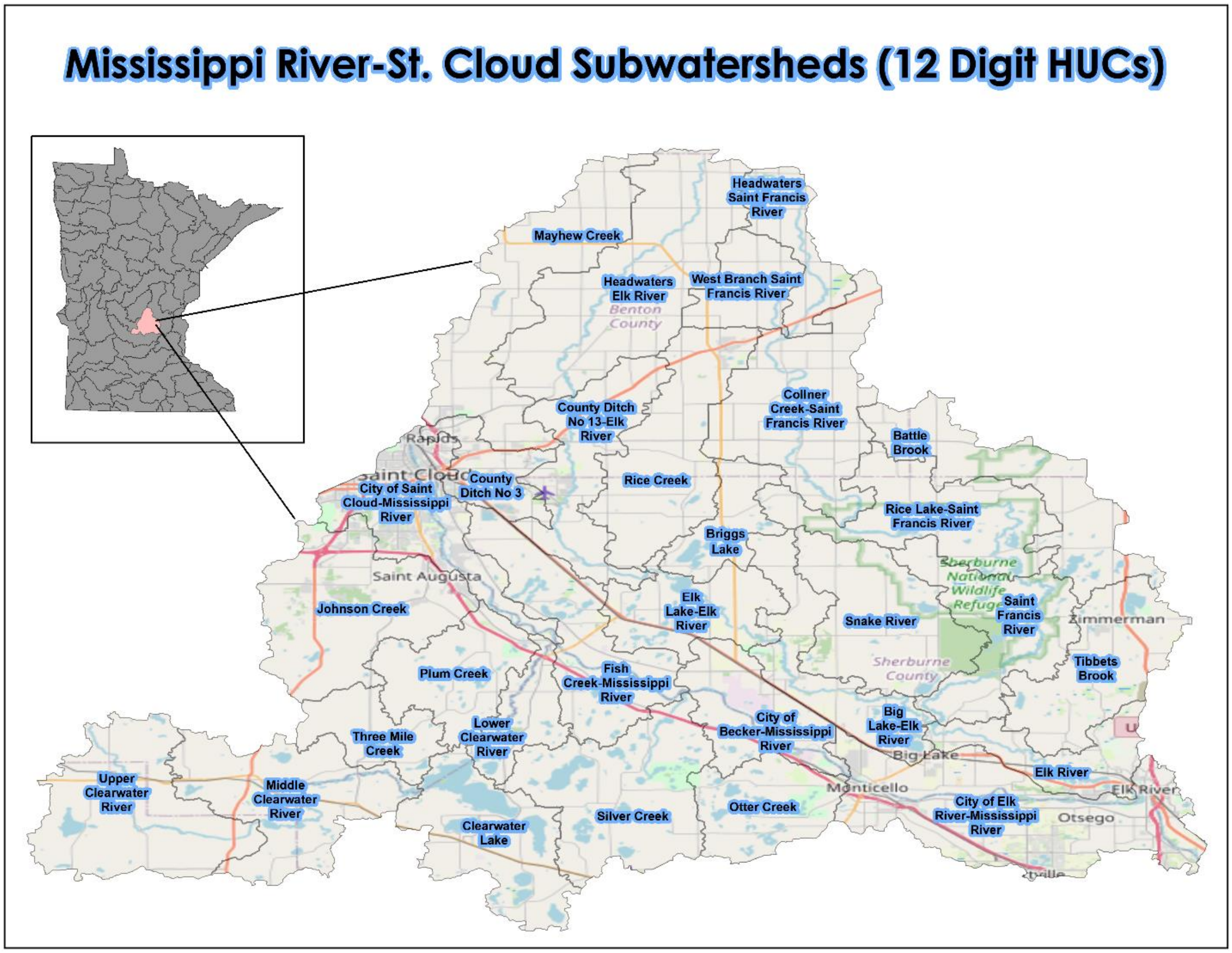


Figure 8. HUC-12 Subwatershed within the MRSCW



2.1.1 Streams

The MRSCW assessment and trends update (MPCA 2022a) evaluated 25 stream reaches for AQL and 17 for AQR within the MRSCW (Table 3). Fifteen (60%) of the assessed reaches are not meeting water quality standards for AQL use, and 94% (16) reaches were found not to meet the AQR use standard. Between the first and second rounds of biological monitoring in this watershed, the MPCA adopted new rules to assess AQL in channelized streams and ditches (MPCA 2023a). These new rules provide reasonable AQL protections for water bodies that were legally altered prior to the advent of the Clean Water Act. Because of the new rules, the most recent assessments include assessment results for five channelized stream segments. In addition, IBIs for cold water streams have also been developed, allowing for the assessment of cold-water tributary streams such as Thiel Creek, Luxemburg Creek, Threemile Creek, and Snake River.

Table 3. Assessment status of stream reaches in the MRSCW.

HUC-12 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life Indicators							Aquatic Life Use	Aquatic Rec. Use
				Fish Index of Biotic Integrity (FIBI)	Macroinvertebrate IBI (MIBI)	Turbidity/TSS	Secchi tube (transparency)	Chloride	pH	Ammonia		Bacteria
Johnson Creek (070102030101)	-639	Johnson Creek	T123 R28W S14, west line to Mississippi R	IC	MTS	MTS	--	MTS	IF	MTS	IMP	IMP
	-633	Johnson Creek (Meyer Creek)	Unnamed cr to Unnamed cr	--	--	--	--	--	--	--	--	IMP
	-635	Johnson Creek (Meyer Creek)	Unnamed cr to Unnamed cr	--	--	--	MTS	--	MTS	--	IF	IMP
Plum Creek (070102030102)	-572	Plum Creek	Warner Lk to Mississippi R	MTS	MTS	IF	--	--	IF	IF	SUP	DEL
	-740	Plum Creek	13th Ave to CSAH 45	EXS	--	NA	NA	--	NA	NA	IMP	--
	-732	Unnamed creek (County Ditch 39)	Headwaters to Plum Cr	--	--	--	MTS	--	IF	--	--	NA
	-550	County Ditch 44	Clear Lk to Clearwater R	EXS	EXS	NA	NA	--	NA	NA	IMP	--

HUC-12 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life Indicators							Aquatic Life Use	Aquatic Rec. Use
				Fish Index of Biotic Integrity (FIBI)	Macroinvertebrate IBI (MIBI)	Turbidity/TSS	Secchi tube (transparency)	Chloride	pH	Ammonia		Bacteria
Upper Clearwater River (070102030201)	-738	County Ditch 20	Hwy 55 to Unnamed cr	EXS	EXS	MTS	NA	--	MTS	NA	IMP	IF
	-549	Clearwater River	CD 44 to Lk Betsy	MTS	MTS	EXS	--	IF	MTS	IF	IMP	IMP
Middle Clearwater River (070102030202)	-566	Unnamed creek (Thiel Creek)	Headwaters to Lk Marie	MTS	MTS	IF	--	--	IF	--	SUP	--
	-717	Clearwater River	Scott Lk to Lk Louisa	EXS	MTS	IF	IF	--	IF	IF	IMP	--
Threemile Creek (070102030203)	-564	Threemile Creek (Hanson Brook)	T122 R28W S21, west line to Unnamed cr	EXS	EXS	IF	IF	--	IF	IF	IMP	--
Mayhew Creek (070102030302)	-749	Mayhew Creek	Unnamed cr to T36 R30W S20, east line	MTS	MTS	IF	MTS	--	MTS	IF	IC	IF
	-750	Mayhew Creek	T36 R30W S21, west line to Elk R	EXS	MTS	MTS	MTS	IF	MTS	IF	IMP	IMP
County Ditch No 3 (070102030303)	-684	Unnamed creek	Unnamed cr to Elk R	DEL	DEL	NA	NA	--	NA	NA	DEL	--
West Branch Saint Francis River (070102030402)	-693	West Branch (St Francis River, West Branch)	Unnamed cr to St Francis R	EXS	EXS	NA	NA	--	NA	NA	IMP	--

HUC-12 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life Indicators							Aquatic Life Use	Aquatic Rec. Use
				Fish Index of Biotic Integrity (FIBI)	Macroinvertebrate IBI (MIBI)	Turbidity/TSS	Secchi tube (transparency)	Chloride	pH	Ammonia		Bacteria
Collner Creek-Saint Francis River (070102030403)	-694	County Ditch 13	Unnamed ditch to St Francis R	MTS	--	NA	NA	--	NA	NA	SUP	--
	-700	St Francis River	Headwaters to Unnamed lk (71-0371-00)	EXS	MTS	MTS	MTS	IF	MTS	IF	IMP	IMP
Rice Lake-Saint Francis River (070102030404)	-695	County Ditch 22	Headwaters to St Francis R	EXS	--	NA	NA	--	NA	NA	IMP	--
	-697	County Ditch 5	Unnamed ditch to Unnamed ditch	MTS	IC	NA	NA	--	NA	NA	SUP	--
Rice Creek (070102030501)	-743	Unnamed creek	-93.994 45.503 to -93.986 45.496	EXS	MTS	--	--	--	--	--	IMP	--
Elk Lake-Elk River (070102030503)	-581	Elk River	Rice Cr to Elk Lk	--	--	--	MTS	--	--	--	--	--
Snake River (070102030504)	-529	Snake River	Unnamed cr to Eagle Lk outlet	EXS	MTS	NA	NA	--	NA	NA	IMP	IMP
	-558	Snake River	Headwaters to Unnamed cr	EXS	MTS	--	--	--	--	--	IMP	--

HUC-12 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life Indicators: Fish Index of Biotic Integrity (FIBI)	Macroinvertebrate IBI (MIBI)	Turbidity/TSS	Secchi tube (transparency)	Chloride	pH	Ammonia	Aquatic Life Use	Aquatic Rec. Use: Bacteria
Big Lake-Elk River (070102030505)	-745	Unnamed creek	Unnamed cr to -93.855 45.428	EXS	MTS	NA	NA	--	NA	NA	IMP	--
	-579	Elk River	Elk Lk to St Francis R	MTS	MTS	IC	--	--	MTS	IF	IC	IMP
Tibbets Brook (070102030506)	-523	Unnamed ditch	Headwaters (Lk Fremont 71-0016-00) to Tibbits Bk	MTS	EXS	NA	--	--	NA	NA	IMP	--
	-735	Tibbits Brook	Rice Lk to Unnamed ditch	MTS	MTS	NA	--	--	NA	NA	SUP	--
	-736	Tibbits Brook	Unnamed ditch to Elk R	MTS	MTS	IF	MTS	IF	MTS	--	SUP	IMP
Silver Creek (070102030602)	-555	Silver Creek	Little Mary Lk to Locke Lk	MTS	MTS	IF	--	--	IF	IF	SUP	--
Otter Creek (070102030604)	-690	Otter Creek	First Lk to Unnamed cr	MTS	MTS	NA	NA	--	NA	NA	SUP	--
City of Elk River-Mississippi River (070102030605)	-528	Unnamed creek	T121 R23W S19, south line to Mississippi R	EXS	EXS	--	--	--	IF	--	IMP	IMP

Abbreviations for Indicator Evaluations: -- = No Data, NA = Not Assessed, IF = Insufficient Information, IC = Inconclusive, MTS = Meets Criteria, EXS = Exceeds Criteria.
Abbreviations for Use Support Determinations: NA = Not Assessed, IC = Inconclusive, IF = Insufficient Information, IMP = does not meet water quality standard and is therefore impaired, SUP = found to meet the water quality standard, DEL = previously impaired, but has been delisted.

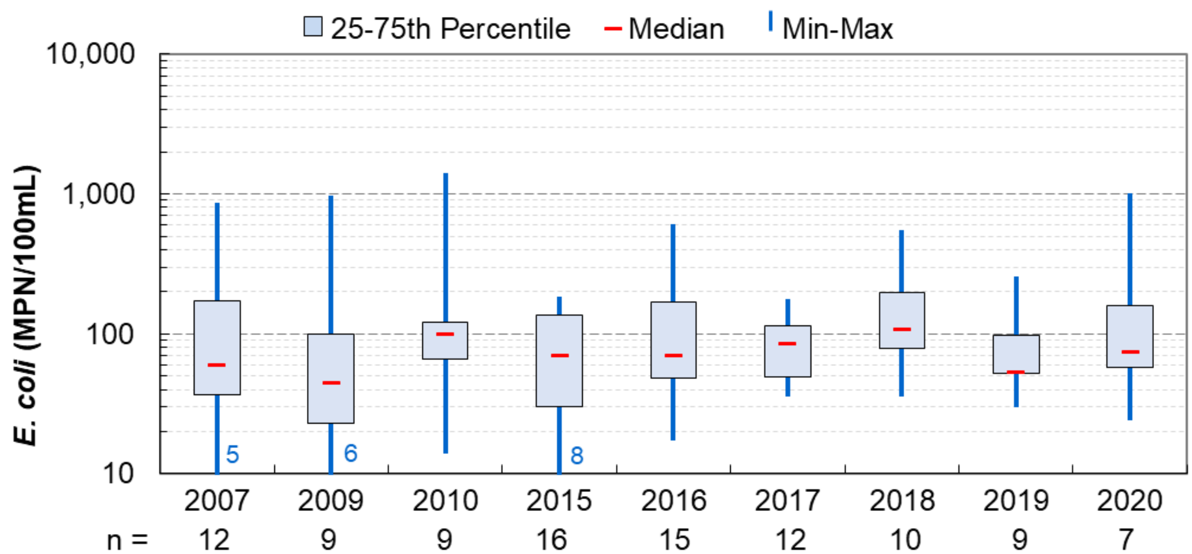
2.1.2 *E. coli* (streams)

"Continued high bacteria concentrations throughout the watershed are still impacting stream recreational uses" (MPCA 2022a, page 6). Three stream monitoring stations with *E. coli* data reported for Cycles 1 and 2 were evaluated to present temporal trends (Table 4) in this report. In the Elk River, *E. coli* levels have been fairly stable, and the interquartile ranges of concentrations have been fairly consistent (Figure 9). In Plum Creek, *E. coli* levels decreased from 2009 to 2014, then slightly increased until 2018, before decreasing again in 2019 (Figure 10). In Johnson Creek, *E. coli* levels decreased from 2009-2010 to 2011 and have been fairly stable from 2015 through 2020; however, in 2015 through 2010 fewer low-level concentrations were reported (Figure 11).

Table 4. Stream monitoring stations in the MRSCW for temporal trend analysis

Station ID	Water body	Assessment Unit ID	Period of Record
S000-278	Elk River	548	2007, 2009-2010, 2015-2020
S003-369	Plum Creek	572	2009, 2014-2019
S003-370	Johnson Creek	639	2009-2011, 2014-2017, 2019-2020

Figure 9. *E. coli* in the Elk River (station S000-278)



Note - A few minima occurred less than 10 and are shown in blue font in the chart above.

Figure 10. *E. coli* in Plum Creek (station S003-369)

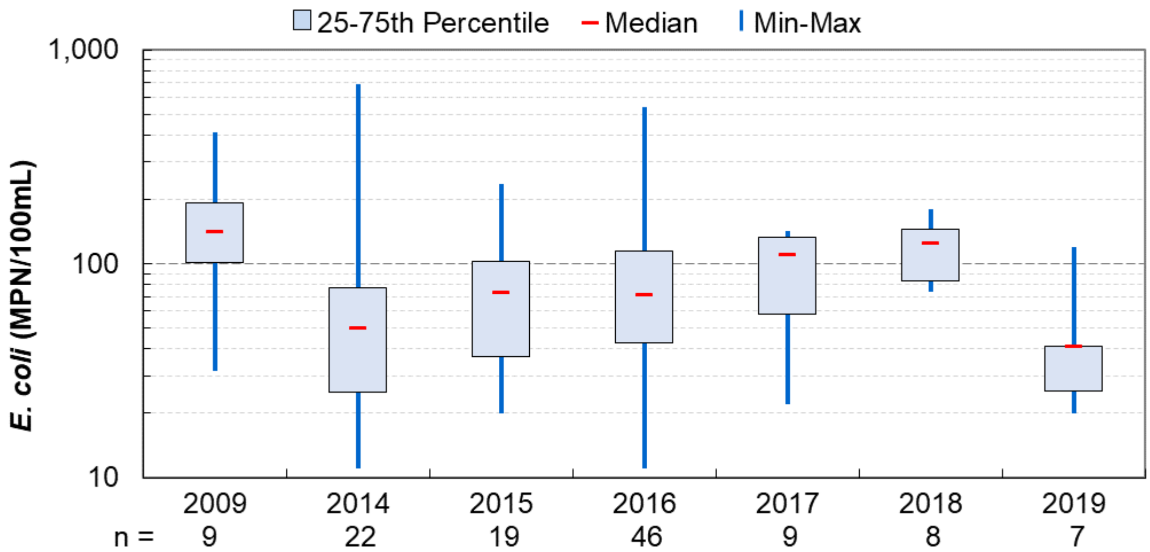
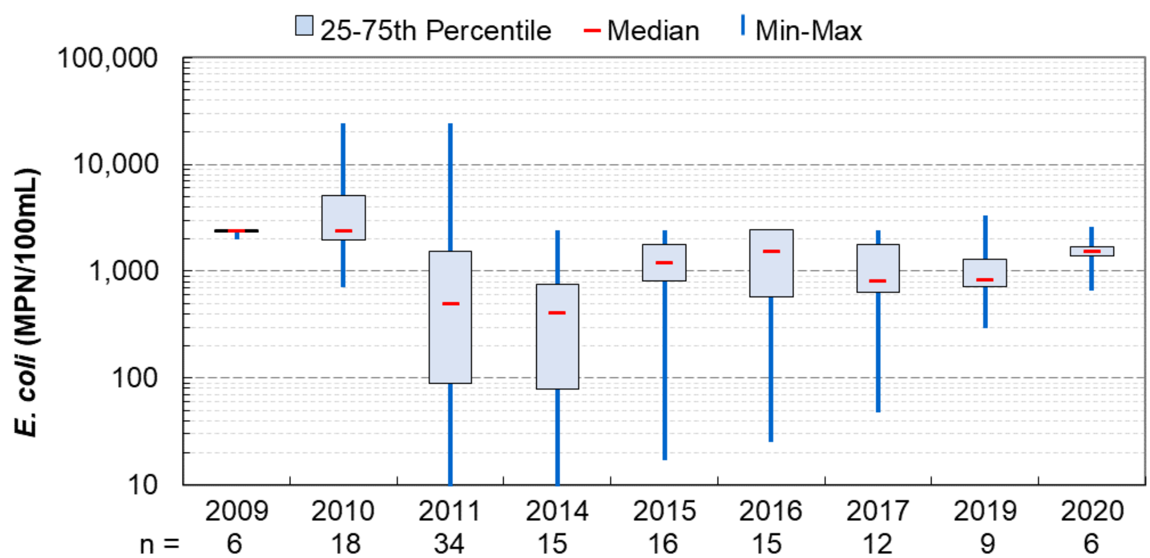


Figure 11. *E. coli* in Johnson Creek (station S003-370)



Plum Creek delisting provides "Sweet Taste of Success" from Minnesota Impaired Waters List

An important tributary to the Mississippi River, Plum Creek, reach 07010203-572, was listed as impaired by failing the state's AQR standards for bacteria contamination in 2012. Strong local leadership, led by Jerry Finch (2nd on bottom left) and the Plum Creek Neighborhood Network (Figure 12) collaborated with a broad network of partners to take on the challenge of improving this stream. Through their unwavering Determination Combined with Strategic Implementation Improves Plum Creek, this reach was subsequently delisted for bacteria in 2020. In 2017, the Plum Creek Neighborhood Network were named "Conservationist of the Year" by the Stearns County Soil and Water Conservation District (SWCD) for their exemplary conservation efforts. Several best management practices (BMPs) were completed as part of this overall restoration process including a large grade stabilization project along a state highway right-of-way (Figure 13).

Figure 12. Plum Creek Neighborhood Network

Figure 13. Kloepper Grade Stabilization Project – MNDOT ROW

2.2 Lakes

The MRSCW assessment and trends update (MPCA 2022a) evaluated 40 lakes for AQR and 22 for AQL within the MRSCW (Table 5). For AQR, 19 (48%) of the assessed lakes are not meeting the water quality standards, while 21 lakes (52%) were found to be fully supporting. For AQL, 7 (32%) were found in non-support while 15 (68%) fully supported AQL standards. Numerous lakes need additional data for a complete assessment for a specific beneficial use, noted in Table 5 below as IF (Insufficient Information). Continuing to collaboratively work with MRSCW partners in collecting monitoring data to fill existing data gaps, allowing for a future assessment, is a priority going forward.

Table 5. Assessment status of lakes within the MRSCW

HUC-12 Subwatershed	Lake ID	Lake	Assessment Method	Aquatic Life Use	Aquatic Recreation Use
Johnson Creek (070102030101)	73-0023-00	Beaver	Deep Lake	SUP	IF
Plum Creek (070102030102)	73-0004-00	Long	Deep Lake	--	IF
	73-0006-00	Crooked	Deep Lake	--	IF
	73-0011-00	Warner	Deep Lake	--	IF
City of Saint Cloud-Mississippi River (070102030103)	73-0611-00	George	Deep Lake	--	DEL
Upper Clearwater River (070102030201)	47-0096-00	Little Mud	Deep Lake	--	SUP
Middle Clearwater River (070102030202)	47-0042-00	Betty	Deep Lake	IMP	IMP
	73-0014-00	Marie	Deep Lake	SUP	IMP
	73-0035-00	School Section	Shallow Lake	IF	SUP
	73-0425-00	Unnamed	Shallow Lake	IF	--
	86-0281-00	Caroline	Deep Lake	SUP	IMP
	86-0282-00	Louisa	Deep Lake	IC	IMP
	86-0284-00	Augusta	Deep Lake	IC	DEL
	86-0297-00	Scott	Deep Lake	--	IMP
	86-0298-00	Union	Deep Lake	IF	DEL
Clearwater Lake (070102030204)	86-0208-00	Swartout	Shallow Lake	--	IMP
	86-0212-00	Albion	Shallow Lake	--	IMP
	86-0213-00	Henshaw	Shallow Lake	--	IMP
	86-0227-00	Cedar	Deep Lake	SUP	SUP
	86-0251-00	Pleasant	Deep Lake	IC	SUP
	86-0252-01	Clearwater (East)	Deep Lake	SUP	SUP
	86-0252-02	Clearwater (West)	Deep Lake	SUP	SUP
Lower Clearwater River (070102030205)	86-0234-00	Bass	Deep Lake	SUP	SUP
	86-0237-00	Unnamed	Shallow Lake	IF	IF
	86-0238-00	Nixon	Deep Lake	--	SUP
	86-0243-00	Grass	Deep Lake	--	SUP
Battle Brook (070102030405)	71-0041-00	Cantlin	Shallow Lake	--	IF
	71-0044-00	Little Diamond	Shallow Lake	IF	IF
	71-0055-00	Elk	Shallow Lake	IC	IMP
Saint Francis River (070102030406)	71-0069-00	Ann	Deep Lake	IC	IF
Briggs Lake (070102030502)	71-0145-00	Julia	Shallow Lake	SUP	IC
	71-0146-00	Briggs	Deep Lake	IMP	IMP
	71-0147-00	Rush	Shallow Lake	SUP	IMP
Elk Lake-Elk River (070102030503)	71-0123-00	Camp	Deep Lake	--	IF
	71-0141-00	Elk	Shallow Lake	SUP	IMP
	71-0067-00	Eagle	Deep Lake	SUP	IMP

HUC-12 Subwatershed	Lake ID	Lake	Assessment Method	Aquatic Life Use	Aquatic Recreation Use
Snake River (070102030504)	71-0085-00	Big Mud	Shallow Lake	IF	IF
Big Lake-Elk River (070102030505)	71-0081-00	Mitchell	Deep Lake	IMP	SUP
	71-0082-00	Big	Deep Lake	IMP	SUP
	71-0096-00	Thompson	Deep Lake	--	IF
Tibbets Brook (070102030506)	71-0057-00	Birch	Deep Lake	SUP	DEL
Fish Creek-Mississippi River (070102030601)	71-0158-00	Pickerel	Deep Lake	--	IF
	71-0159-00	Long	Deep Lake	--	IF
	71-0167-00	Round	Deep Lake	--	IF
Silver Creek (070102030602)	86-0139-02	Little Mary (North Bay)	Shallow Lake	--	IF*
	86-0152-00	Millstone	Shallow Lake	--	IF*
	86-0156-00	Mary	Deep Lake	IMP	IF
	86-0163-00	Limestone	Deep Lake	SUP	IF
	86-0168-00	Locke	Deep Lake	IMP	IMP
	86-0223-00	Indian	Deep Lake	IC	IF*
	86-0224-00	Sandy	Shallow Lake	--	IF
	86-0229-00	Mink	Deep Lake	SUP	IMP
	86-0230-00	Somers	Deep Lake	IC	IMP
	86-0233-00	Sugar	Deep Lake	SUP	SUP
	86-0246-00	Long	Shallow Lake	--	IF
Otter Creek (070102030604)	86-0065-00	Unnamed	Shallow Lake	IF	IF
	86-0069-00	Long	Deep Lake	IF	IF
	86-0073-00	Cedar	Deep Lake	--	IF
	86-0073-02	Little Cedar	Deep Lake	--	IF
	86-0146-00	Ida	Deep Lake	IF	SUP
	86-0148-00	Eagle	Deep Lake	IMP	SUP

Abbreviations for Use Support Determinations: NA = Not Assessed, IC = Inconclusive, IF = Insufficient Information, IMP = does not meet water quality standard and is therefore impaired, SUP = found to meet the water quality standard, DEL = previously impaired, but has been delisted. *Indicates lakes that do not have sufficient information to be assessed in 2019 but are listed on the impaired waters list from 2011.

2.2.1 Total Phosphorus (Lakes)

Three lakes with TP monitoring data reported for Cycles 1 and 2 were evaluated in the WRAPS process to present temporal trends (Table 6) in this report. Shallow (1-meter or less) growing season (June through September) average TP concentrations showed a decreasing trend in all three lakes.

In Betty Lake, shallow TP concentrations decreased considerably over several decades (Figure 14). Shallow TP concentrations ranged from 110 to 1,100 µg/L in the late 1970s and early 1980s and only ranged from 34 to 306 µg/L in the 2010s. Shallow TP concentrations also decreased in Julia Lake (Figure 15) and Bass Lake (Figure 16) but across much smaller ranges than Betty Lake. In Julia Lake, shallow growing season TP average concentrations ranged from 118 to 165 µg/L in the 1980s and from

49 to 76 µg/L in the 2010s. In Bass Lake, except for 1981 (48 µg/L) and 2015 (39 µg/L), shallow growing season TP average concentrations ranged from 12 to 28 µg/L over the period of record.

Table 6. Lake monitoring stations in the MRSCW for temporal trend analysis

Station ID	Water body	Assessment Unit ID	County	HUC (07010203)	Period of Record
47-0042-00-201	Lake Betty [a]	47-0042-00	Meeker	02 02	1979-1987, 1993, 1995, 1997, 1999, 2001-2003, 2005, 2007, 2009-2012, 2014-2021
71-0145-00-203	Julia Lake	71-0145-00	Sherburne	05 02	1982, 1984, 1986, 1988, 1989, 1993, 2002, 2006-2020
86-0234-00-101	Bass Lake	86-0234-00	Wright	02 05	1981, 1994, 1996, 1998, 1999, 2001, 2005, 2008-2010, 2015-2021

Note a: Lake Betty is also known as Lake Betsy.

Figure 14. Shallow TP in Betty Lake (station 47-0042-00-201)

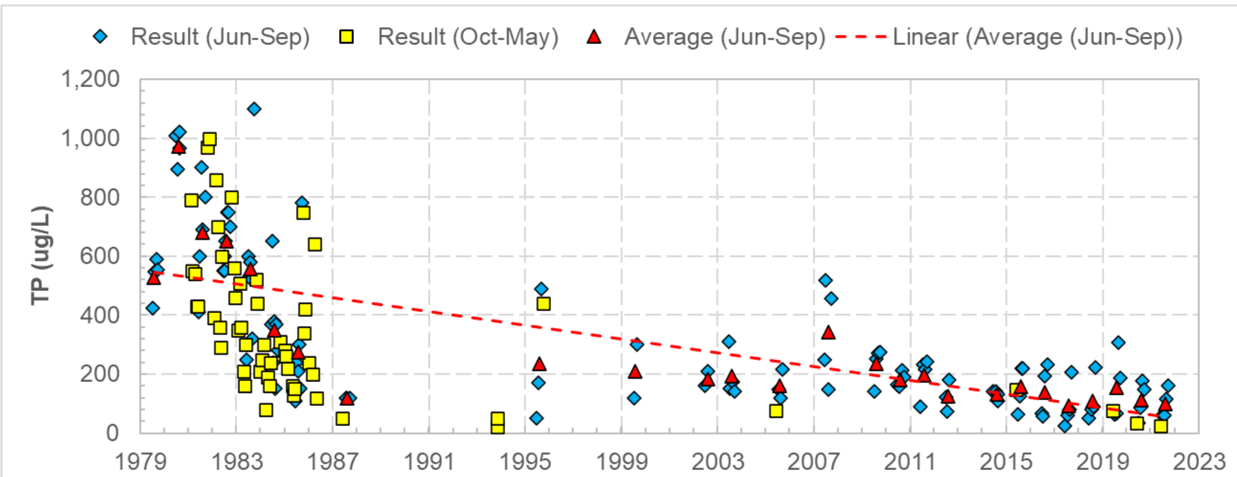


Figure 15. Shallow TP in Julia Lake (station 71-0145-00-203)

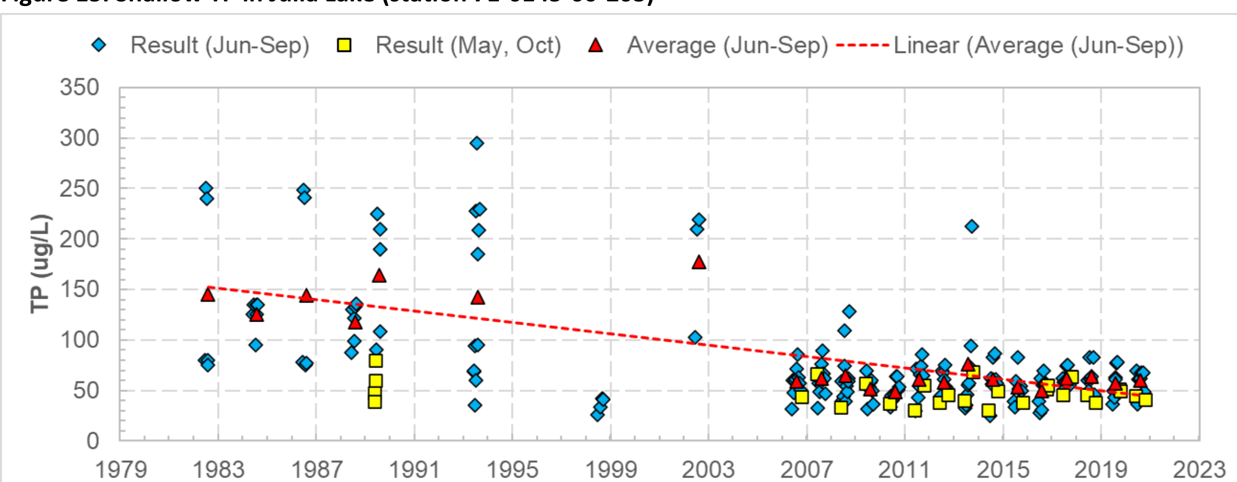
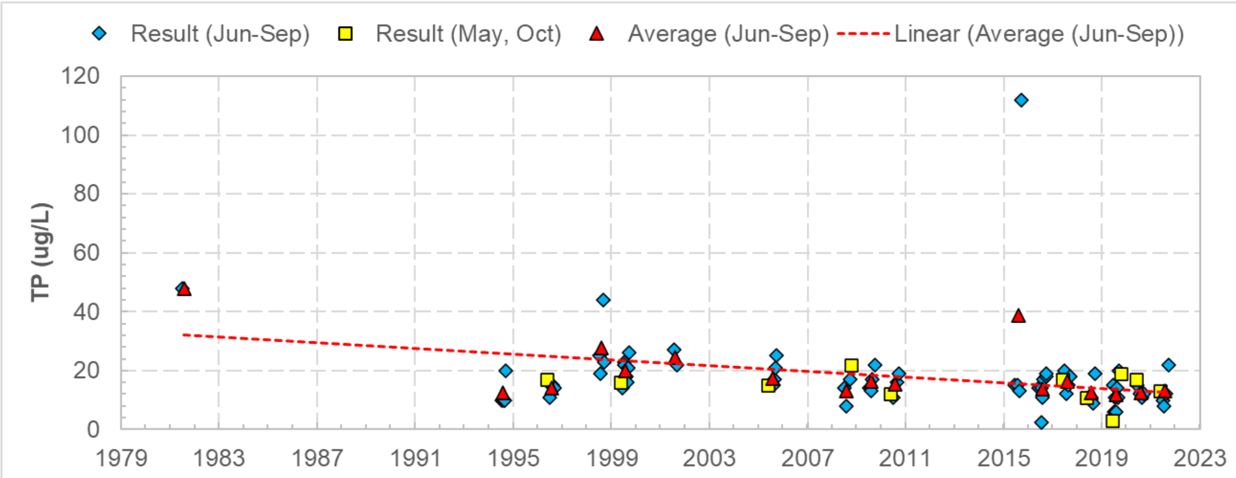


Figure 16. Shallow TP in Bass Lake (station 86-0234-00-101)



By George we have Success!

Several positive water quality improvements occurred throughout the MRSCW in the past decade, including the delisting of four lakes from Minnesota's impaired waters list as shown in Table 5 above. These improvements are noteworthy accomplishments and are a strong reflection of the water quality efforts of the MRSCW local conservation organizations and their partnerships. The City of St. Cloud provided an excellent example of this with a positive water quality outcome through their strategic planning and implementation efforts such as Figure 17 through the Lake George Water Quality Improvement Project. Lake George was listed as being impaired by excessive nutrients in 2012, which greatly concerned the city as the lake is a centerpiece of the community. Subsequently, through strategically focused pollution reduction efforts by the City of St. Cloud and its partners, the lake's phosphorus levels have been significantly reduced. The delisting of the lake in 2022 was a nonpoint success story honorably recognized by the EPA.

Figure 17. Dredging of the Stormwater Treatment Pond "Little George" – November 2018. Photo Credit – City of St. Cloud

2.3 Water quality trends

The MRSCW assessment and trends update (MPCA 2022a) evaluated long term trends where sufficient data was present for lake water clarity as well as annual stream nitrogen, phosphorus and sediment pollutant loads calculated as part of the Watershed Pollutant Load Monitoring Network (WPLMN). The WPLMN is a partnership including state and federal agencies, Metropolitan Council Environmental Services, state universities, and local partners, that collects data on water quality and flow in Minnesota. Since 2007, the network of partners has been collecting data in order to understand long-term trends and observe changes over time.

The MPCA uses the data in computer modeling, setting wastewater effluent limits, studies and watershed restoration and protection strategies it develops with local partners. Local partners then use the data for planning and to implement the best strategies in priority locations.

WLPMN monitoring sites span three ranges of scale:

- Basin – major river main stem sites along the Mississippi, Minnesota, Rainy, Red, Des Moines, Cedar, and St. Croix rivers
- Major Watershed – tributaries draining to major rivers with an average drainage area of 1,350 square miles (8-digit HUC scale)
- Subwatershed – major branches or nodes within major watersheds with average drainage areas of approximately 300-500 square miles

Long-term trends

Data analysis conducted by the MPCA in the IWM process and in the development of the MRSCW assessment and trends update indicated observations of many positive water quality improvements throughout the MRSCW (MPCA 2022a). Statistically significant improvements since IWM Cycle 1 (2009 – 2010) were noticed in both fish and macroinvertebrate communities across the MRSCW. Water clarity trends also improved on 20 lakes with 1 declining trend (Albion, Wright County). No change was determined on 13 lakes. See Figure 18, Figure 19, and Table 7 for more information. However, even with the positive changes in the watershed, problems still exist and efforts will be necessary to restore the health of these waters.

Lake Clarity Trends

Figure 18. Water Clarity Trend Map for Lakes within the MRSCW (MPCA 2023e)

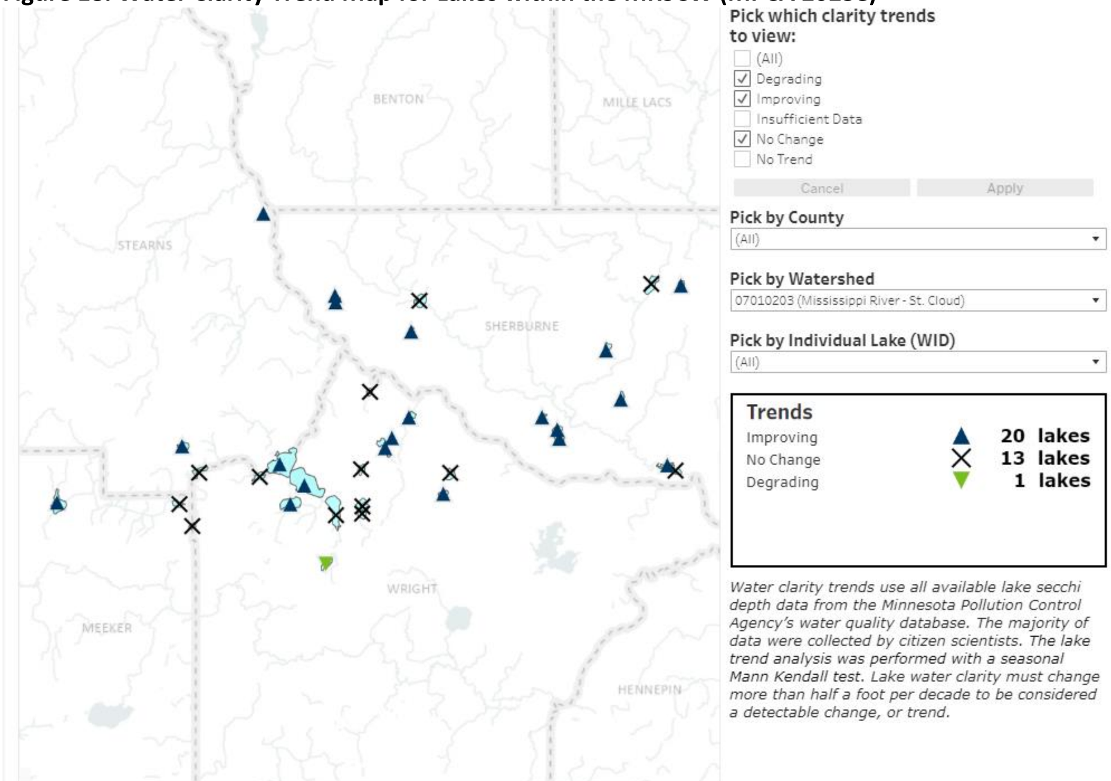


Figure 19. Aibion Lake – Degrading water clarity trend description (MPCA 2023e)

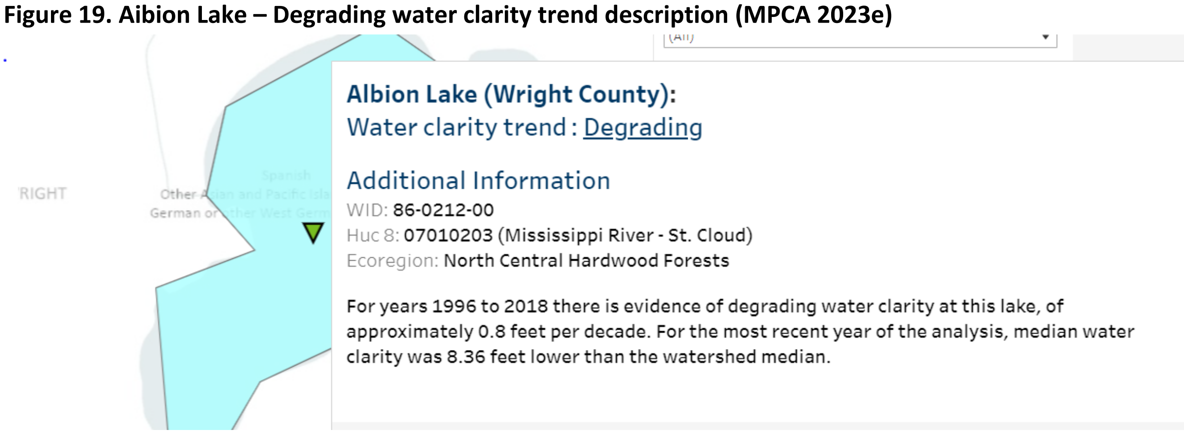


Table 7. List of MRSCW Lakes with clarity trend data

Lake Name	Lake ID	County	Trends
Mayhew	05-0007-00	Benton	No Trend
Clear	47-0095-00	Meeker	Improving
Betty	47-0042-00	Meeker	No Change
Union	86-0298-00	Meeker	No Change
Little Mud	47-0096-00	Meeker	No Trend
Upper Orono	71-0013-01	Sherburne	Improving
Cantlin	71-0041-00	Sherburne	Improving
Birch	71-0057-00	Sherburne	Improving
Ann	71-0069-00	Sherburne	Improving
Mitchell	71-0081-00	Sherburne	Improving
Big	71-0082-00	Sherburne	Improving
Thompson	71-0096-00	Sherburne	Improving
Camp	71-0123-00	Sherburne	Improving
Pickerel	71-0158-00	Sherburne	Improving
Round	71-0167-00	Sherburne	Improving
Lower Orono	71-0013-02	Sherburne	No Change
Elk	71-0055-00	Sherburne	No Change
Elk	71-0141-00	Sherburne	No Change
Fremont	71-0016-00	Sherburne	No Trend
Eagle	71-0067-00	Sherburne	No Trend
Julia	71-0145-00	Sherburne	No Trend
Briggs	71-0146-00	Sherburne	No Trend
Rush	71-0147-00	Sherburne	No Trend
Long	71-0159-00	Sherburne	No Trend
School Section	73-0035-00	Stearns	Improving
George	73-0611-00	Stearns	Improving
Clearwater (East)	86-0252-01	Stearns	Improving
Clearwater (West)	86-0252-02	Stearns	Improving
Louisa	86-0282-00	Stearns	No Change
Augusta	86-0284-00	Stearns	No Change
Long	73-0004-00	Stearns	No Trend
Crooked	73-0006-00	Stearns	No Trend
Warner	73-0011-00	Stearns	No Trend
Marie	73-0014-00	Stearns	No Trend
Otter	73-0015-00	Stearns	No Trend
Melrose Deep Quarry	73-0701-00	Stearns	No Trend
Caroline	86-0281-00	Stearns	No Trend
Eagle	86-0148-00	Wright	Improving
Limestone	86-0163-00	Wright	Improving
Locke	86-0168-00	Wright	Improving
Ember	86-0171-00	Wright	Improving
Pleasant	86-0251-00	Wright	Improving
Ida	86-0146-00	Wright	No Change

Lake Name	Lake ID	County	Trends
Fish	86-0183-00	Wright	No Change
Indian	86-0223-00	Wright	No Change
Cedar	86-0227-00	Wright	No Change
Mink	86-0229-00	Wright	No Change
Somers	86-0230-00	Wright	No Change
Albion	86-0212-00	Wright	Degrading
Birch	86-0066-00	Wright	No Trend
Cedar	86-0073-00	Wright	No Trend
Mary	86-0156-00	Wright	No Trend
Swartout	86-0208-00	Wright	No Trend
Henshaw	86-0213-00	Wright	No Trend
Sugar	86-0233-00	Wright	No Trend
Bass	86-0234-00	Wright	No Trend
Nixon	86-0238-00	Wright	No Trend
Grass	86-0243-00	Wright	No Trend
Scott	86-0297-00	Wright	No Trend

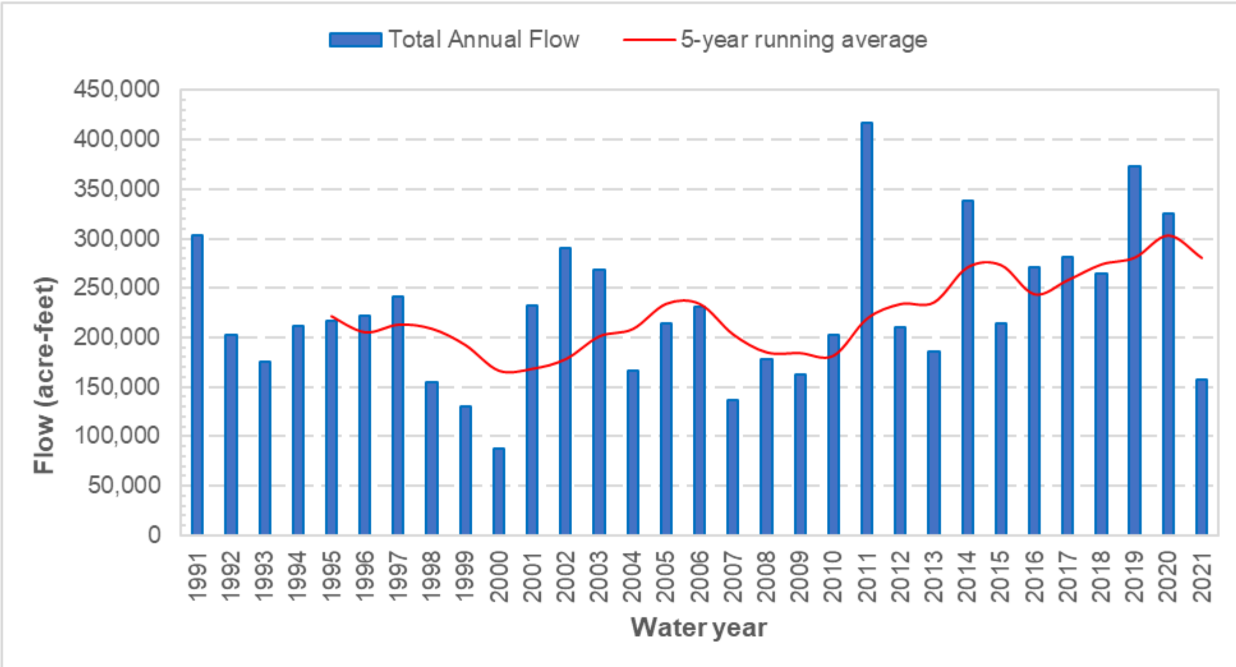
2.3.1 Flow trends

The U.S. Geological Survey currently operates two continuously recording flow gages in the MRSCW. Long-term flow trends were evaluated using daily average flow data from the gage on the Elk River near Big Lake, Minnesota (gage 05275000). The other gage is on the Mississippi River and long-term trends at this gage would not represent flow conditions in the MRSCW. The Elk River gage has operated since 1911; however, gaps are present in the daily average flow record in 1911, 1917, 1918 through 1934, and 1987 through 1990.

In the recent evaluation of hydrologic change, Minnesota Department of Natural Resources (DNR 2023b) found that hydrologic conditions changed in 2001 at the Elk River gage. These changes were associated with an increase in precipitation that led to increased runoff and a shift in higher flow, with the annual peak-flow shifting from mid-April to late-June. Refer to *the Evaluation of Hydrologic Change Technical Summary* (DNR 2023b) for discussion of the data and analyses used to identify these changing hydrological conditions.

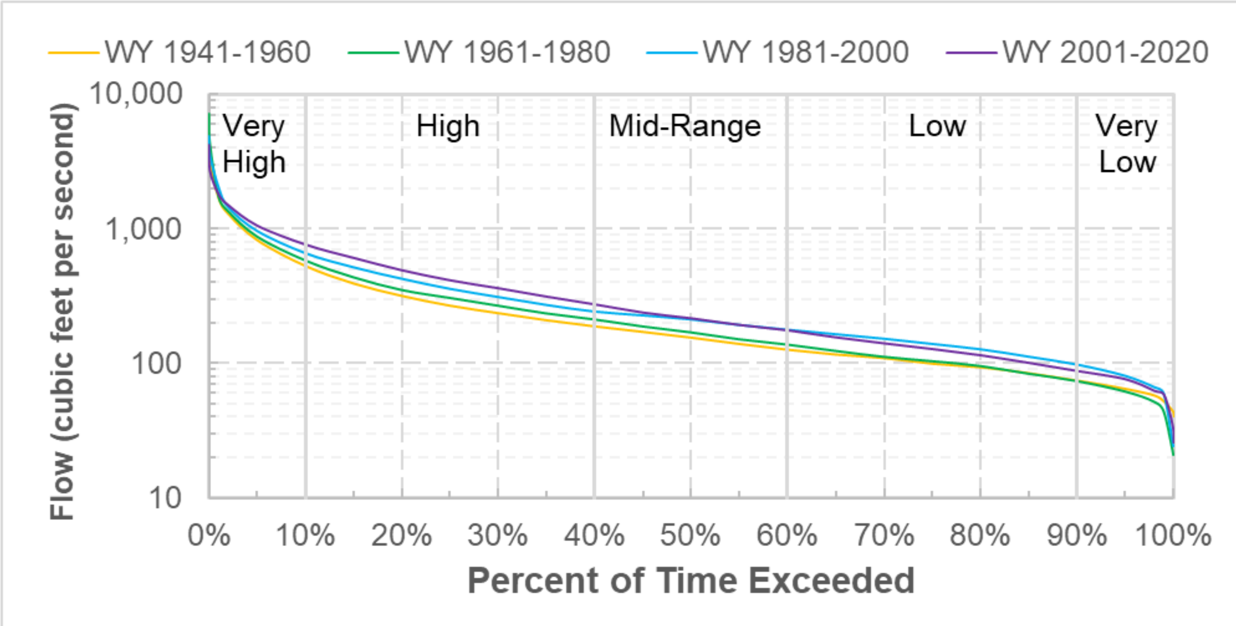
For this WRAPS update, a short summary of hydrologic conditions and temporal trends at the Elk River near Big Lake, Minnesota, gage is presented. Evaluation of water years (WY) 1991 through 2021 indicates considerable interannual variability between total annual flows. Generally, the 5-year running average of total annual flow indicates that flow has increased over this 30-year period (Figure 20).

Figure 20. Total annual flow each year in the Elk River near Big Lake, Minnesota (gage 05275000; water years 1991-2021)



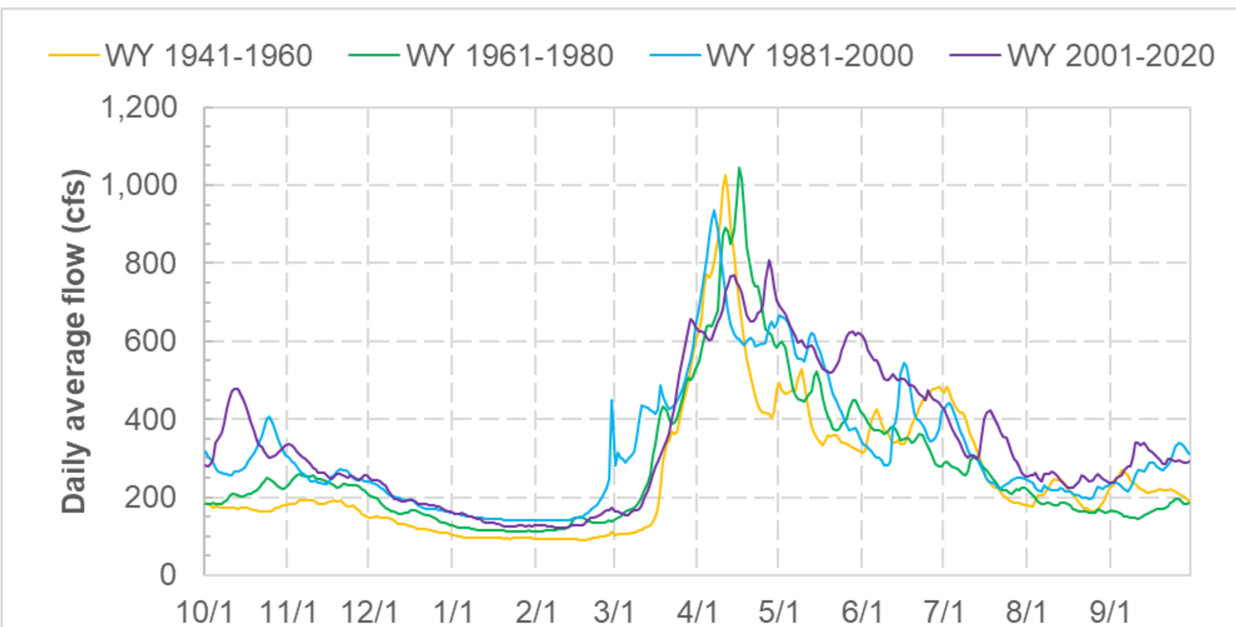
Flow duration curves and daily average flows were developed for four 20-year periods to evaluate long-term flow trends in the Elk River near Big Lake, Minnesota (gage 05275000); the four periods are WYs 1941-1960, 1961-1980, 1981-2000, and 2001-2020. Generally, in the very high and high flow conditions, flows increase temporally (Figure 21). In the mid-range flow conditions, flows in the two more recent periods (WYs 1981-2000 and 2001-2020) are about 40 cfs greater than flows in the older two periods (WYs 1941-1960 and 1961-1980).

Figure 21. Flow duration curves for Elk River near Big Lake, Minnesota (gage 05275000; water years 1941-2020)



The most recent 20-year period (WYs 2001-2020) has lower April peak flows than the other three periods, but has higher May and June flows (Figure 22). In this most recent period, the peak flows are lower but occur over a longer period. Such results are generally consistent with DNR (2023b), but this analysis averaged 20-years, whereas DNR (2023b) evaluated individual years.

Figure 22. Daily average flow for Elk River near Big Lake, Minnesota (gage 05275000; water years 1941-2020)



2.3.2 Climate Trends

Overall, across Minnesota, climate measurements are showing a shift in foundational climate conditions (DNR June 2019). Other ecological processes are changing in response. Communities and individuals making decisions about managing land and water resources for infrastructure, flood protection, habitat protection, water supply, and other needs must be aware of this shift and informed about its potential impacts.

The DNR [Climate Summary for Watersheds, Mississippi River - St. Cloud (state.mn.us)] Report summarizes climate data using 30-year averages, and compares the most recent 30 year average (1989 through 2018) to the entire climate record average (1895 through 2018). This approach generates values for the amount of change (deviation) seen in the most recent 30 years when compared to the entire 120-year period of record for temperature and precipitation.

Figure 23 and Figure 24 illustrate a changing climate within the MRSCW, with overall upward trends noticed in average annual temperature and precipitation. A breakdown of the DNR June 2019 MRSCW climate summary seasonal data indicates the greatest temperature increase (departure of + 2.8 inches) is occurring in the winter season (December through February), while the greatest upward trend in precipitation (departure of +1 inches) is occurring in the spring season (March through May).

Figure 23. Annual Average Temperature within the MRSCW (1895 – 2018)

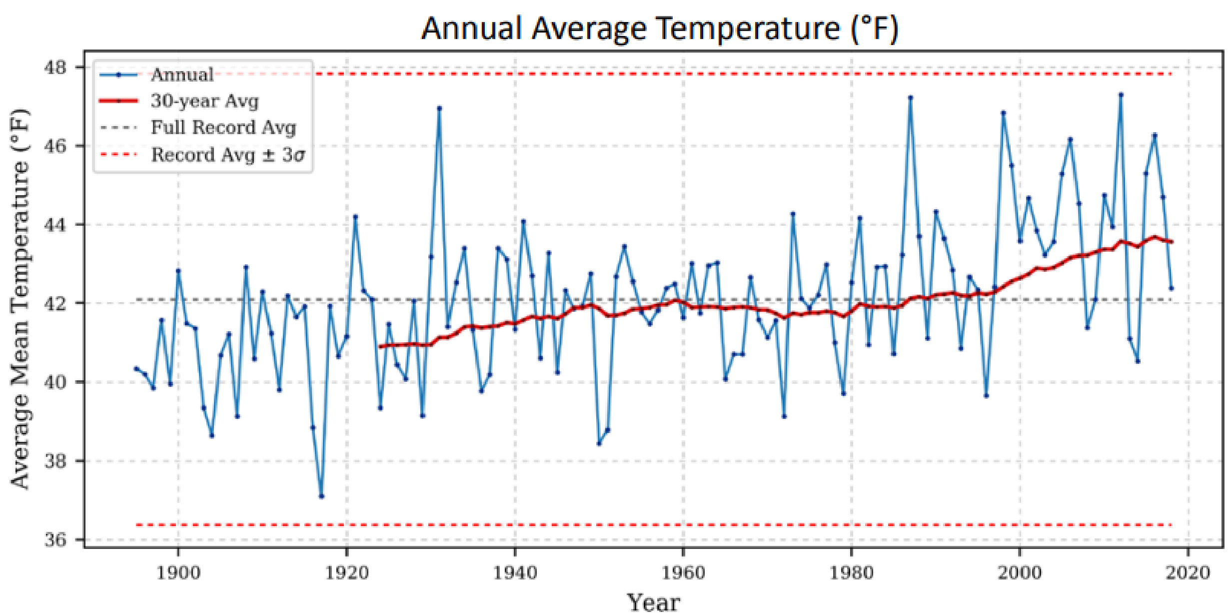
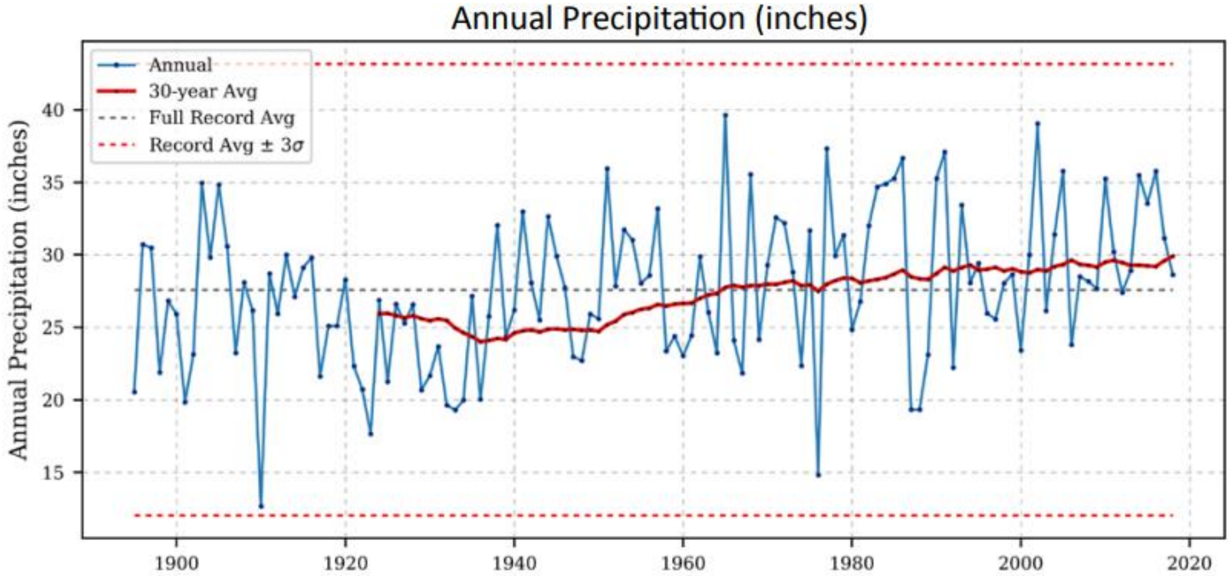


Figure 24. Annual Average Precipitation within the MRSCW (1895 – 2018)



2.3.3 Watershed Pollutant Load Monitoring Network

There are three WPLMN subwatershed sites within the MRSCW (Table 8 and Figure 25). These sites are monitored seasonally from ice out to October 31. Approximately 25 to 35 water quality samples are collected at each WPLMN monitoring site per year. The average flow weighted mean concentration (FWMC) for the selected years (where data is available) is shown below for the three MRSC Subwatershed sites in Figure 26.

Table 8. WPLMN Sites within the MRSCW

Site type	Station Name	WPLMN Station ID/ MPCA EQuIS ID
Subwatershed	Clearwater River nr Clearwater, CR 145	H17008003/S004-508
Subwatershed	Elk River nr Big Lake MN	E17046001/S000-278
Subwatershed	St. Francis nr Big Lake, 164th St	H17049003/S002-952

Figure 25. WPLMN sampling stations shown by EQuIS ID

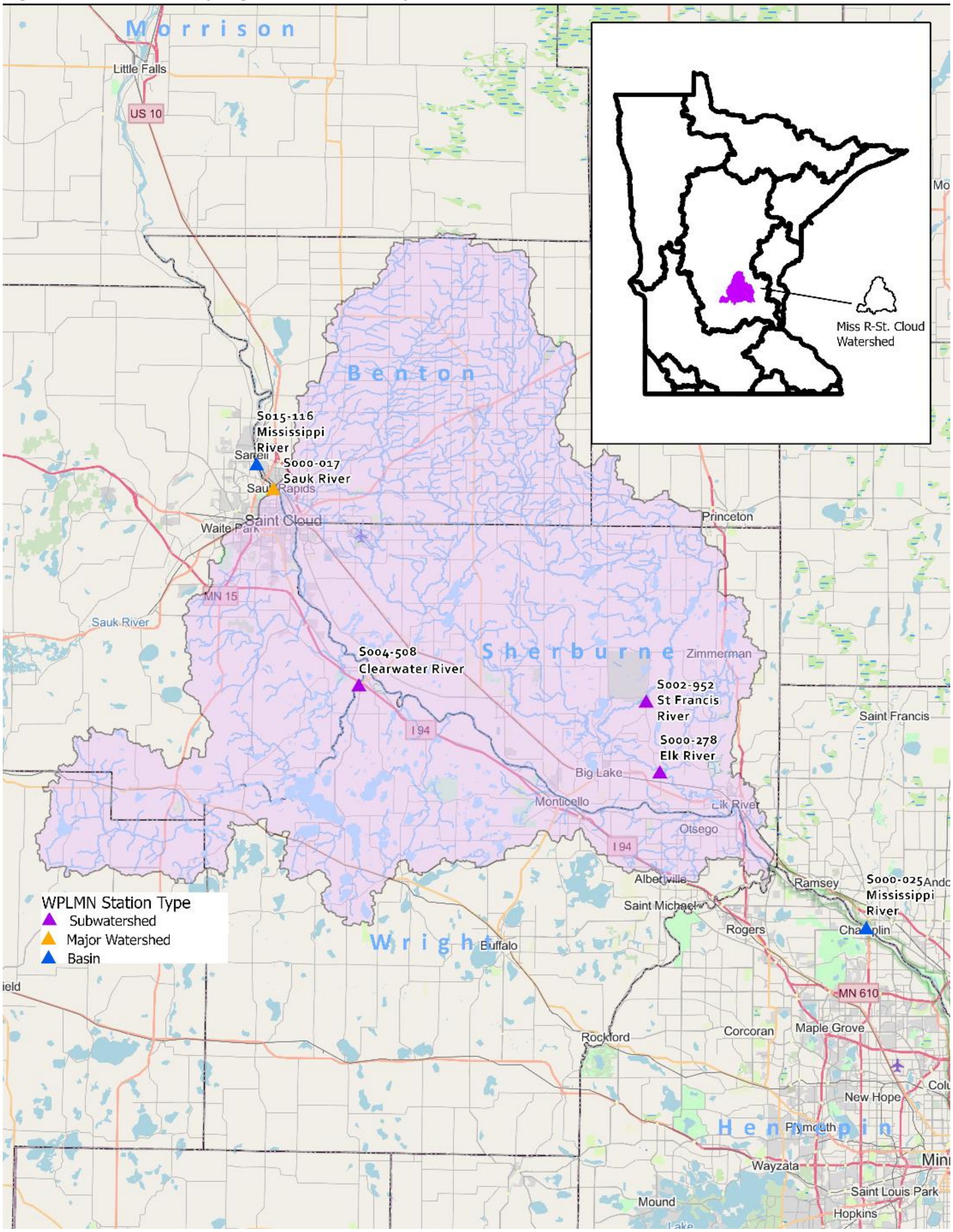
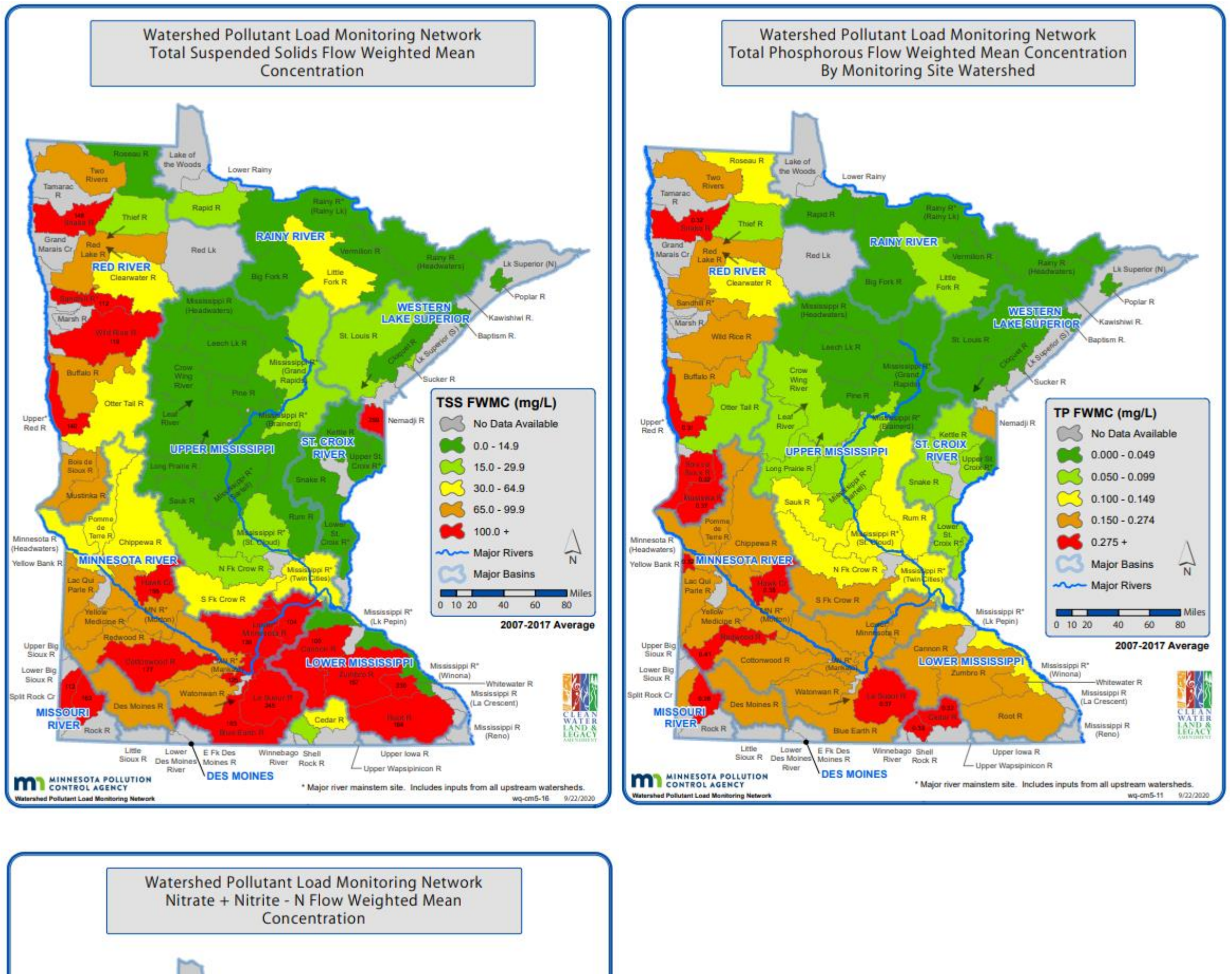


Figure 26. Average flow weighted mean concentrations for TSS, TP, and NO3-NO2-N for MRSC Subwatershed sites (available data from 2014 – 2021).

Dashed line indicates average concentration for years shown.

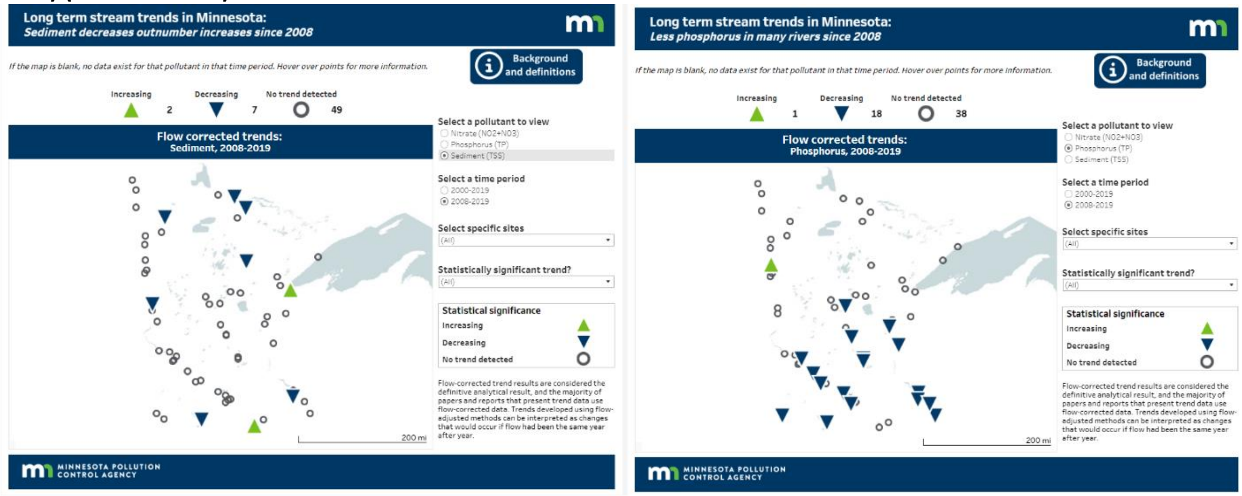
While there are no major watershed or basin sites currently located within the MRSCW, a basin site (Mississippi River at Anoka, Minnesota – WPLMN Site #200410001/EQuIS site # S000-025) exists just downstream of the MRSCW where annual pollutant loads are calculated. The WPLMN information gathered at this site was factored into the statewide major watershed results shown below in (Figure 27) where FWMC for TSS, TP, and nitrate plus nitrite nitrogen (NO3+NO2-N) are compared statewide on a major watershed basis. In general, the FWMCs for all parameters for the MRSCW are shown to be one to two tiers higher than the lowest contributing watersheds which are primarily situated to the north, while contributing lower pollutant loading than watersheds situated in southern and northwestern/western Minnesota. In evaluating statewide long-term stream trends from 2008 through 2019 for sediment (TSS), phosphorus (TP) and nitrate (NO2+NO3) significant decreasing trends are generally noticed statewide for TSS and TP (MPCA 2023m). However, significant statewide increases in NO2+NO3 exist, including the UMRB flowing to and from the MRSCW (Figure 28). Efforts to address and make reductions to this nutrient loading and is a priority for the state of Minnesota and its partners now and going forward. See MPCA's Reducing nutrients in waters webpage for additional information on statewide nutrient reduction efforts and progress.

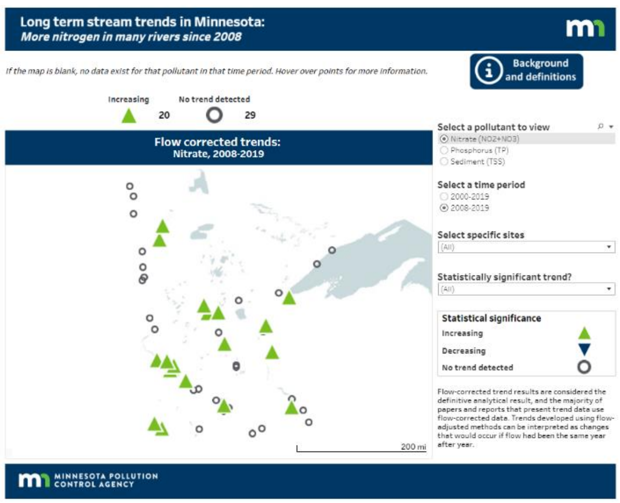
Figure 27. 2007-2016 Average annual TSS, TP, and NO3-NO2-N flow weighted mean concentrations by major watershed (MPCA WPLMN 2023j).



See [WPLMN reports and data | Minnesota Pollution Control Agency (state.mn.us)] for additional information.

Figure 28. Long-term stream trends in MN 2008-2019 for Sediment (TSS), Phosphorus (TP) and Nitrate (NO2 + NO3) (MPCA 2023m)





*See Long-term Stream Trends | Tableau Public for more information and expanded view of maps.

2.4 Stressors and sources

In order to develop appropriate strategies for restoring or protecting water bodies, the stressors and/or sources impacting or threatening them must be identified and evaluated. Biological SID is conducted for river reaches with either fish or macroinvertebrate biota impairments and encompasses the evaluation of both pollutant and non-pollutant (e.g., altered hydrology, fish passage, habitat) factors as potential stressors. Pollutant source assessments are done where a biological SID process identifies a pollutant as a stressor, as for the typical pollutant impairment listings. Section 3 provides further detail on stressors and pollutant sources. If a nonpollutant stressor is linked to a pollutant (e.g., habitat issues driven by TSS or low DO caused by excess phosphorus), a TMDL is required. Nonpollutant stressors are not subject to load quantification and therefore do not require TMDLs. Waters determined to be stressed by degraded habitat and other nonpollutant stressors are not addressed by TMDLs but are still priorities for restoration efforts.

Different from stressors, sources of pollutants are determined through a pollutant source assessment. A pollutant source assessment for pollutant related TMDLs is provided in the MRSC TMDL Report (MPCA

2024a). A full pollutant source assessment was conducted for the MRSW for pollutants of concern and is provided in below sections.

Stressors of biologically impaired river reaches

Stressors of biologically impaired stream reaches were determined in the Mississippi River St. Cloud SID Update, 2022 (MPCA 2022b). Biological sampling from the Cycle 2 (2019) monitoring effort resulted in four stream reaches being assessed as having impaired fish and/or macroinvertebrate communities. One reach was also identified as vulnerable to future impairment, and another reach (Unnamed Creek – 07010203-684) was able to be delisted due to restoration action. In addition to the four new impairments from the Cycle 2 monitoring, eight stream reaches that were sampled in Cycle 1 (2009), but were deferred due to being channelized, were also assessed as impaired. These reaches, along with two additional reaches that were not investigated from Cycle 1 were brought into the SID update process. These reaches are listed below (Table 9) and locations shown in Figure 29.

Table 9. Summary of aquatic life impairments and stressors in the MRSCW.

Stream	AUID	Aquatic Life Impairment	Monitoring Data Source Year	Dissolved Oxygen	Phosphorus	TSS	Connectivity	Hydrology/ Geomorphology	Habitat	Flow
Luxemburg Creek (Trib. to Johnson Creek)	-561	Vulnerable	Vulnerable in 2019						•	
Johnson Creek	-639	Fish	Additional Reach not Investigated in 2011					•	•	
Plum Creek*	-740	Fish	Channelized Stream From 2009 Sampling	?	?	?		•	•	•
County Ditch 44*	-550	Fish, Macroinvertebrates	Channelized Stream From 2009 Sampling	•	•	•		•	•	•
County Ditch 20*	-738	Fish, Macroinvertebrates	Channelized Stream From 2009 Sampling	•	•	◊	?	•	•	•
Threemile Creek	-545	Fish	New Impairment from 2019 Sampling			?		•		

Stream	AUID	Aquatic Life Impairment	Monitoring Data Source Year	Dissolved Oxygen	Phosphorus	TSS	Connectivity	Hydrology/ Geomorphology	Habitat	Flow
Threemile Creek	-564	Fish, Macroinvertebrates	New Impairment from 2019 Sampling			?		•		
Unnamed Creek	-684	Fish, Macroinvertebrates	Delisted due to restoration, 2021							
St. Francis River, West Branch*	-693	Fish, Macroinvertebrates	Channelized Stream From 2009 Sampling		X		•	•		•
County Ditch 22*	-695	Fish	Channelized Stream From 2009 Sampling				•	•	•	•
Unnamed Creek*	-743	Fish	Channelized Stream From 2009 Sampling				•	•	•	
Snake River*	-558	Fish	New Impairment from 2019 Sampling				•	•	•	

Stream	AUID	Aquatic Life Impairment	Monitoring Data Source Year	Dissolved Oxygen	Phosphorus	TSS	Connectivity	Hydrology/ Geomorphology	Habitat	Flow
Snake River*	-529	Fish	New Impairment from 2019 Sampling				•	•	•	
Unnamed Creek*	-745	Fish	Channelized Stream From 2009 Sampling		?			•	•	
Unnamed Ditch*	-523	Macroinvertebrates	Channelized Stream From 2009 Sampling					•	•	
Silver Creek*	-662	Fish, Macroinvertebrates	Additional Reach not Investigated in 2011	?	•	?	•	•	•	•

Denotes Stearns County

Denotes Sherburne County

Denotes Meeker County

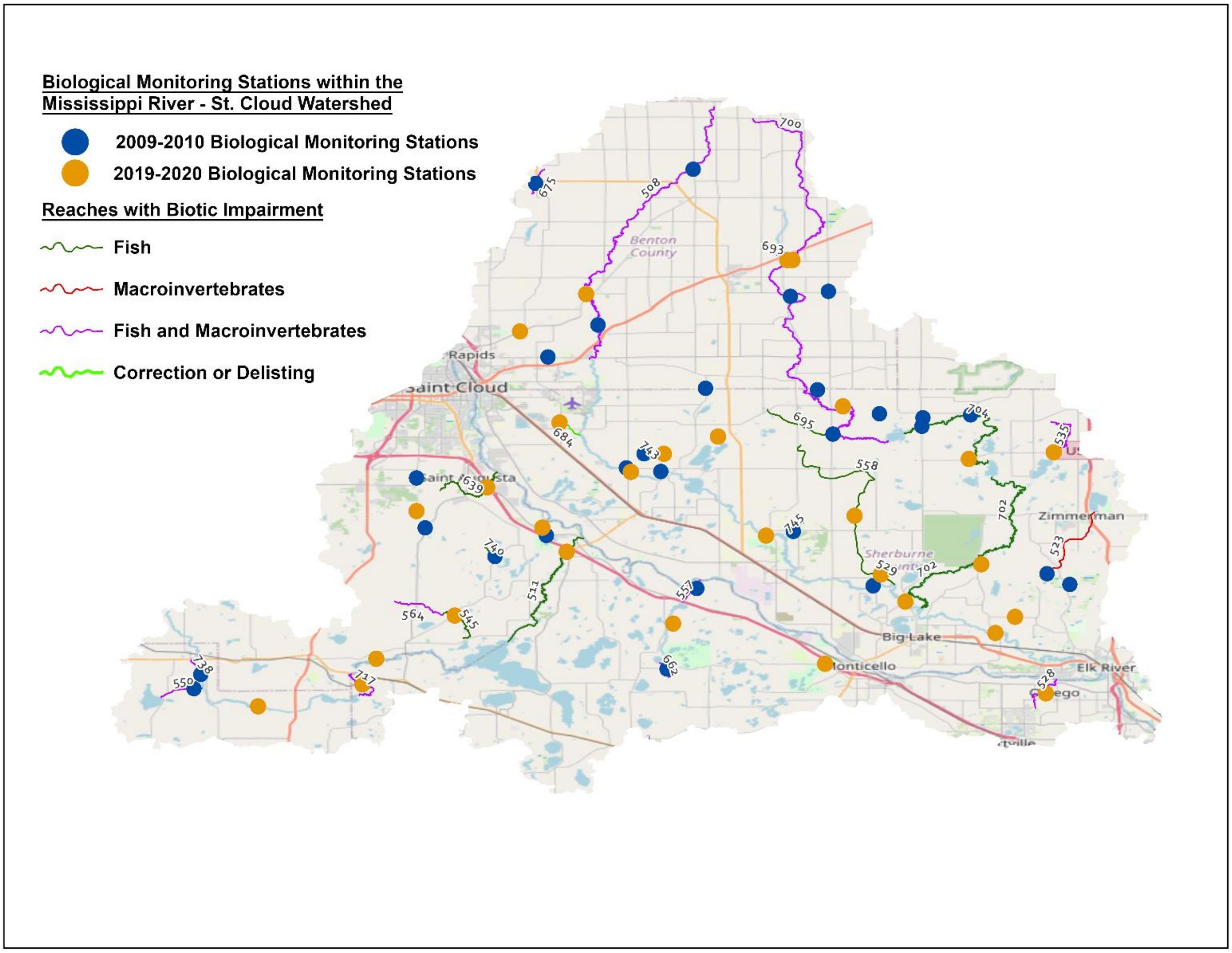
Denotes Wright County

Denotes Benton County

*** • = direct stressor (stressor directly contributing to the biological impairment), X = secondary stressor (stressor that is not the direct stressor, but is still contributing to the biological impairment), ◊ = Possible contributing root cause (stressor that is not a direct or secondary stressor, but may be contributing to other stressors, causing stress to the biological communities, ? = Inconclusive**

Please note that some of the stream reaches are channelized within the MSCRW and those discussed within this report may also serve as public drainage ditches.

Figure 29. Biological Monitoring Stations and Biological Impairments within the MRSCW.



Excerpts of the summaries provided for each AUID analyzed in the SID report (MPCA 2022b) are included below. See the Mississippi River St. Cloud SID Update, 2022 for additional information.

- **Luxemburg Creek (Tributary to Johnson Creek) (561)**. There is one biological monitoring station (09UM044) on AUID -561 that was sampled in 2009 as part of the Cycle 1 monitoring effort and repeated in 2019 as part of the Cycle 2 monitoring effort. The fish and macroinvertebrate samples were assessed in 2021, which indicated that while these communities were still meeting standards, the IBI scores fell significantly between 2009 and 2019. Due to this decline, Luxemburg Creek was identified as vulnerable to future impairment, and was included in the SID process. The Minnesota Stream Habitat Assessment (MSHA) habitat scores for Luxemburg Creek were rated as good following the 2009 fish sample but dropped slightly after the 2019 samples.
- **Johnson Creek (639)**. Geomorphology and habitat quality declines from the upstream portion to the downstream portion of Johnson Creek. Due to the lower channel slope and additional sediment input from historic cattle management practices, the lower portion of Johnson Creek has poor habitat quality, as the pools and riffles have filled in with sand. Due to the extensive chemistry dataset collected on Johnson Creek, the conventional chemistry stressors such as DO, TSS, and TP were able to be ruled out as stressors to the AQL within the creek, as these parameters are meeting their respective standards.

Figure 30. Large sand delta located at the confluence of Johnson Creek and the Mississippi River. Courtesy Google Earth 7/24/2021

- **Plum Creek (740)**. The fish Tolerance Index Values (TIVs) indicate that DO is a stressor to the fish community within this section of Plum Creek; however, this may be the result of the low DO tolerant fish species also having the ability to survive in streams with poor habitat and altered hydrology. Therefore, altered hydrology is the direct stressor to the biology in Plum Creek. Poor sinuosity, poor channel development, and fine sediment were noted within the MSHA assessment. These are the result of channel over widening and the creation of a new channel through large wetlands. As a result of channelization, the altered geomorphology and habitat of Plum Creek is impeding the ability of intolerant fish species from surviving in the creek.
- **County Ditch 44 (550)**. Macroinvertebrate TIVs indicated that TSS, DO, and phosphorus all have the potential to stress the AQL within County Ditch 44, with DO and phosphorus having the strongest signals. The elevated TP and unstable DO levels within the chemistry dataset collected on County Ditch 44 further indicate that TP and DO are stressors to the AQL within the ditch. Altered hydrology and geomorphology have also impacted the AQL within County Ditch 44, by removing habitat, increasing the amount of nutrients drained from the landscape and from Clear Lake to the downstream Clearwater River, and altering the historic flow conditions.
- **County Ditch 20 (738)**. The TIVs from the biological sample that was collected on County Ditch 20, indicated that TSS, DO, and phosphorus are stressors to the AQL within County Ditch 20. The chemistry dataset also indicated that the DO levels within the ditch are unstable, and the phosphorus levels were severely elevated. Although the average TSS value was below the standard, there were elevated values within the dataset that indicated that TSS may be a stressor. Due to the chemistry data and TIVs from the biological sample, TSS, DO, and phosphorus are all direct stressors to the AQL within County Ditch 20. Altered hydrology and geomorphology have also impacted the AQL within County Ditch 20, by removing habitat, increasing the amount of nutrients drained from the landscape to the downstream Clearwater River, and altering the historic flow conditions, by increasing the amount of land that is drained though the ditch.

- **Threemile Creek (545)**. This AUID flows for 3.4 miles from the outlet of Laura Lake to just upstream of Otter Lake, 2.7 miles east of South Haven. Threemile Creek (AUID 545) remains natural throughout the entire reach. There is one biological monitoring station (09UM032) that was sampled for fish and macroinvertebrates in 2009, 2012, 2013, and 2019. This reach was assessed as a coldwater stream in 2021, which resulted in a new fish impairment. The fish stream class is class 11 (Northern Coldwater), and the macroinvertebrate stream class is class 9 (Southern Coldwater). The habitat and geomorphology are altered and are the direct stressors to the AQL. Coldwater fish may not have existed historically, and due to the absence of source populations of coldwater fishes, it will be difficult to meet the fish coldwater IBI standards without the manual reintroduction of coldwater fishes.

Figure 31. Eroding Streambank on the -545 reach of Threemile Creek

- **Threemile Creek (564)**. This AUID flows for three miles from just west of CR 1 to the confluence with the outlet of Laura Lake, three miles north of South Haven. Threemile Creek (AUID 564) is mostly natural, with one short section that is channelized. There is one biological monitoring station (12UM146) that was sampled for fish and macroinvertebrates in 2012. This reach was assessed as a coldwater stream in 2021, which resulted in new fish and macroinvertebrate impairments. The fish stream class is class 11 (Northern Coldwater), and the macroinvertebrate stream class is class 9 (Southern Coldwater). The habitat and geomorphology are altered and are the direct stressors to the AQL. Coldwater fish may not have existed historically, and due to the absence of source populations of coldwater fishes, it will be difficult to meet the fish coldwater IBI standards without the manual reintroduction of coldwater fishes.
- **Unnamed Creek (684)**. There is one biological monitoring station (09UM006) that was sampled for fish and macroinvertebrates in 2009, and then repeated in 2019. Fish were listed on the impaired waters list in 2002, and macroinvertebrates were listed in 2006. The fish stream class is class 7 (Low Gradient), and the macroinvertebrate stream class is class 6 (Southern Forest Streams Glide/Pool). After the 2019 sampling, the fish and macroinvertebrate IBI scores vastly improved, which prompted a delisting for both communities. Due to the improved scores, SID staff investigated the creek to try to determine the cause of the improved scores. As part of this

investigation, it was discovered that the culvert had been replaced at the 45th Ave SE crossing. The culvert replacement project significantly improved the overall connectivity of this reach and was a major factor contributing to the 2022 impaired waters delisting.

- **St. Francis River, West Branch (693)**. The dam within the Sherburne National Wildlife Refuge is a connectivity barrier to the fish community within the St. Francis River, West Branch. The TIVs within the fish and macroinvertebrate samples on the St. Francis River, West Branch indicate that low DO and TSS are not stressors, but elevated phosphorus is a secondary stressor. The habitat, hydrology, and geomorphology are heavily altered within the headwaters of the St. Francis River, West Branch, and have caused unstable flow conditions within the river. Therefore habitat, hydrology, and geomorphology are the direct stressors to the fish and macroinvertebrates in the St. Francis River, West Branch.
- **County Ditch 22 (695)**. The fish TIVs are indicating that low DO and elevated phosphorus are stressors to the AQL within County Ditch 22. However, due to the limited number of fish species collected and the lack of chemistry data, lower confidence was placed in the TIV metrics. The habitat, hydrology and geomorphology are heavily altered within County Ditch 22. These alterations have caused unstable flow conditions within the ditch and are the direct stressors to the fish within County Ditch 22. In addition, macroinvertebrates were not able to be sampled due to the stream being dry, which is further indication that altered hydrology is a stressor to the fish community within County Ditch 22.
- **Unnamed Creek (743)**. The fish TIV scores indicated that DO may be a stressor, but the macroinvertebrate TIV scores indicate that DO, TSS, and phosphorus are not stressors due to a healthy mixture of intolerant and tolerant taxa. The habitat and geomorphology are heavily altered within Unnamed Creek and are direct stressors to the AQL within Unnamed Creek. Perched culverts and beaver dams are barriers to fish passage from Rice Creek to Unnamed Creek and are direct stressors to the fish community within Unnamed Creek.
- **Snake River (529 and 558)**. The Snake River has been channelized throughout the entire reach. There is one biological monitoring station (09UM026) that was sampled for fish and macroinvertebrates in 2009, and then repeated in 2019. The Snake River was assessed in 2021, which determined that the Snake River has cold water temperatures and should be held to coldwater stream standards. This assessment resulted in a new fish impairment. The fish stream class is class 11 (Northern Coldwater) and the macroinvertebrate stream class is class 9 (Southern Coldwater). The primary stressors are poor habitat and geomorphology, with excess TSS being carried downstream to the Elk River during high flow periods. Beaver dams are barriers to fish passage throughout the Snake River, and therefore, connectivity is a direct stressor to the fish community within the Snake River. Restoration of the Snake River to support a coldwater fishery would require significant channel alterations. The current river channel is over-widened and lacks the habitat complexity that is required to support a healthy coldwater fishery.

Figure 32. Aerial view of an old beaver dam, showing the velocity fish barrier and the suspended sediment within the Snake River.

- **Unnamed Creek (745)**. The habitat, hydrology, and geomorphology are heavily altered within Unnamed Creek, and are direct stressors to the AQL within the ditch. However, due to the improvement within the 2021 fish sample, with the presence of the sensitive species, Smallmouth Bass, this reach is currently under review for a potential correction to the original impairment and may be removed from the impaired waters list. The impairment status of this reach is currently under review as the fish sample from 2021 is meeting the modified use standards. Therefore, it would be prudent to determine if this reach will be removed from the impaired waters list in the future.
- **Unnamed Ditch (523)**. The habitat, hydrology, and geomorphology are heavily altered in Unnamed Ditch - Sherburne County Ditch #1. This degraded habitat, which is caused by the creation of a new stream channel through a series of wetlands, is the direct stressor to the macroinvertebrates. The TIVs within the fish and macroinvertebrate samples on Unnamed Ditch - Sherburne County Ditch #1 indicate that low DO and elevated phosphorus are stressors, but more chemistry data is needed to make a final determination.
- **Silver Creek (662)**. The habitat, hydrology, and geomorphology have been impacted by the channel alterations in the headwaters of the creek and are direct stressors to the AQL within Silver Creek. The dam on the downstream reach of Silver Creek is a barrier and impedes fish movement into Silver Creek from the Mississippi River. Therefore, connectivity is a direct stressor to the fish community. The TIVs within the fish and macroinvertebrate samples on Silver Creek indicate that low DO, elevated phosphorus, and TSS are stressors. Phosphorus values are significantly elevated within the dataset for Silver Creek and several upstream sections of the creek, indicating that phosphorus is a direct stressor to the AQL. The DO and TSS datasets are limited, and are therefore, inconclusive at this time.

The Impact of Altered Watercourses

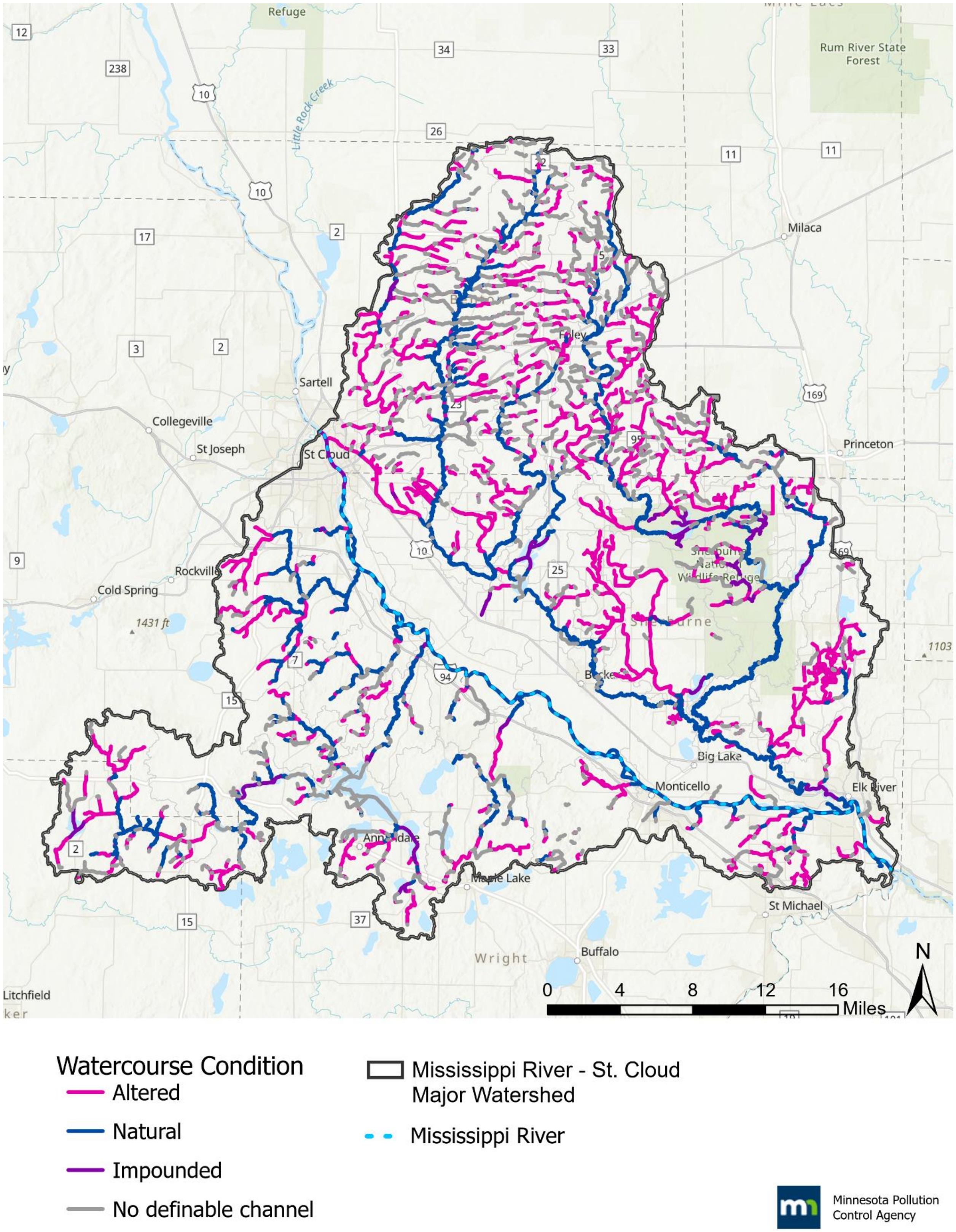
From MPCA's website [The impact of altered watercourses | Minnesota Pollution Control Agency (state.mn.us)](). Approximately 41,204 miles of streams in Minnesota (49.6% of the total) have been altered in some way by humans. Channelizing, ditching, and damming projects have changed the natural course of streams and their drainage areas. Altered stream channels can result in higher flows, higher levels of pollutants entering waterways, and degraded habitat. They can also make the environment less resilient to extreme weather (MPCA 2023h).

In the past streams and rivers were altered to:

- increase agriculture capacity
- increase land value
- improve highway and railway transportation
- remove swamps and wetlands (mistakenly thought of as "disease-breeding areas")

In the MRSCW there are approximately 1322 miles of streams of which around 557 miles (42%) have been altered to some extent (Esri. ArcGIS 2023). See Appendix F for a breakdown of the extent of altered water courses by HUC-12 within the MRSCW. Many of the stream resources noted in the above section fall within this altered category. Below (Figure 33) is an altered watercourse map for the MRSCW.

Figure 33. Altered Watercourses within the MRSCW



DNR Lake FIBI monitoring within the MRSCW

The narrative in this section is provided by DNR 2023d. The FIBI was used to assess 31 lakes within the MRSCW (Figure 34; Table 10). A total of 15 lakes had FIBI scores at or above the impairment threshold and were assessed as fully supporting AQL use, including one lake that scored above the exceptional threshold (Sugar - 86023300) and may warrant additional protection. Seven lakes were deemed to have inconclusive information to make an assessment decision, with scores above and below the impairment threshold, or reduced sampling confidence. Ida Lake (86014600) and Betty Lake (47004200) had insufficient information to make an assessment decision due to a lack of recent survey data. Four of the seven lakes assessed as inconclusive information, Elk (71005500), Pleasant (86025100), Louisa (86028200) and Augusta (86028400), were also considered to be vulnerable to future impairment. Six lakes were assessed as not supporting AQL use because they had FIBI scores that were below the impairment threshold (Table 10). These lakes include Mitchell (71008100), Big (71008200), Briggs (71014600), Eagle (86014800), Mary (86015600), and Locke (86016800). After examining many candidate causes for the biological impairments, the following stressors were identified as probable causes of stress to AQL within the MRSCW:

- Eutrophication
- Physical Habitat Alteration
- Temperature Regime Changes
- Decreased DO

The approach used to identify biological impairments in lakes includes the assessment of fish communities present in lakes throughout a major watershed. The FIBI utilizes fish community data collected from a combination of trap nets, gill nets, beach seines, and backpack electrofishing. From these data, an FIBI score can be calculated for each lake that provides a measure of overall fish community health based on species diversity and composition. The DNR has developed four FIBI tools to assess different types of lakes throughout the state. More information on the FIBI tools and assessments based on the FIBI can be found at the DNR Lake Index of Biological Integrity (IBI) Website. Although an FIBI score may indicate that a lake's fish community is impaired, a weight of evidence approach is still used during the assessment process that factors in considerations such as sampling effort, sampling efficiency, tool applicability, location in the watershed, and any other unique circumstances to validate the FIBI score. Along with Figure 34 and Table 10 see Appendix C for further details of the DNR's findings.

Figure 34. DNR Fish IBI MRSCW Monitoring Locations and Summary

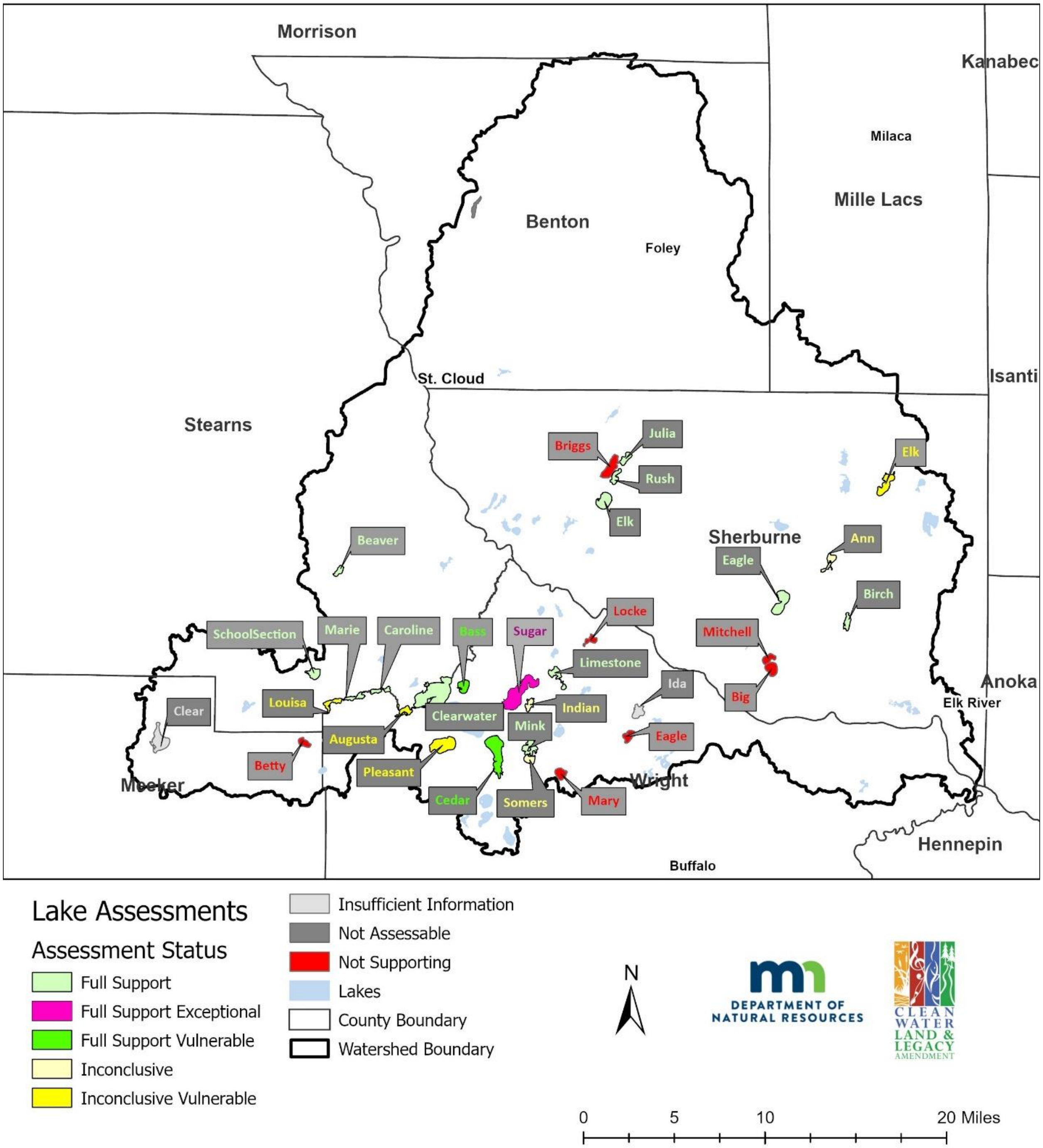


Table 10. Summary of watershed and shoreline stressor information for the 31 MRSCW lakes that were assessed using FIBI Tools (DNR 2023d)

Lake ID #	Lake Name	FIBI Tool	Assessment Status	Percent Watershed Disturbance	Total Phosphorus (ppb)	Dock Density (#/mi)	Score the Shore score	Secchi Mean	Chl-*a* mean
05000700	Mayhew	NA	NA	87.50	119.67	6.6	-	0.53	108
47004200	Betty	2	NS	83.84	195.53	12.2	-	1.83	22
71005500	Elk	7	IC - Vuln	57.13	73.38	26.5	77.6	3.1	37.28
71005700	Birch	7	FS	19.36	29.79	11	82	7.0	16.17
71006700	Eagle	7	FS	32.42	39.43	34	72	4.7	11.15
71006900	Ann	4	IC	37.28	23	11	82.5	13.0	5
71008100	Mitchell	2	NS	68.62	17.76	47.6	53.4	10.8	5.33
71008200	Big	2	NS	70.58	15.4	44.3	48.6	13.3	4.43
71014100	Elk	7	FS	74.84	120.93	25.8	81.7	2.7	47.67
71014500	Julia	7	FS	47.87	56.35	42.6	62.8	2.9	22.11
71014600	Briggs	2	NS	48.28	82.41	42	61.7	3.6	37.76
71014700	Rush	7	FS	48.87	97.03	28.8	70.9	2.7	46.75
73001400	Marie	5	FS	77.12	199.71	26.3	68.9	4.9	34.55
73002300	Beaver	4	FS	80.45	17	13.3	68.1	12.2	5
73003500	School Section	5	FS	82.59	18.31	6.2	75.5	11.6	3.1
86006900	Long	4	IF	47.54	-	0.3	-	-	-
86007300	Cedar	NA	NA	46.71	17.33	4.5	-	5.07	
86014600	Ida	2	IF	37.51	14.43	26.4	69	13.4	4.29
86014800	Eagle	2	NS	47.87	29.1	26.9	58.8	7.8	12.1
86015600	Mary	2	NS	69.17	21	7.1	85.1	7.3	11
86016300	Limestone	2	FS	45.61	24	8.1	84.3	10.3	10
86016800	Locke	2	NS	59.96	53.34	33	62.5	4.7	26.21
86022300	Indian	2	IC	49.30	31.2	24.8	76.5	8.5	6.32
86022700	Cedar	2	FS - Vuln	62.90	25.7	33.6	62	8.0	9.13
86022900	Mink	7	FS	72.95	121.8	10.5	77.2	4.2	42.46
86023000	Somers	2	IC	68.87	60.25	19	75	4.9	31.89
86023300	Sugar	2	FS - Exc	49.94	17.73	42.2	52.2	11.0	5.89

Lake ID #	Lake Name	FIBI Tool	Assessment Status	Percent Watershed Disturbance	Total Phosphorus (ppb)	Dock Density (#/mi)	Score the Shore score	Secchi Mean	Chl-*a* mean
86023400	Bass	2	FS - vuln	53.74	17.16	33	66.5	14.1	3.47
86025100	Pleasant	2	IC - Vuln	64.48	21.71	38.1	52.5	9.3	8.34
86025200	Clearwater	2	FS	69.82	27	23.5	67.3	12	9.6
86028100	Caroline	2	FS	76.52	76	10.1	86.5	5.6	27.17
86028200	Louisa	2	IC - Vuln	78.34	128.47	12.3	77.9	5.8	27.21
86028400	Augusta	2	IC - Vuln	75.98	47.16	27.6	67.8	7.3	13.36

[1] "FS" indicates fully supporting aquatic life use, "IC" indicates inconclusive information, "IF" indicates insufficient information, "NS" indicates not supporting aquatic life use, and "Vuln" indicates vulnerable to future impairment.

[2] Percent watershed disturbance is calculated as the percentage of land in each lake's contributing watershed that was classified as developed, agricultural, or barren based on 2016 National Land Cover Database land use data.

[3] Total phosphorus is calculated as the 10-year average of measurements taken June 1–September 30, 2009–2019. Data for separate sub basins was averaged.

[4] Dock density is calculated using a count of visible docks from Google Earth satellite imagery 2015–2019, or FSA 2019 imagery.

[5] Score the Shore scores (Perleberg et al. 2019) assess the quantity and integrity of lakeshore. The DNR Score the Shore is a tool used to gauge the level of riparian shoreline disturbance, with "low" scores indicating a more disturbed riparian lakeshore habitat and "high" scores representing a relatively undisturbed riparian lakeshore habitat. For more information see Score Your Shore: | a citizen shoreline description survey | Minnesota DNR (state.mn.us)

2.4.1 Pollutant sources (HSPF Modeling Summary - Tributaries)

Sources of phosphorus, nitrogen, and sediment in the MRSCW were quantified with the Hydrologic Simulation Program–Fortran (HSPF) model application of the MRSCW (Figure 35 through Figure 40). HSPF is a comprehensive model of watershed hydrology and water quality that allows the integrated simulation of point sources, land and soil contaminant runoff processes, and in-stream hydraulic and sediment-chemical interactions. The results provide hourly runoff flow rates, sediment concentrations, and nutrient concentrations, along with other water quality constituents, at the outlet of any modeled subwatershed.

TP, total nitrogen (TN), and sediment were simulated in the HSPF model for the MRSCW. Model results were used to calculate yields (mass per area per time) and sources. Point sources were a significant source of loads to the MRSCW outlet, due to point sources that discharged directly to the Mississippi River. Since the focus of this WRAPS update is the tributaries to the Mississippi River, sources loads were compiled for the tributaries to the north bank (e.g., Benton and Sherburne counties) and south bank (e.g., Stearns and Wright counties) of the Mississippi River.

TP yields by model subbasin are plotted in Figure 35. TP yields were highest in the upper Elk River and upper Mayhew Creek Subwatersheds in Benton County, while TP yields were lowest in eastern Sherburne County. TP source loads are presented in Figure 36. Cropland was the predominant source of TP loading. Cropland loading was relatively higher in the south bank tributaries (82%; mostly Stearns and Wright counties) than the north bank tributaries (70%; mostly Benton and Sherburne counties). Also, point sources contributed more relative load in the north bank tributaries than the south bank tributaries, which is expected since more urban development is present in Benton and Sherburne counties.

TN yields by model subbasin are plotted in Figure 37. TN yields were highest in the upper Elk River and upper Mayhew Creek subwatersheds in Benton County, middle St. Francis River Subwatershed in Sherburne County, the upper Johnson Creek Subwatershed in Stearns County, upper Silver Creek Subwatershed in Wright County, and portions of the Clearwater River Subwatershed in Stearns and Wright counties. TN source loads are presented in Figure 38. Cropland was also the predominant source of TN loading to the north bank (35%) and south bank (41%) tributaries, with considerable contributions from wetlands (24% and 26%, respectively).

Sediment yields by model subbasin are plotted in Figure 39. Like TP, sediment yields were highest in the upper Elk River and upper Mayhew Creek Subwatersheds in Benton County, while yields were lowest in eastern Sherburne Counties. High sediment yields near the city of St. Cloud may be the result of urban development but may also be an artifact of model construction (e.g., this area receives load from the HSPF model's upstream boundary conditions for the Mississippi River). Cropland was also the predominant source of sediment loading to the north bank (61%) and south bank (83%) tributaries (Figure 40). Pasture/hay (15%) and grassland (12%) were also relatively considerable sediment sources in the north bank tributaries.

Figure 35. Simulated TP yields across the MRSCW (1995-2015)

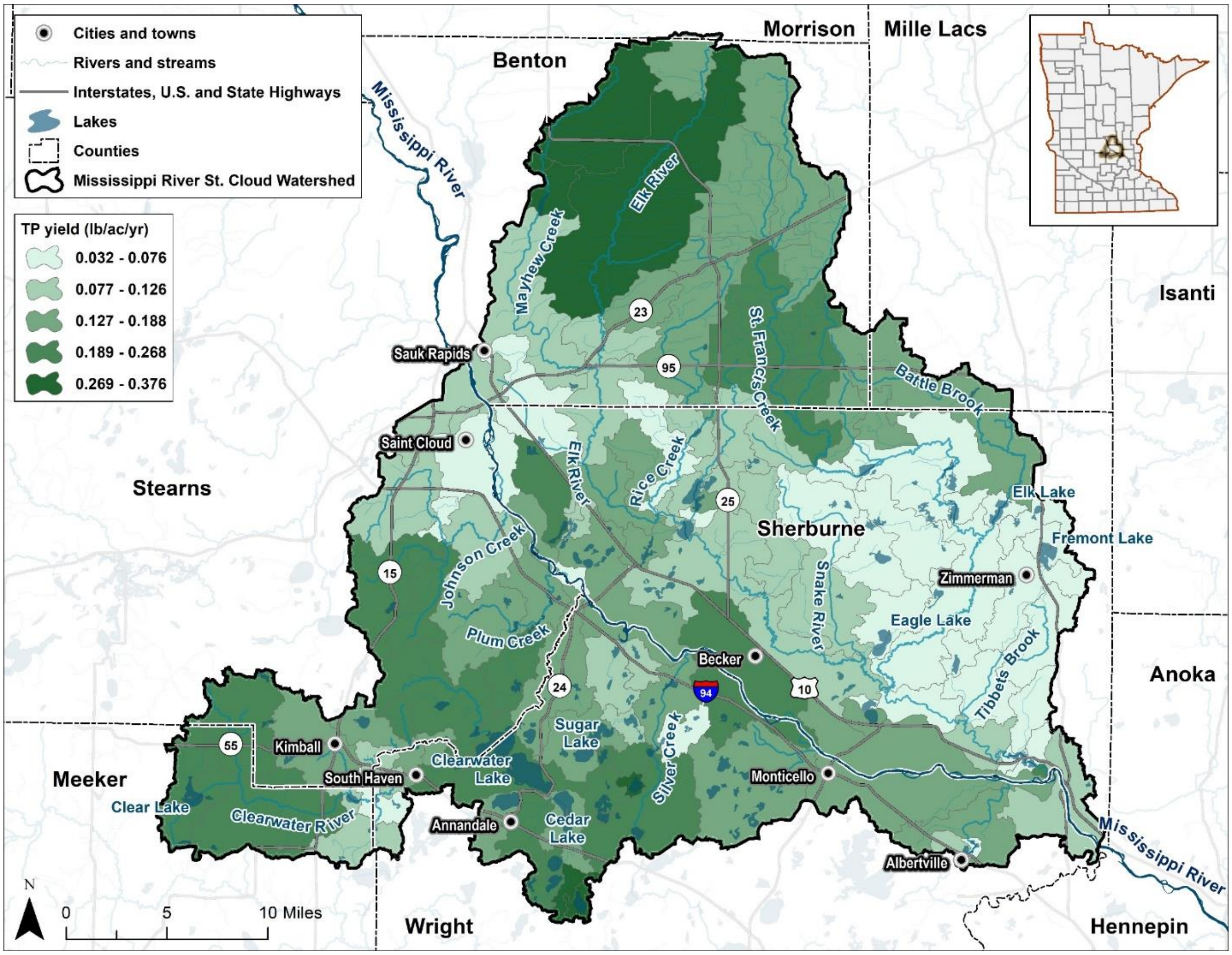
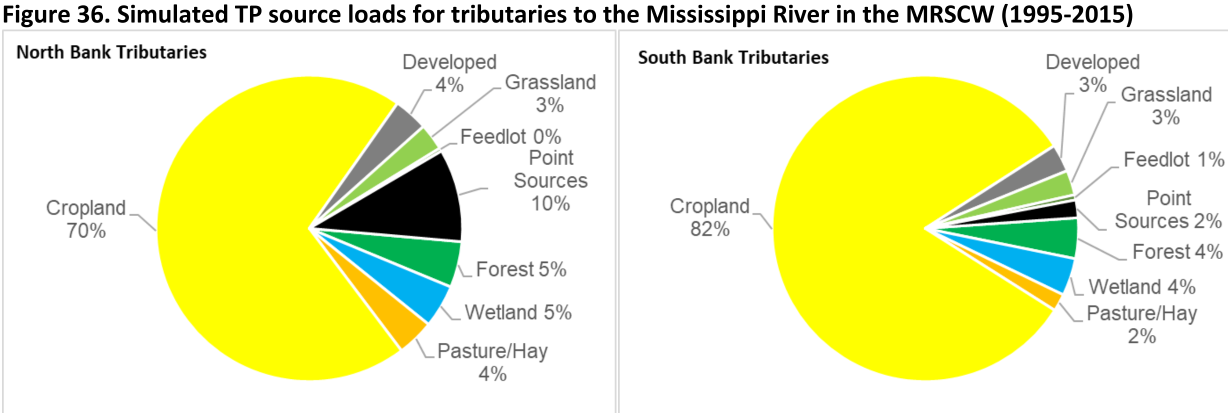


Figure 36. Simulated TP source loads for tributaries to the Mississippi River in the MRSCW (1995-2015)



Note: Percentages were rounded to the nearest integer. 0% is a nonzero number that is less than 0.5%.

Figure 37. Simulated TN yields across the MRSCW (1995-2015)

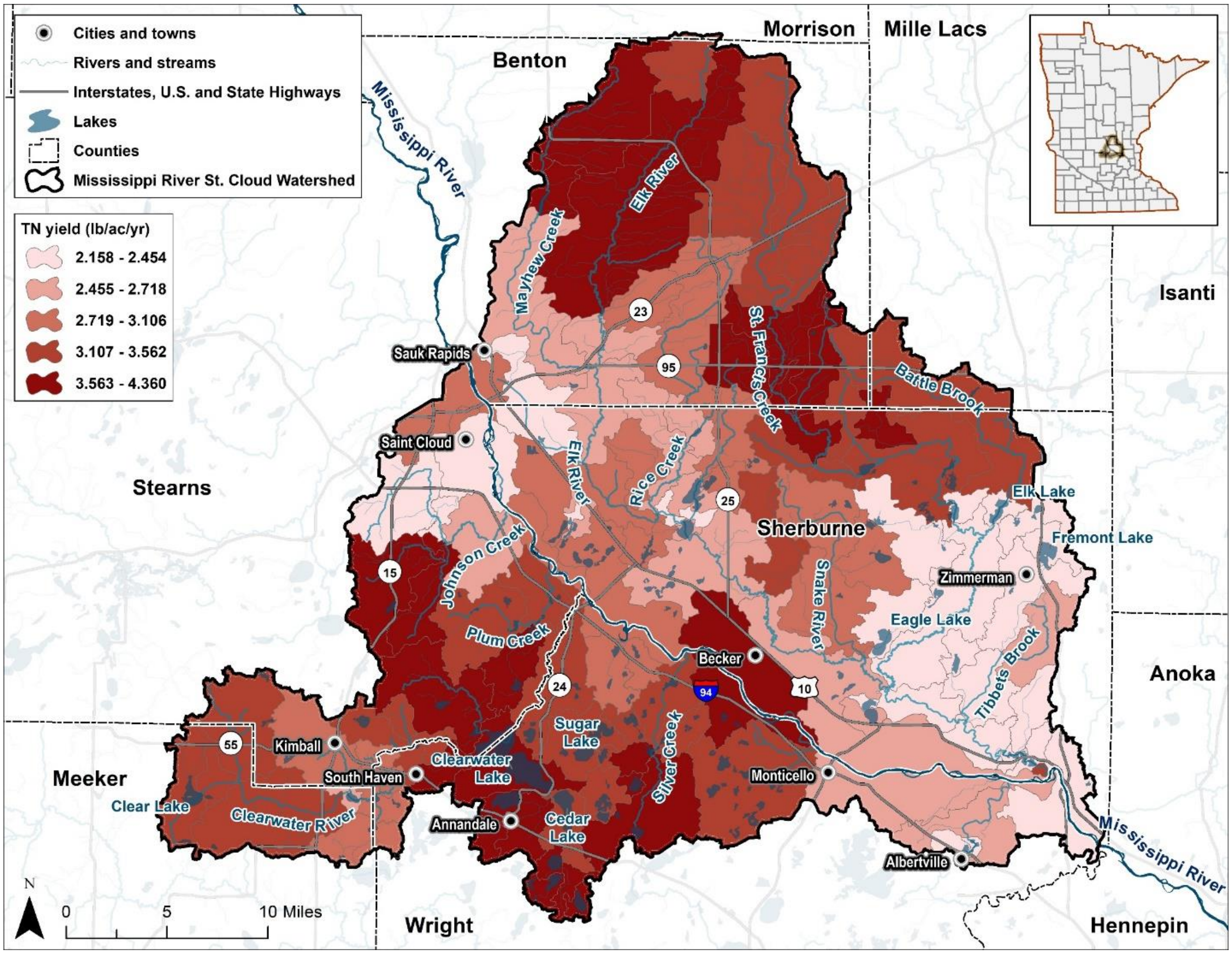
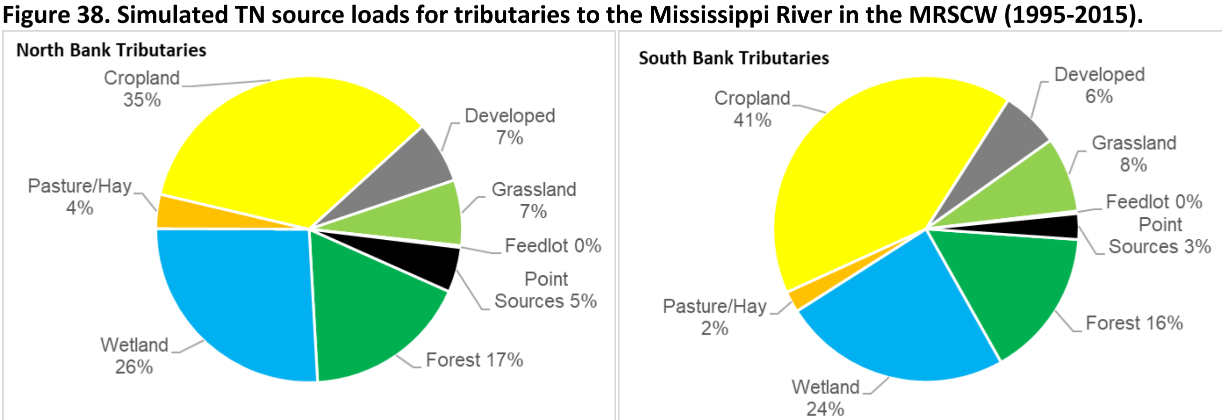


Figure 38. Simulated TN source loads for tributaries to the Mississippi River in the MRSCW (1995-2015).



Note: Percentages were rounded to the nearest integer. 0% is a nonzero number that less than 0.5%.

Figure 39. Simulated sediment yields across the MRSC watershed (1995-2015)

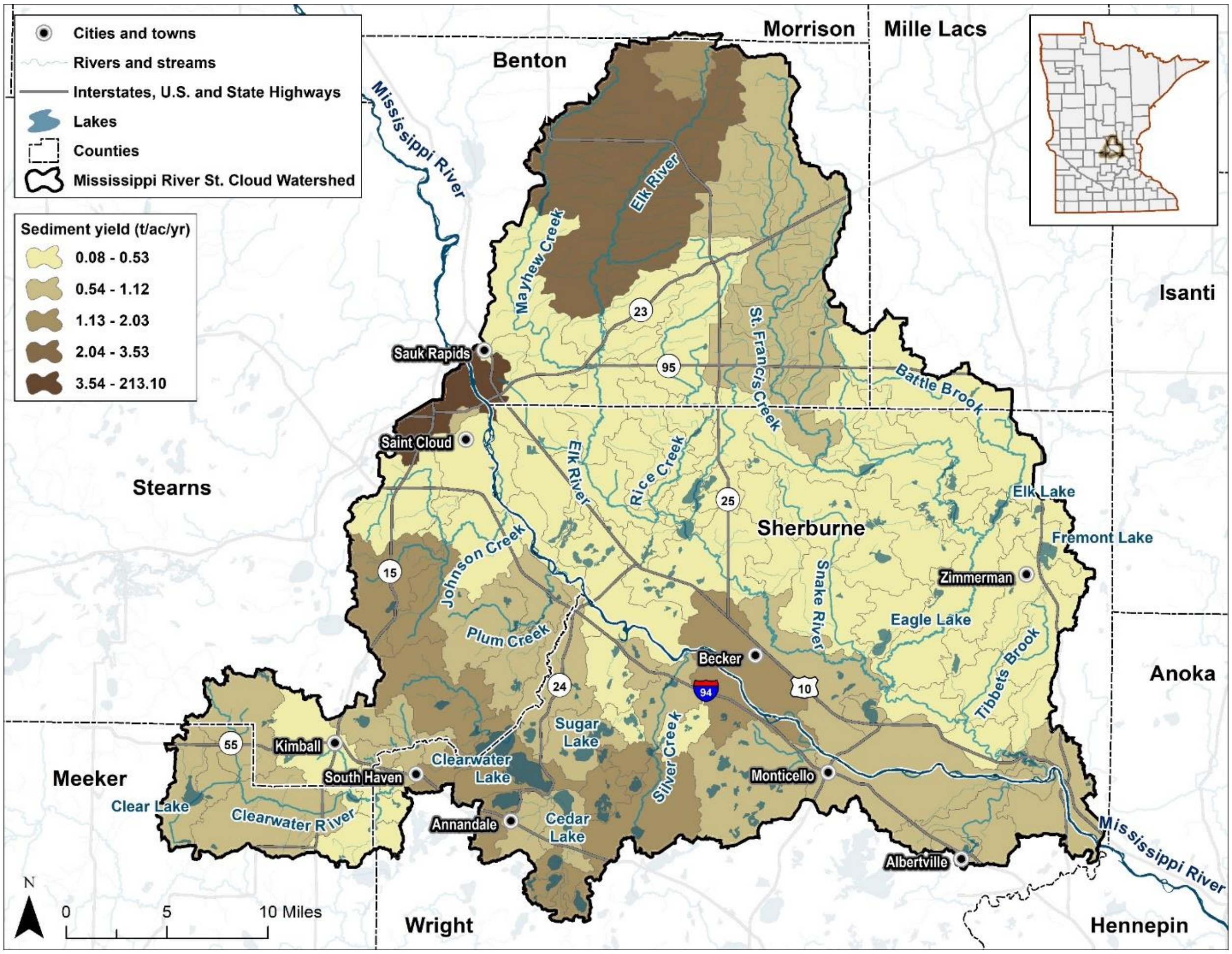
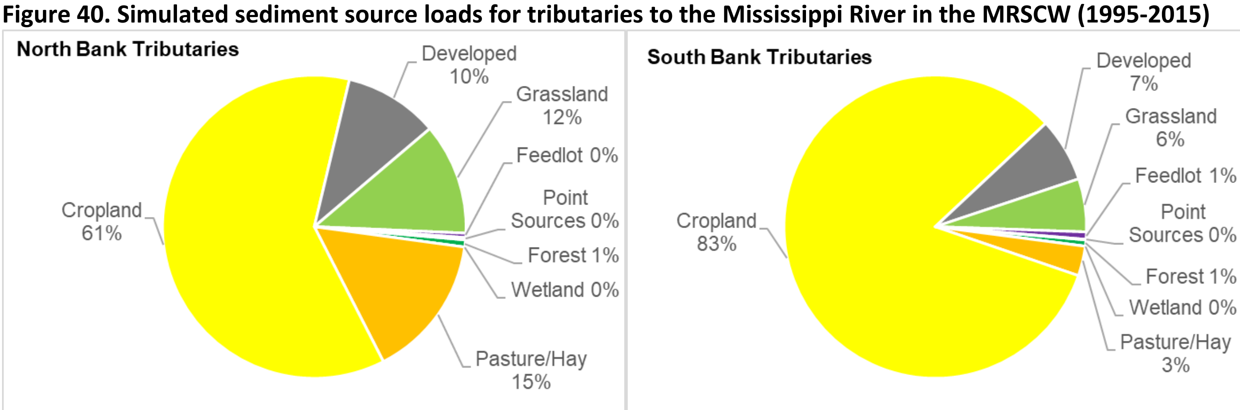


Figure 40. Simulated sediment source loads for tributaries to the Mississippi River in the MRSCW (1995-2015)



Note: Percentages were rounded to the nearest integer. 0% is a nonzero number that less than 0.5%.

2.4.1.1 MRSCW Source Loads – Mississippi River vs. Tributaries

Section 2.3.1 presented relative source loads from the tributaries discharging to the north (left) and south (right) banks of the Mississippi River. Note that source loads were previously presented above and are presented herein; source loads are the loads discharges to water bodies. Source loads do not account for in-stream processes. Loads will decrease as they flow downstream through the stream-network.

Point sources that directly discharge to the Mississippi River were the largest sources of TP (84%) and TN (76%) loading in the areas draining directly to the Mississippi River in the MRSCW (Figure 41). The second largest source in the direct drainages to the Mississippi River, for both TP (12%) and TN (8%) was cropland. Cropland (56%) and developed land (31%) are the largest sources of TSS in the direct drainages to the Mississippi River (Figure 42).

Figure 41. TP (left) and TN (right) load from direct drainages and discharges to the Mississippi River

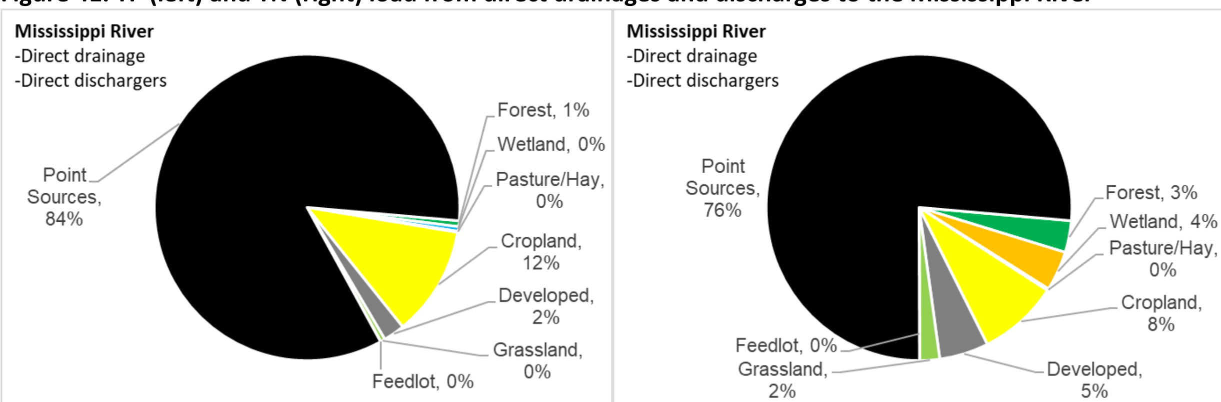
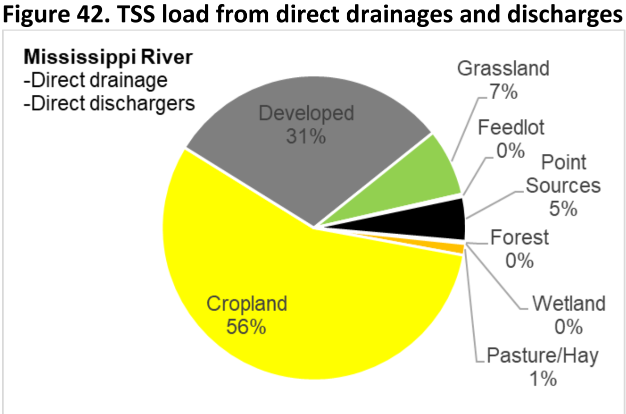


Figure 42. TSS load from direct drainages and discharges to the Mississippi River



Side-by-side comparison of the three sets of pie-charts (TP, TN, and TSS) for source loading from Mississippi River direct drainage, north bank tributaries, and south bank tributaries can be misleading because the pie-charts are at relative scales. Cropland and point sources contribute the most and second-most (respectively) TP loading in the watershed (Figure 43), with cropland dominant in the tributaries and point sources dominant in the direct drainages to the Mississippi River. Similarly, point sources and cropland contribute the most and second-most (respectively) TN loading in the watershed (Figure 44), with cropland followed by wetlands dominant in the tributaries and point sources dominant in the direct drainages to the Mississippi River. With TSS, cropland contributed the most loading and urban developed land contributed the second-most TSS loading (Figure 45).

Figure 43. TP source loading in the MRSCW

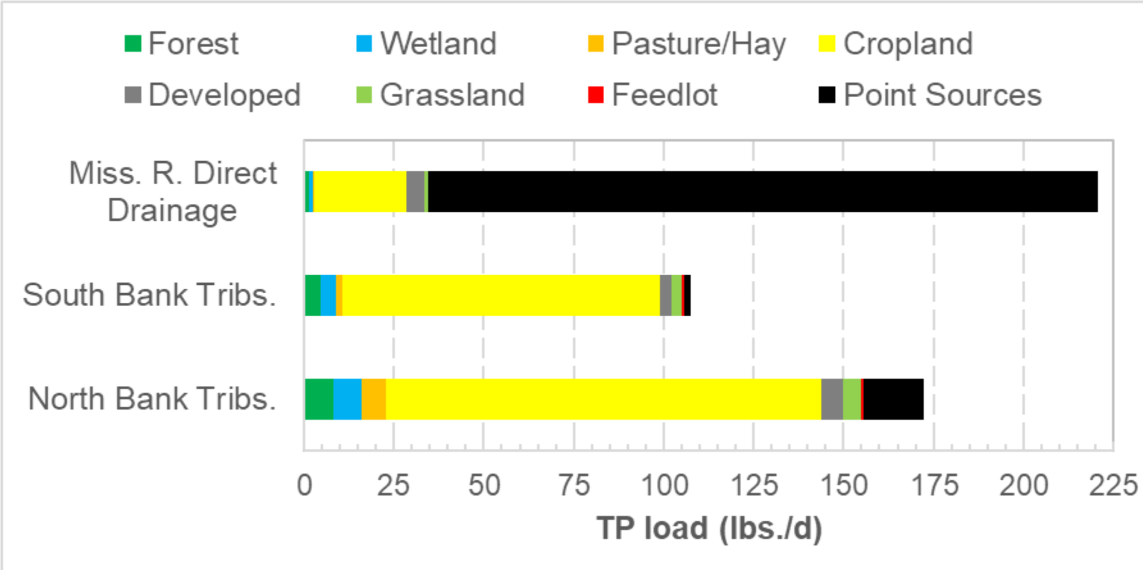


Figure 44. TN source loading in the MRSCW

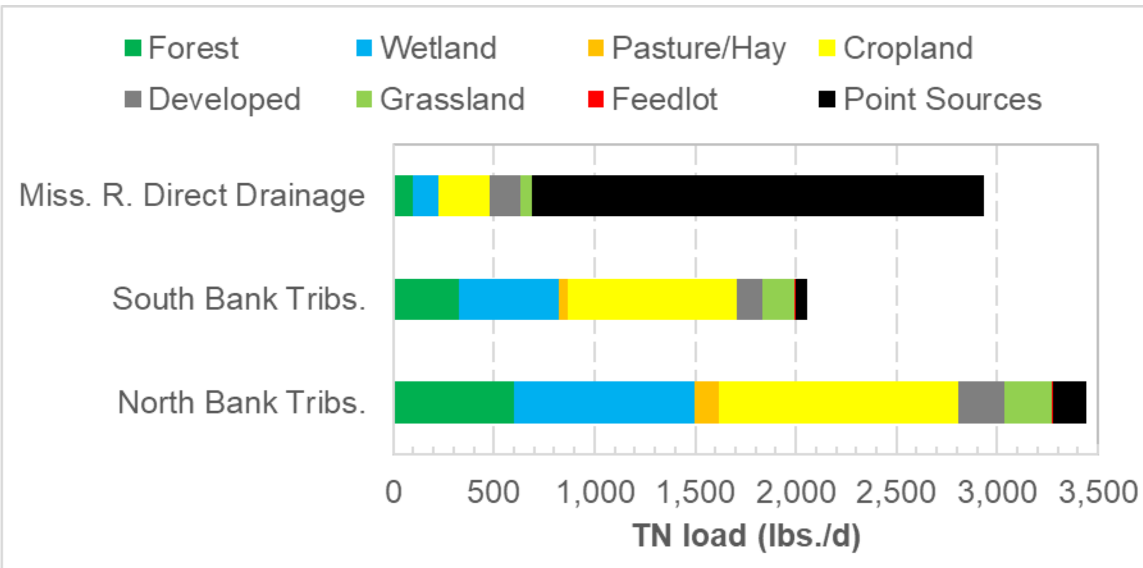
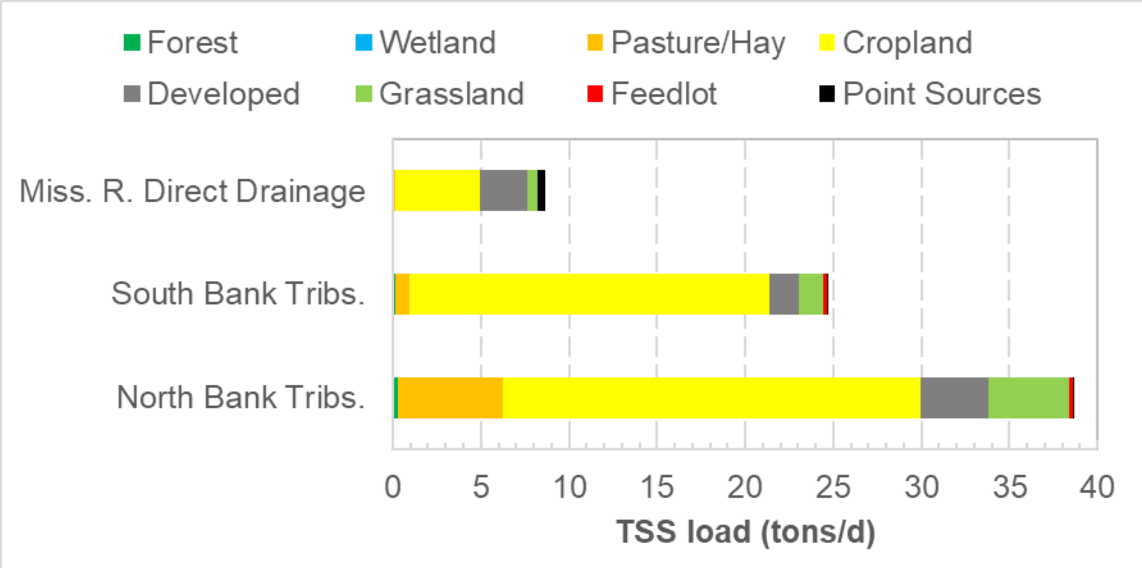


Figure 45. TSS source loading in the MRSCW



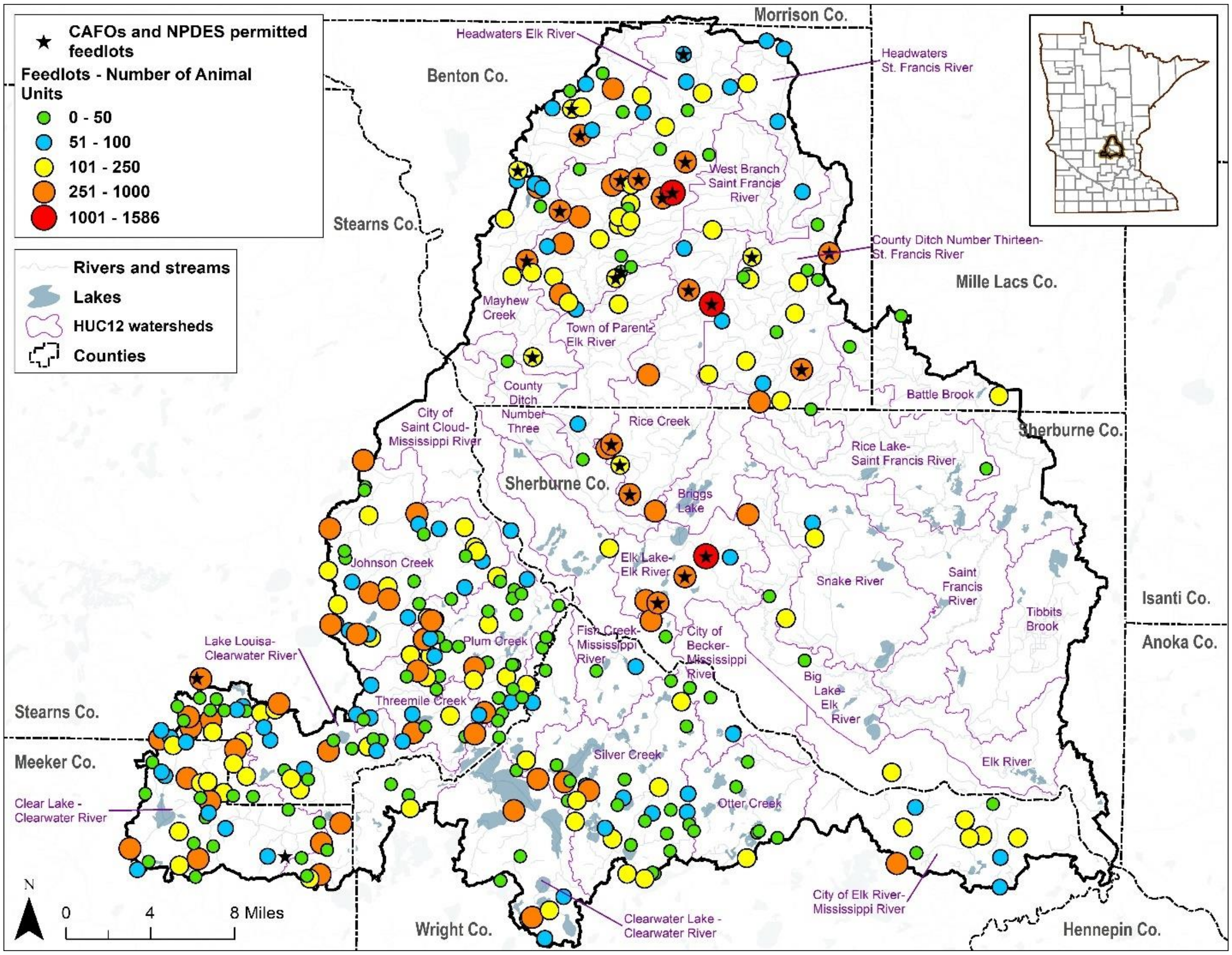
2.4.2 Concentrated Animal Feeding Operations and Feedlots

Concentrated animal feeding operation (CAFO) is a federal definition that implies not only a certain number of animals but also specific animal types. The MPCA uses the federal definition of a CAFO in its permit requirements of animal feedlots along with the state definition of an animal unit (AU). In Minnesota, CAFOs and non-CAFOs that have 1,000 or more AUs must operate under a National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) permit.

Feedlots and manure storage areas can be a source of *E. coli* and nutrients due to runoff from the animal holding areas or the manure storage areas. The MRSCW TMDL Report (MPCA 2024a) identifies feedlots and waste from livestock as one of the significant sources of *E. coli* to the impaired streams in the MRSCW. Animal waste from CAFOs can be delivered to surface waters from failure of manure containment or runoff from the CAFO itself. See the corresponding MRSCW TMDL Report for specific information on existing CAFO's and NPDES/SDS permits.

Waste from livestock is a source of concern when feedlots are numerous and/or are located close to surface water bodies. In addition, improperly treated or improperly applied manure that is applied to agricultural fields can be a source of *E. coli* to surface water. All animal operations, registered and nonregistered, have a potential to contribute *E. coli*. Likelihood of this contribution is based on management of animal areas and the associated manure. The MPCA Data Desk provided the feedlot locations and numbers and types of animals in registered feedlots (Figure 46). For ease of comparison, animal counts were converted into animal units. Per Minn. R. ch. 7020, "animal unit" means a unit of measure used to compare differences in the production of animal manure that employs as a standard the amount of manure produced on a regular basis by a slaughter steer or heifer for an animal feedlot or manure storage area, calculated by multiplying the number of animals of each type by the respective multiplication factor and summing the resulting values for the total number of animal units.

Figure 46. MRSCW permitted feedlots and associated Animal Units



2.4.3 Other *E. coli* sources

Potential sources of *E. coli* in the MRSCW include stormwater, wastewater, animal feeding operations (AFOs), wildlife, pets, septic systems and other human sources, along with natural growth. The pollutant load capacity of the MRSCW *E. coli*-impaired streams was determined using load duration curves (LDCs) in the associated MRSC TMDL (MPCA 2024a). See section 3.6 Pollution Source Summary for a detailed description on *E. coli* and other pollutant sources impacting and/or potentially impacting the MRSCW.

2.4.4 NPDES/SDS Permitted Sources

The number of municipal, industrial and agricultural entities that are permitted under the NPDES/SDS within the MRSCW are shown in Table 11 at the HUC-12 watershed level. The name and location of these permitted facilities can be found in Appendix D. Additional information on these or other permitted sources within or outside the MRSCW can be found at "What's in My Neighborhood" (WIMN). Due to the large number and the temporary nature of construction stormwater permits, these permits are not included in the table below. The number of acres covered under construction stormwater permits within the MRSCW declined over the period of 2018 through 2022 (Figure 47) but remains robust overall when compared to other major watersheds statewide.

Table 11. Point sources (NPDES/SDS permitted) in the MRSCW

HUC-12 Subwatershed (HUC 07010203)	CAFO Feedlot (MNG440000)	Industrial Stormwater (MNR050000)	Industrial Stormwater, No Discharge (MNRNE0000)	Industrial Wastewater (MN0000000)	Industrial Wastewater, Multiple general permits	Municipal Stormwater (MS400000)	Municipal Wastewater (MN0000000)
Johnson Creek (01 01)	--	3	3	--	1 [a]	--	1
Plum Creek (01 02)	--	--	--	--	--	--	1
City of Saint Cloud-Mississippi River (01 03)	--	14	11	1	1 [b]	7	--
Upper Clearwater River (02 01)	1	--	--	--	--	--	1
Middle Clearwater River (02 02)	--	--	3	--	--	--	2
Clearwater Lake (02 04)	--	2	1	--	--	--	1
Lower Clearwater River (02 05)	--	2	--	--	--	--	1
Headwaters Elk River (03 01)	1	--	--	--	2 [b]	1	1
Mayhew Creek (03 02)	--	--	1	--	1 [b]	--	7
County Ditch No 3 (03 03)	--	11	7	--	1 [a]	9	--
Town of Parent-Elk River (03 04)	--	--	--	--	--	2	--
Headwaters Saint Francis River (04 01)	--	--	1	--	1 [b]	--	--
Battle Brook (04 05)	--	--	--	--	1 [c]	--	3
Saint Francis River (04 06)	--	--	--	--	--	1	2
Rice Creek (05 01)	1	--	3	--	--	1	2
Elk Lake-Elk River (05 03)	1	--	1	--	--	--	--
Snake River (05 04)	--	--	--	--	--	1	3
Big Lake-Elk River (05 05)	--	--	1	--	--	2	1
Tibbets Brook (05 06)	--	1	--	--	--	4	7
Elk River (05 07)	--	2	4	1	1 [a], 1[d]	5	2
Fish Creek-Mississippi River (06 01)	--	2	1	--	1 [b]	3	1
Silver Creek (06 02)	--	--	--	--	1 [b]	--	--
City of Becker-Mississippi River (06 03)	--	5	1	--	--	--	2
Otter Creek (06 04)	--	2	--	--	--	--	--
City of Elk River-Mississippi River (06 05)	--	14	20	--	--	6	6

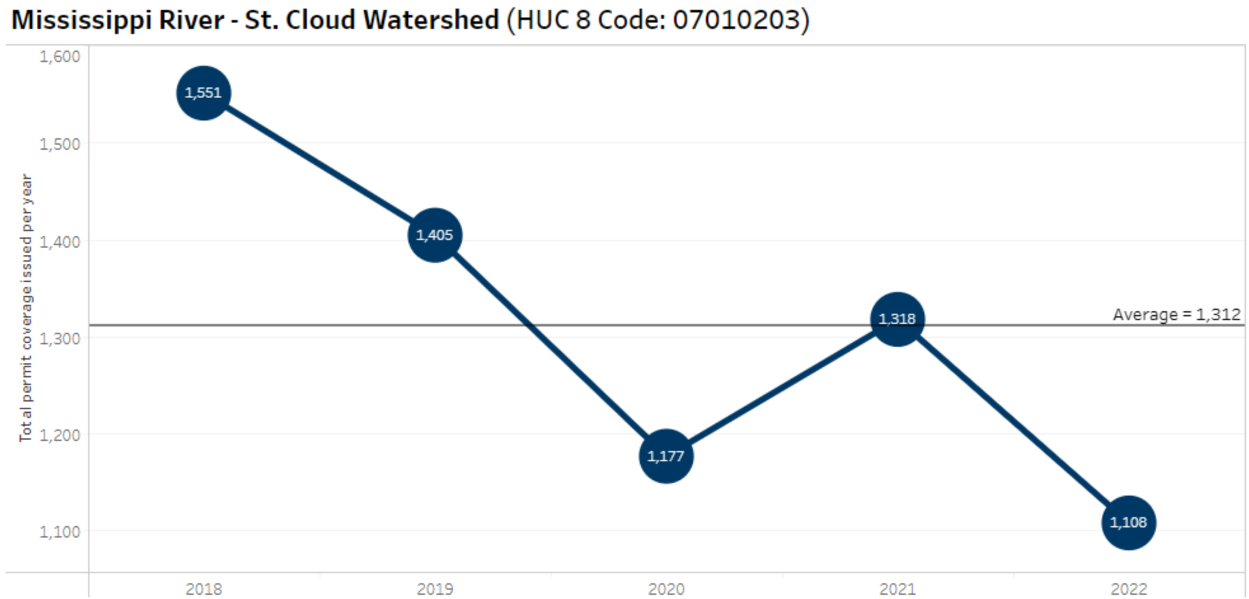
a. Industrial Wastewater, Water Treatment Plant Subsurface Disposal (MNG820000)

b. Industrial Wastewater, Nonmetallic Mining / Associated Activities (MNG490000)

c. Industrial Wastewater, Industrial By-Product (MNG960000)

d. Industrial Wastewater, Non-Contact Cooling Water (MNG250000)

Figure 47. MRSCW acreage covered under Construction Stormwater permits (2018-2022)



Percent of watershed under permit coverage for the selected time period

Avg. annual total permit issuance for watershed (acres)	Total watershed acreage	
1,312	717,376	0.18%

2.4.5 Pollutant loading from wastewater treatment facilities

The MPCA tracks estimated and observed pollutant load calculations from wastewater treatment facilities (WWTF) over time through the Healthier watersheds: Tracking the actions taken webpage. Figure 48 through Figure 50 provide the pollutant loading values for WWTF within the MRSCW from 2000 to 2019 according to the Healthier Watersheds webpage for phosphorus, and TSS. Nitrogen loading is not recorded on the Healthier Watersheds tracking system. Pollutant loading values shown in the below figures are a mix of observed data and values estimated based on previously reported values. The loads are considered accurate but are based on calculations and not raw data. Loads are derived by multiplying the monthly average concentration and monthly total flow. These calculated loads are used for research and planning purposes and may vary slightly from discharge monitoring reports due to calculation methods. Note, in 2005, new rules expanded monitoring requirements for facilities and is therefore used as a baseline for loading rates. Since 2005, TP loading from WWTF has decreased 82%, TSS has decreased 60%, and oxygen demand (CBOD) has decreased 9% in the MRCSW. Figure 48 illustrates the phosphorus reduction progress by the various wastewater treatment plants located within the MRSCW. Overall, significant improvements in facility treatment and subsequent loading into the MRSCW have occurred since 2000.

Figure 48. Phosphorus loading (kilograms) from WWTF in the MRSCW 2000 to 2021 (MPCA 2023c)

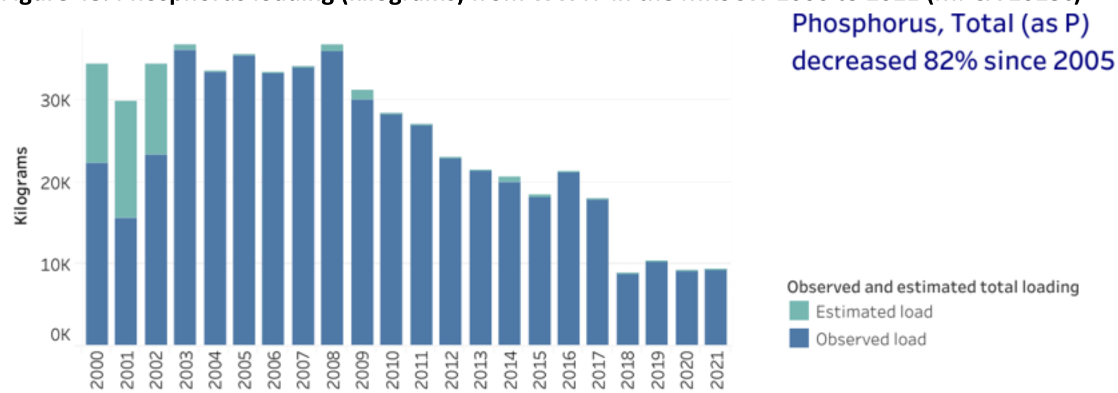


Figure 49. TSS loading (kilograms) from WWTF in the MRSCW 2000 to 2021 (MPCA 2023c)

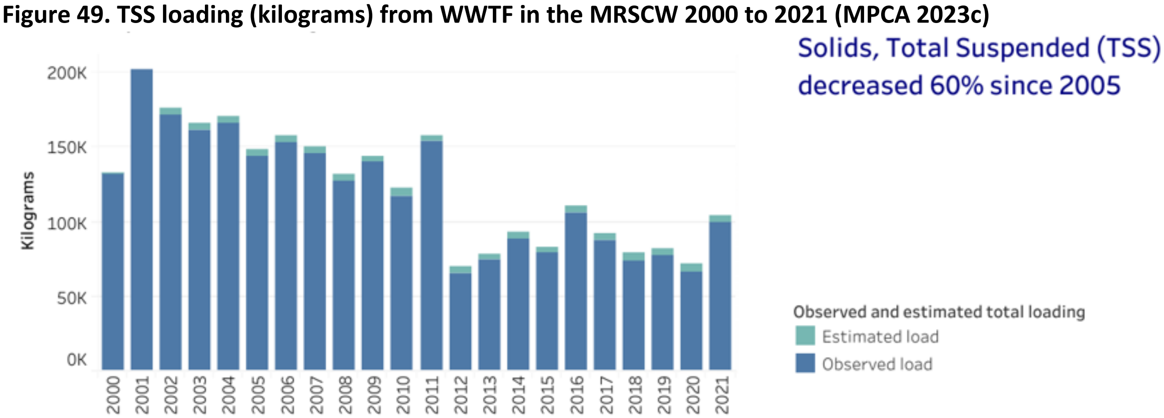
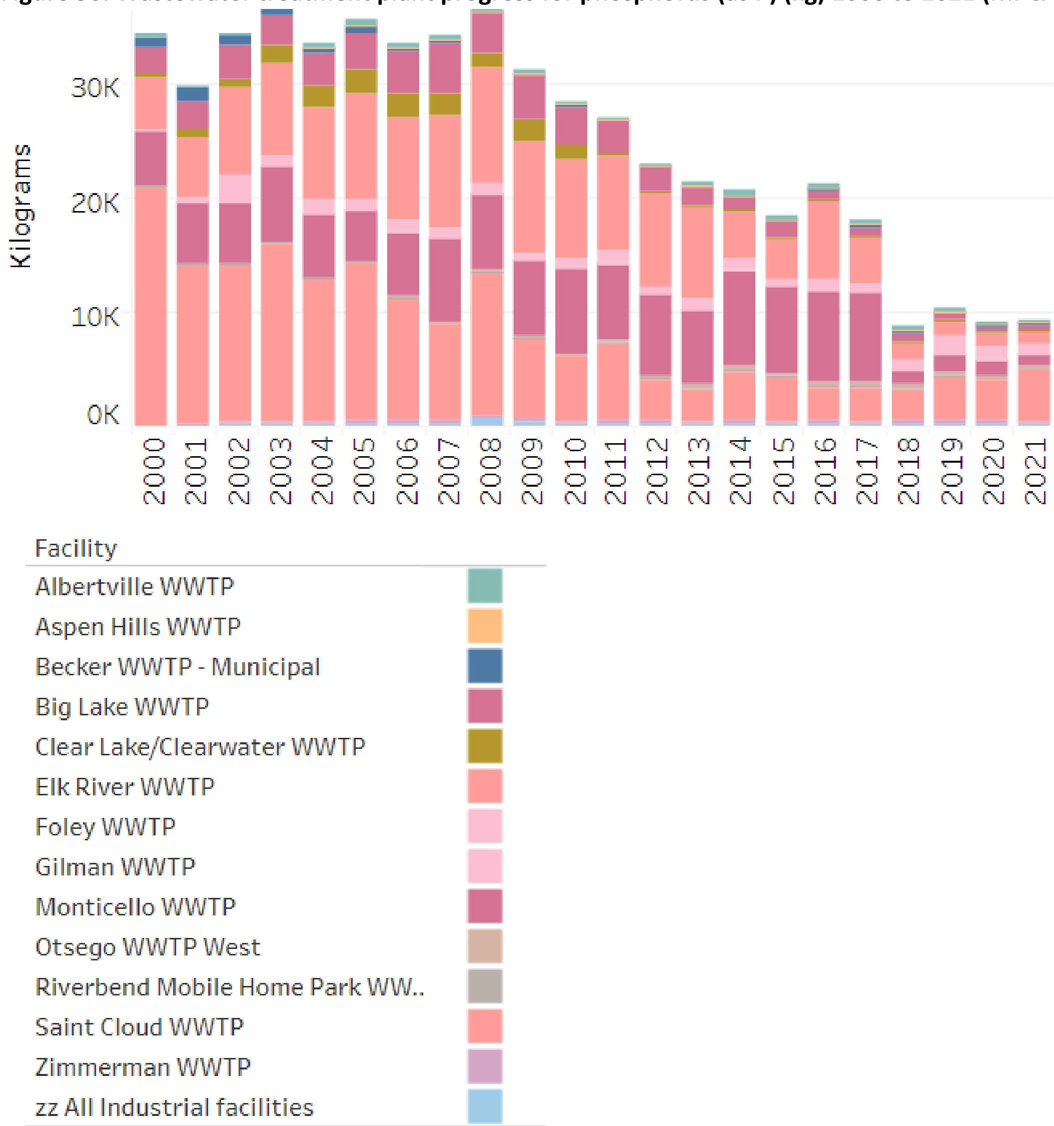


Figure 50. Wastewater treatment plant progress for phosphorus (as P) (kg) 2000 to 2021 (MPCA 2023c)



2.5 TMDL summary

The Clean Water Act and EPA regulations require that TMDLs be developed for waters that do not support their designated uses (fishable, swimmable, consumable). A TMDL is a study to determine what is needed to restore and maintain water quality standards in waters that are not currently meeting them. Water bodies with impairments determined to be caused from a pollutant are addressed with the development of a TMDL; water bodies determined to be impaired from a nonpollutant stressor do not require the development of a TMDL. TMDLs within the MRSCW include:

- Mississippi River - St. Cloud Watershed TMDL (MPCA 2024a). This TMDL study concurrently completed as a part of this WRAPS project addresses 10 stream impairments for *E. coli*, 6 lake impairments for nutrients, and 1 stream impairment each for fish and benthic macroinvertebrate bioassessments within the MRSCW.

- Mississippi River (St. Cloud) Watershed TMDL, 2015. During Cycle 1 of the IWM Cycle, this TMDL study addressed 2 low DO, 1 aquatic macroinvertebrate, 1 turbidity, and 13 lake eutrophication impairments in the MRSCW.
- Upper Mississippi River Watershed TMDL Study and Protection Plan, 2014. The Upper Mississippi River Bacteria TMDL describes the reduction in pollutant loading for 22 stream reaches that have impaired AQR due to *E. coli*, 7 of which are located within the MRSCW.
- Elk River Watershed Association TMDL Report, 2012. This TMDL study addressed four 303d impairments on three water bodies including: bacteria and turbidity impairments on the Elk River between Big Elk Lake and the St. Francis River, and nutrient impairments in Mayhew Lake and Big Elk Lake.
- Clearwater River Watershed District-Five Lakes Nutrient TMDL for Lake Caroline, Lake Augusta, Albion Lake, Henshaw Lake, Swartout Lake, 2010. This TMDL Study prepared by Wenck Associates, Inc. (Wenck) for the CRWD, addresses nutrient impairments for five lakes in the CRWD: Lake Caroline (86-0281); Lake Augusta (86-0284); Albion Lake (86- 0212); Swartout Lake (86-0208); and Henshaw Lake (86-0213).
- Upper Mississippi Clearwater River: County Ditch #44 to Lake Betsy Dissolved Oxygen TMDL, 2010. Through this study, the critical reach, critical flow regime, and critical time period for the DO impairment were each identified.
- Upper Watershed TMDL Studies for Clearwater River Watershed District, 2009. The Clearwater River and the Clearwater River Chain of Lakes are the predominant water features in the district. The six lakes and one 10-mile stream reach addressed in this report comprise the upper portion of the CRWD, Clearwater River and the Clearwater River Chain of Lakes.

The above mentioned completed TMDL reports and numerous other related watershed reports in the MRSCW can also be accessed on the MPCA's MRSCW webpage Mississippi River - St. Cloud | Minnesota Pollution Control Agency (state.mn.us).

In addition, several water bodies within the MRSCW have aquatic consumption impairments due to high levels of mercury in fish tissue. Because the focus of the watershed condition assessment is the AQL, AQR, and limited resource value designated uses, the aquatic consumption impairments are not addressed here. For more information on mercury impairments, see the Minnesota statewide mercury TMDL (MPCA 2023g).

3. Goals and recommendations

The second IWM cycle of the MRSCW provided important information on the overall health of the surface water resources within the MRSCW. Utilizing the WRAPS update and the companion TMDL information to support the ongoing MRSCW 1W1P process (One Watershed, One Plan | MN Board of Water, Soil Resources) and help guide the subsequent implementation strategies is highly recommended. The following information in this section highlights resource priorities to consider while moving forward in the essential effort to restore and protect the water resources within the MRSCW.

3.1 Existing impaired and vulnerable waters

3.1.1 Lakes

At the time of the development of this WRAPS Update, 32 lakes within the MRSCW were listed for being impaired by nutrients on the 2024 Inventory of Impaired Waters tab of Minnesota's 2024 Impaired Waters List. Of this total, 23 Lakes had a completed TMDL with 9 awaiting TMDL development. The concurrent MRSC TMDL Report (MPCA 2024a) included TMDLs addressing the excess nutrients for six of these lakes. Using the MRSCW TMDL as a tool in helping to address the overall nutrient loading of these lakes is recommended. These and the other MRSCW nutrient impaired lakes, which have a previously completed TMDL and remain the Impaired Waters List, should be considered high priority targets for future water planning implementation planning efforts (e.g., 1W1P). The MRSCW has a good history of success in dealing with such issues as is evident by the four nutrient impaired lakes which were successfully delisted from the Impaired Waters List in 2022. Success stories such as these delistings provide excellent examples to the public and stakeholders, which in turn goes a long way in maintaining the significant positive water quality momentum in the MRSCW.

Fishing pier on Little Mary Lake (LML), Lake Maria State Park – Photo Credit DNR. LML impaired by nutrients

Currently, Lake Julia (Sherburne County) is situated as a lake that is "barely" impaired by nutrients. Achieving a nutrient delisting for Lake Julia, through continued restoration efforts going forward towards the Cycle 3 IWM (starting 2029), appears realistic and this water quality goal should continue to receive high priority consideration going forward in the local water planning process. Conversely, Albion Lake is the only lake within the MRSCW with a documented declining water clarity trend of the 34 lakes with sufficient data for trend analysis. Targeting restoration practices in the effort to reverse this trend should be considered a high priority.

There are seven lakes within the MRSCW that were determined by the DNR to be in nonsupport of AQL based on FIBI scores below the impairment threshold established for similar lakes, and four lakes were classified as vulnerable to future impairment based on FIBI near impairment threshold. Where possible, BMPs should be implemented to reduce excess nutrients into these lakes. In addition, physical habitat alterations are likely a main stressor affecting the fish communities in many of these lakes. Shoreline development on these lakes is high and has resulted in the loss of both riparian vegetation and native floating-leaf and emergent plant stands that serve as important habitat for fish and other organisms.

Restoration of developed shorelines with natural shoreline buffers should be prioritized when physical habitat alteration has been identified as a stressor to a biologically impaired or vulnerable lake. Shoreland owners can significantly improve shoreline habitat by choosing to reestablish or maintain native plants along their property. Natural shorelines provide overhead cover to fish and wildlife species, contribute important coarse woody habitat into the lake, and provide a buffer for nutrient runoff from lawns and impervious surfaces (DNR 2023d).

3.1.2 Streams

The MRSC TMDL (MPCA 2024) addresses 11 impaired stream segments within the MRSCW with TMDLs developed for *E. coli* (10) and for TSS (1). See the MRSC TMDL for specific information on the TMDLs and the accompanying load reduction strategies aimed at restoring these stream segments back to state standards.

Over the past 15+ years, some of the highest bacteria loading within Minnesota's UMRB has occurred through the tributaries within the MRSCW. Some of these bacteria impairments have been successfully addressed over the years, resulting in noteworthy success stories, while several others remain impaired or are threatened for impairment. Continued efforts working with landowners on the implementation of BMPs for riparian pastureland areas continues to be a priority in the MRSCW. However, in some cases the potential sources of bacteria impacting the water resource are not clearly evident. In these situations, more investigative work may be needed and/or the use of tools such as microbial source tracking to help determine the primary bacteria source(s) types.

Battle Brook (Sherburne County). Impaired by *E. coli.* Photo Credit – Sherburne SWCD

The continued use of the MRSC TMDL project findings through the 1W1P process in the planning of strategies to address the numerous bacteria impaired and threatened waters within the MRSCW is recommended.

Altered hydrology and connectivity issues remain significant systemic stressors in the majority of the existing AQL impairments and vulnerable stream reaches within the MRSCW. In the MRSCW there are approximately 1,322 miles of streams of which around 557 miles (42%) have been altered to some extent (Esri. ArcGIS 2023). Addressing these issues, which in some cases dates to drainage activities in the late 1800's to the early 19th century, often presents complicated and potentially expensive obstacles. The MRSCW partner network continues to proactively explore ways to identify and restore hydrologically impacted systems. Addressing these systematic issues, to the extent possible going forward, within strategic local water planning processes (e.g., 1W1P) will be important efforts towards the restoration, protection, and enhancement of impacted surface water resources, while in turn increasing the overall resiliency of the MRSCW and its resources in withstanding the impacts from potential future extreme climatic impacts.

3.2 Protecting Water Quality

All waters in the MRSCW require protection in some capacity, including those listed as impaired and those with insufficient data. It is important to prioritize areas for protection, however, to better focus implementation of water planning efforts (e.g., 1W1P). For example, waters that are particularly threatened or vulnerable may be considered at risk for further degradation and impairment and prioritized for protection efforts. Alternatively, or in addition, unique and high value resources that exhibit the highest biological, cultural, and social significance in the region may also be prioritized for protection to ensure their continued high quality. This section provides an overview of information and strategies that can be used when considering protection during implementation efforts.

State identified Priority, Significant and Sensitive Waters

There are several lakes and streams within the MRSCW that have been identified as high priority waters based on their biological significance and their sensitivity to phosphorus and other contaminants (see Figure 51 and Figure 52) and corresponding tables in the Appendices G through I. Recognizing these important resource features and their current state designations can significantly help in the overall prioritization of the MRSCW surface water resources in the efforts to protect, enhance or restore their vital beneficial uses.

Figure 51. MRSCW Lakes of Biological and Phosphorus Sensitivity Significance

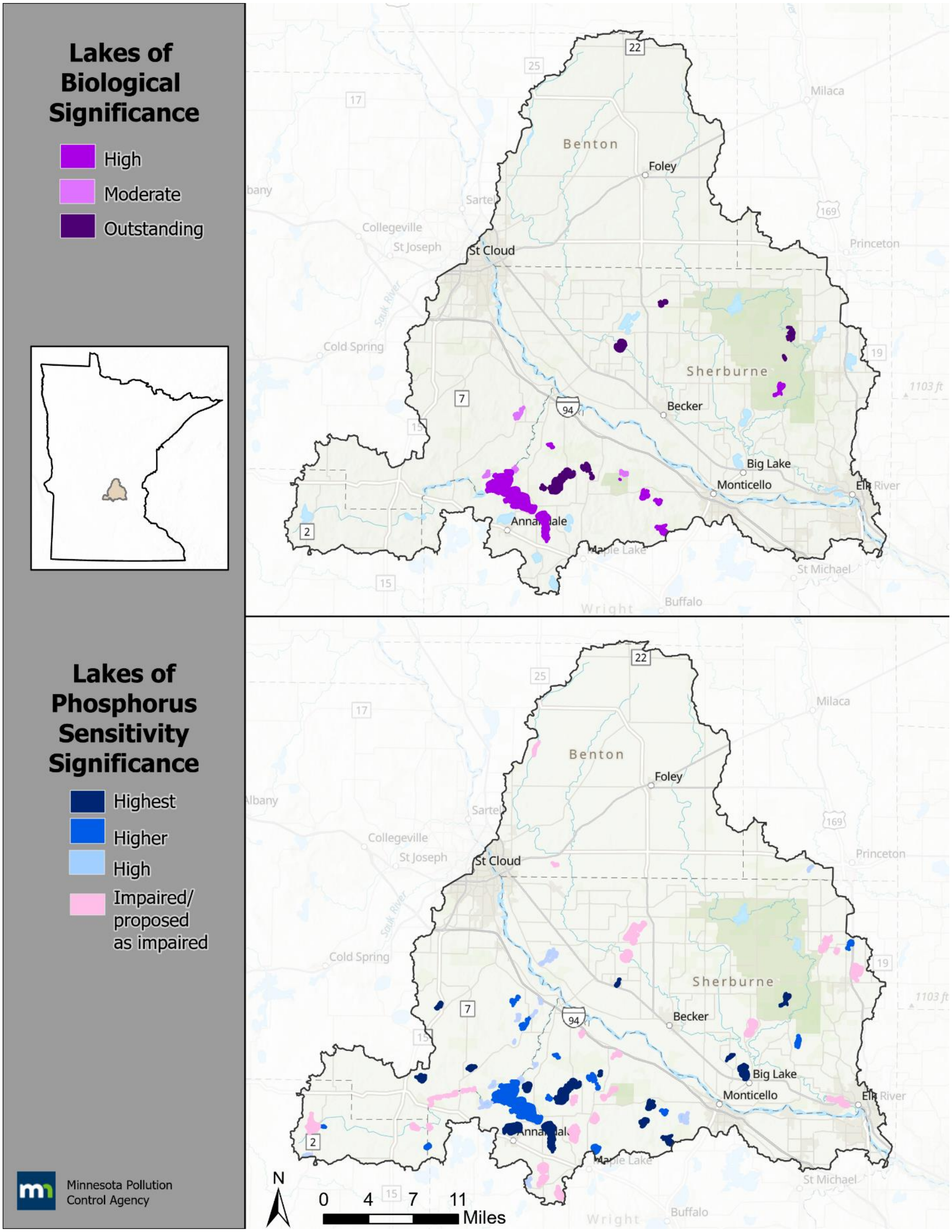
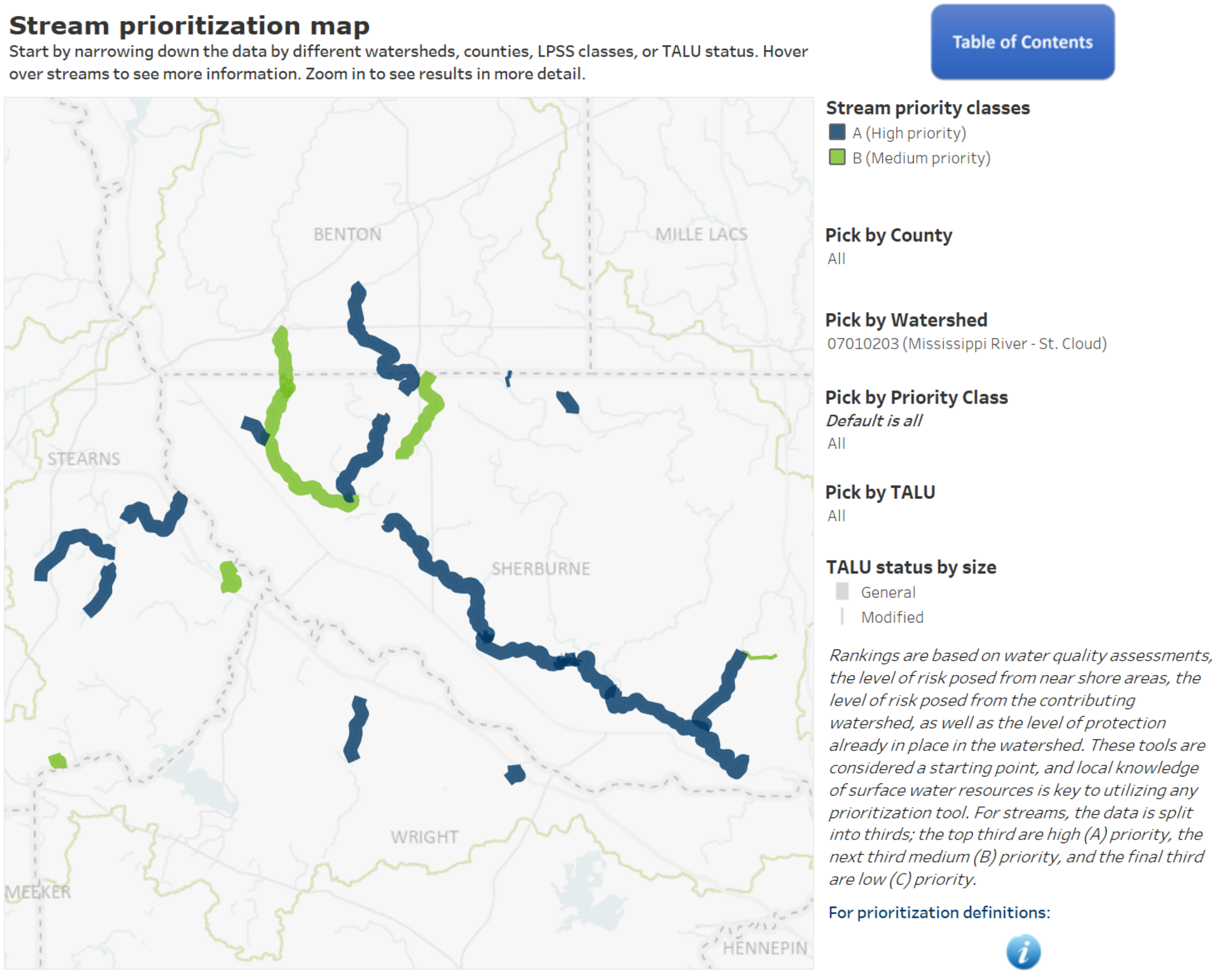


Figure 52. Stream prioritization based on state water quality assessments



MRSCW Lake Protection Report

It was decided by the MRSC WRAPS/TMDL local partner group and MPCA TMDL staff in 2022 to complete Lake Protection studies for three lakes within the MRSCW as a supplemental component of the overall MRSC WRAPS project. A lake protection study was subsequently developed for three high priority lakes in the MRSC: Big, Mitchell, and Sugar Lakes. Protection studies establish 1) water body condition targets for a water body that already meets water quality standards, and 2) load reduction goals (or other similar action items) to meet those targets. These condition targets and goals inform implementation efforts. Recent in-lake monitoring data (2012 through 2021) for all three lakes suggest they are currently meeting eutrophication standards established by the State of Minnesota for deep lakes in the North Central Hardwood Forest (NCHF) ecoregion. All three lakes are heavily used by local and regional residents for fishing, boating, swimming, and other recreational activities. For these reasons, local partners in the MRSCW have identified these lakes as high priorities for protection. The ultimate goal of this lake protection study is to maintain or improve the quality of the protection lakes. This study is intended to accompany and complement the MRSC WRAPS report and the MRSC TMDL (MPCA 2024a). For each of the three lakes, this report provides a summary of the lake and watershed conditions, current and historic water quality conditions, and a description of the fish community and stressors. This report concludes with the primary topics of concern for each lake, and provides target condition, goals, and management strategies that local partners should consider in improving and protecting lake water quality and fish habitat moving forward.

Utilizing this protection tool (MPCA 2024b) for these lakes in the 1W1P implementation planning process is recommended. See below for additional information on these lakes and other lakes noted by local watershed partners for similar protection considerations in the future.

- Big 71-0082-00. Fish bioassessments impairment (listed in 2022). Water chemistry data is very good to excellent.
- Mitchell 71-0081-00. Fish bioassessments impairment (listed in 2022). Connected to Big Lake.
- Sugar 86-0233-00. The FIBI is considered exceptional. One of the few Cisco and muskie lakes in the MRSCW. It is a unique high-quality lake situated at the southern Cisco range in Minnesota.
- Other Lakes noted by partners for Lake Protection Consideration and/or additional data needs in future include: Ann 71-0069-00, Beaver 73-0023-00, Crooked 73-0006-00, Long 73-0004-00, Warner 73-0011-00

Stormwater management

Effectively managing stormwater runoff has been and will continue to be a critical element in protecting the surface water quality of the MRSCW. Currently, 4 of the 10 fastest growing communities in Minnesota are either in or on the edge of the MRSCW (e.g., Otsego – in, Rogers, Dayton, Sartell – edge). It is anticipated that the overall intensity of the land use will continue to increase substantially in and around the MRSCW in the next decade. With this increase, comes the threat of increased stormwater runoff carrying pollutants such as sediment and phosphorus with the runoff water. As urbanization occurs and the percentage of impervious surface increases, an increasing amount of precipitation runs off the landscape and eventually is discharged to receiving waters. The continued effort towards strategic growth, where critical lands/areas are left undisturbed to the extent possible reducing stormwater runoff, will be an essential component in protecting the water resources of this watershed now and for future generations.

Intense rainfall carries a plume of sediment from runoff into a storm drain. MPCA photo.

Multiple Benefits

Considering multiple uses/benefits to the extent possible when evaluating and prioritizing strategies for water quality protection is an excellent strategy in making the most of implementation efforts. This approach takes into consideration that strategies to solve our clean water needs are not separate from other conservation and recreational needs. The MRSCW has many rare features and/or sites of biodiversity significance that will greatly benefit from the implementation of strategic conservation practices aimed at the restoration and protection of the water resources in the MRSCW. Important recreational examples include the Mississippi River designation within the MRSCW as a Wild and Scenic River and serving as a popular route for day-long canoe trips. This portion of the river also provides excellent recreational fishing opportunities and is recognized for its high-quality smallmouth bass fishing.

Chloride Management

There is no way to "repair" chloride-contaminated water bodies. Chloride is a permanent pollutant because it does not break down and cannot feasibly be removed from water. The MPCA's Statewide Chloride Management Plan looks at chloride pollution statewide, expanding the focus from the Twin Cities. Greater Minnesota is also seeing chloride impacts from water softening, fertilizer, and other sources (road salt is the main problem in urban areas). Preventing chloride pollution is the only way to deal with it. Staying ahead of this issue by working to protect lakes and streams while they are still in good condition is essential. The MPCA's Statewide chloride resources website serves as an excellent resource for partners working on this issue.

Climate Adaption

Developing and implementing strategies, initiatives and measures to help human and natural systems cope with and become more resilient to climate change impacts is an important consideration in long-term water resource/environmental planning. Climate change has the potential to affect ecosystems, infrastructure, and sectors of our economy. The impacts on these systems will depend on their sensitivity to climate change and their ability to adapt. The goal of adaptation is to increase natural and societal resilience to climate change. See Climate adaptation resources | Minnesota Pollution Control Agency (state.mn.us) for additional information.

Flash Flooding occurs after a severe storm moves through the St. Cloud area. Photo courtesy of WJON.

Celebrate Success Stories

Continuing to pursue, recognize and promote water quality success stories within the MRSCW promotes further success. Within the last decade, the MRSCW has seen several successfully restored streams and lakes. Two examples of this include the nutrient delisting of Lake George in the city of St. Cloud and the bacteria delisting of Plum Creek in Stearns County. One common theme that ties all these successes together and helps promote success going forward is that through partnerships, strategic planning and action, the state and its partners supported approach to restoring and protecting water quality is working. The 2022 assessment cycle in the MRSCW brought three chemistry delistings with documented improvements in water quality. See MRSCW assessment and trends update for additional information.

3.2.1 Protecting recreational waters during winter use

In the land of 10,000 plus lakes and around 92,000 miles of streams there are plenty of opportunities to enjoy time on the water recreating taking advantage of these wonderful resources. One of the main recreational focus areas in Minnesota is sport fishing, where over 1,000,000 anglers purchase various fishing licenses each year generating an annual economic impact to the state of over 4 billion dollars (Outdoor News 2023).

In Minnesota, fishing is a year-round opportunity that does not end in the winter months. In fact, one of the major sport fishing industry growth areas is in the winter, angling through one of the many frozen water resources (primarily lakes) in the state. In some cases, the winter season is participated more intensely by anglers and generates more economic impact than in summer. One of the main reasons for the increase in winter angling is the many advancements in technology and equipment, making this sport a more comfortable, productive, and enjoyable recreational option than it once was in the "good old days" of using more primitive gear.

One such technology advancement has occurred in the last 20 or so years with the invention of the modern day "wheelhouse" shelter, which provides many of the comforts of home to the angler, which in turn allows for longer stays (including overnight – multiple days) on the ice. While this has been a significant plus for the overall ice fishing industry in the state, there have been numerous occurrences of misuse of Minnesota's water resources as it pertains to litter and discharging wastewater on the ice as a result. While wheelhouse use is in the forefront, this conscious effort to prevent waste on the ice applies to all anglers using Minnesota's resources in the winter and throughout the year. Recently a campaign has been developed to get this message across - Keep it Clean MN – Be Nice to Our Ice with new state legislation passed Chapter 60 - MN Laws to help protect our water resources in this regard.

Within the MRSCW, several popular ice fishing destinations exist and provide quality winter experiences for thousands of anglers annually. Proactively communicating the message of "Keep It Clean MN" is recommended where necessary to protect our lakes and streams, while supporting highly important tradition of ice fishing in Minnesota.

3.3 Drinking water protection and priority

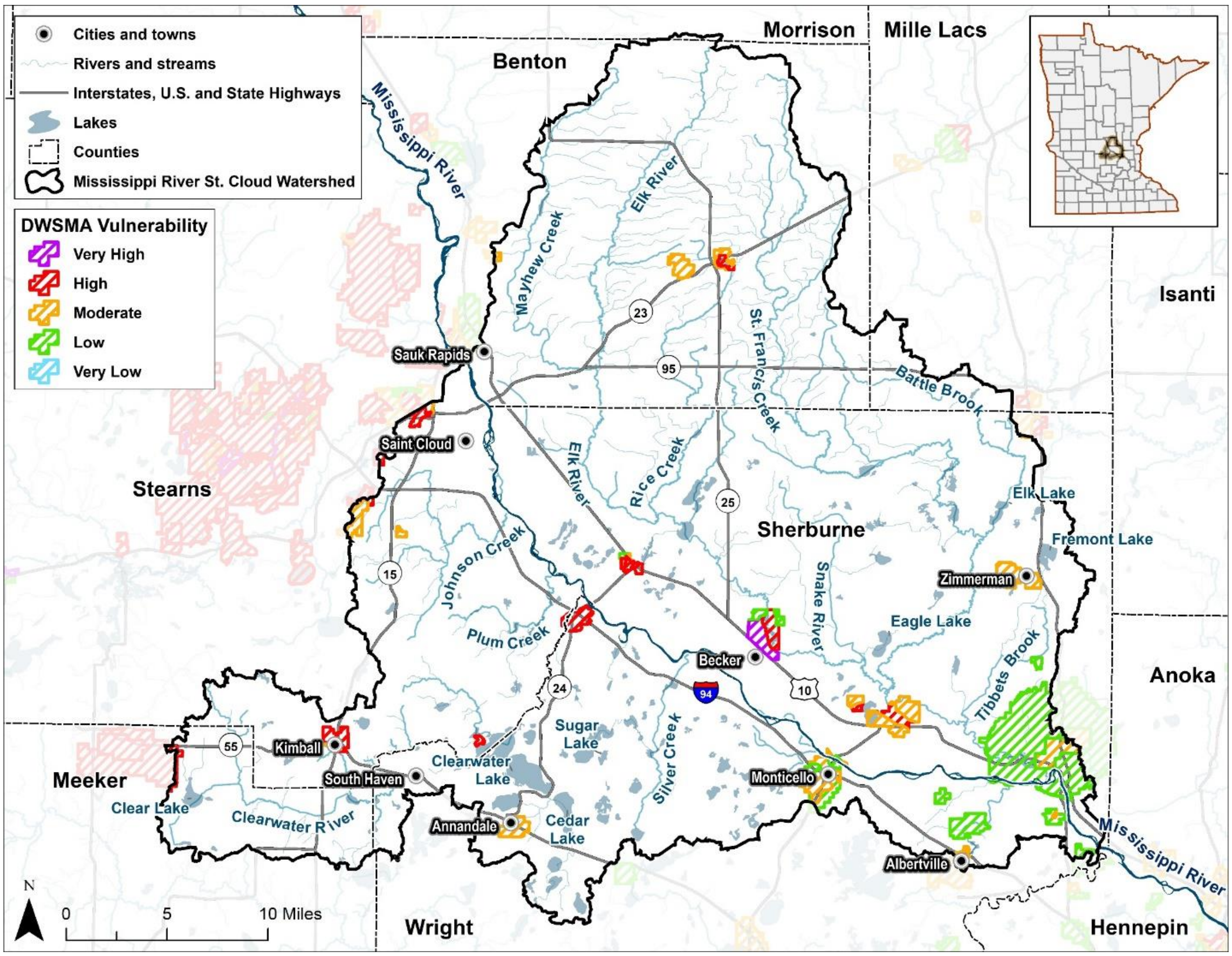
The city of St. Cloud is the most upstream city in the United States to obtain its drinking water supply from the Mississippi River. The Mississippi River serves as the drinking water supply for the St. Cloud Water Treatment Facility and the Minneapolis Water Treatment and Distribution Services. Additionally, the Mississippi River is also one of the main water supplies for the St. Paul Regional Water Services. The approximate population being served by these water facilities as of 2023 is St. Cloud (67,344), Minneapolis (425,300) and St. Paul (397,797) for a total of 890,441 users.

The restoration and protection of the Mississippi River for a drinking water source is crucial in maintaining public health and safety and for keeping the cost of drinking water treatment low. The drinking water authorities in St. Cloud, Minneapolis, and St. Paul work collaboratively to develop and implement three surface water source protection plans.

Priority areas in source water protection plans are delineated based on time of travel for a potential contaminant to reach the intake point and help guide management decisions based on the calculated potential risk to the drinking water source (acute or chronic). The entire MRSCW is a drinking water supply management area (DWSMA) for the cities of Minneapolis and St. Paul. Both cities source water protection plans identify the MRSCW as a "Priority Area B" (Minneapolis Water Works 2005, 2009; Saint Paul Regional Water Services 2005, 2008). The DWSMA for the city of St. Cloud is immediately upstream of the MRSCW (City of St. Cloud Public Utilities 2005, 2007).

The Minnesota Department of Health (MDH) has developed a ranking system for groundwater sources that supply drinking water to determine vulnerability. The MDH defines DWSMA vulnerability as an assessment of the likelihood for potential contaminant sources to contaminate a public water supply well based on the aquifer's inherent geologic sensitivity and the chemical and isotopic composition of the groundwater. DWSMA vulnerability in the MRSCW is presented in Figure 53.

Figure 53. DWSMA vulnerability in the MRSCW



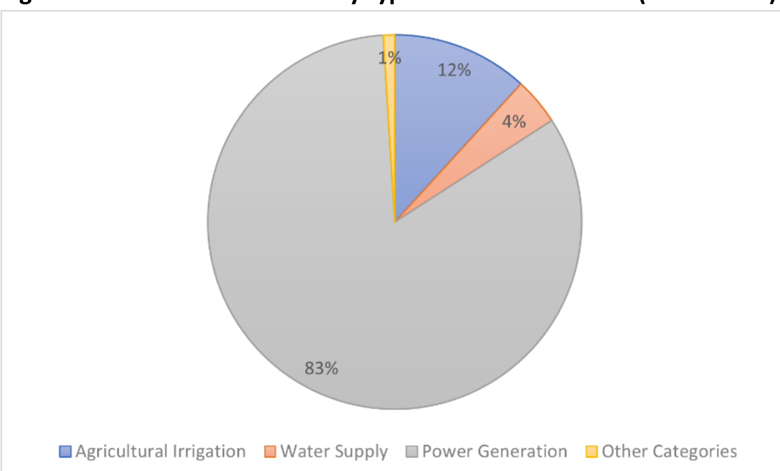
Groundwater protection considerations

Groundwater protection should also be considered when determining protection strategies in the MRSCW as there is a strong connection between surface and groundwater sources in this watershed. These considerations will be further expanded upon in other/forthcoming planning efforts (e.g., 1W1P, Groundwater Restoration and Planning Strategy).

High-capacity water withdrawals

The DNR permits all high-capacity water withdrawals in the state where the pumped volume exceeds 10,000 gallons per day or one million gallons per year. Permit holders are required to track water use and report back to the DNR annually. According to the 2021 DNR permitting and reporting systems (MPARS), the vast majority of water withdrawals in the MRSCW are used for power generation, at 83.1% (MPARS 2022). Agricultural irrigation is the second highest use of high-capacity water withdrawal at 11.8% and water supply at 4.1% (Figure 54). Additional categories include noncrop irrigation, industrial processing, water level maintenance, and special categories (livestock watering and dust control). Withdrawals in the watershed are a mix of ground and surface water withdrawals as shown in Figure 54 andFigure 55; with surface water accounting for 85% and groundwater accounting for 15% of all permitted high-capacity withdrawals. However, groundwater withdrawals have exhibited a significant increasing trend ($p<0.001$) since 1988 (Figure 56). In addition to an increase in overall groundwater withdrawals, the DNR also reports an increase in agricultural irrigation, noncrop irrigation, water supply, industrial processing, and special categories over time. For more information on the water permitting and reporting system (MPARS) see: https://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html.

Figure 54. Water withdrawals by type within the MRSCW (DNR 2023a)



For detailed information on groundwater withdrawals within the MRSCW, please see MDH's Mississippi River St. Cloud Groundwater Restoration and Protection Strategies Report, which is currently in draft form. Once this report is complete it will be posted to the following MDH website: Groundwater Restoration and Protection Strategies (GRAPS) Clean Water Fund - MN Dept. of Health (state.mn.us)

Figure 55. Active status permitted high-capacity withdrawals in 2021 (DNR 2023a)

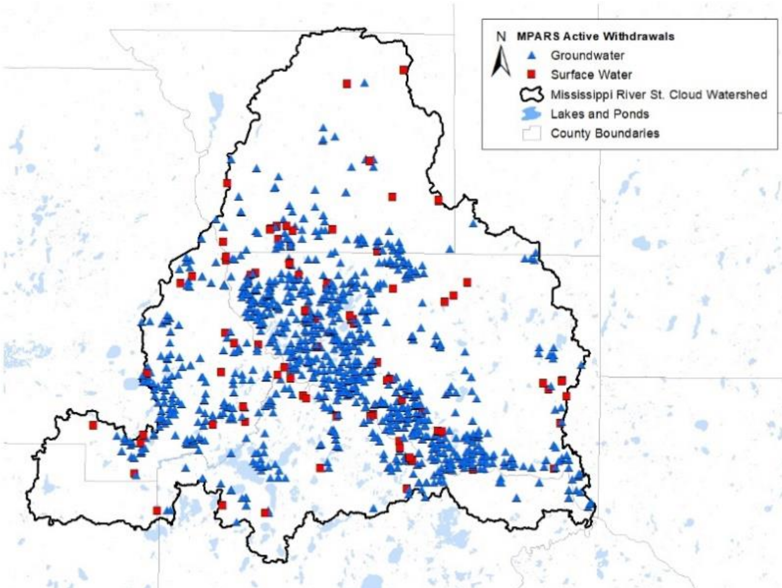
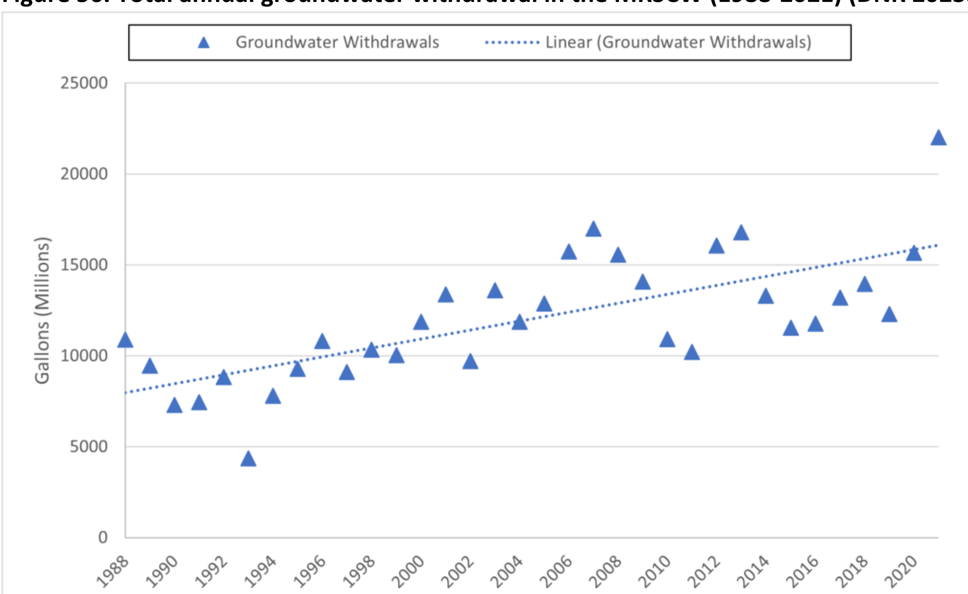


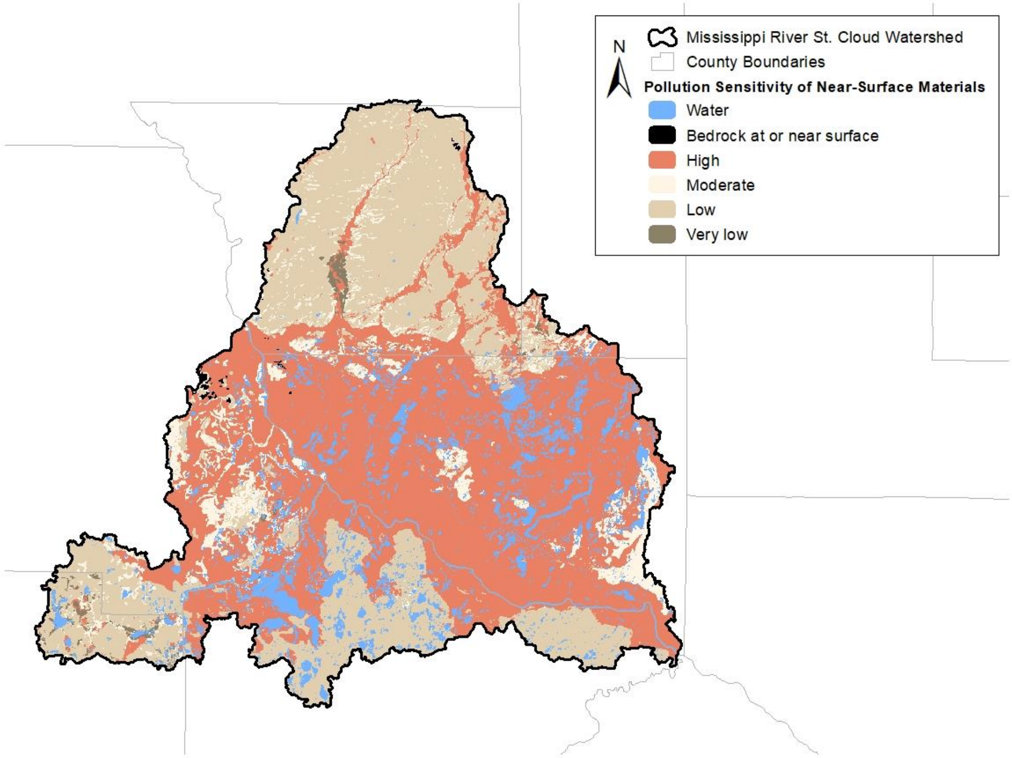
Figure 56. Total annual groundwater withdrawal in the MRSCW (1988-2021) (DNR 2023a)



Groundwater pollution sensitivity

The DNR completed a statewide evaluation of pollution sensitivity of near-surface materials. Results of this evaluation can be used to estimate pollution vulnerability of groundwater within 10 feet of the land surface. Estimates of the report determined that the MRSCW has primarily high to moderate groundwater pollution sensitivity overall, most likely due to the presence of sand and gravel quaternary geology (Figure 57). A clear overlap exists between areas of high groundwater pollution sensitivity and the presence of high-capacity wells provided in Figure 57.

Figure 57. Pollution sensitivity of near surface materials. Image from DNR Watershed Health Assessment Framework, 2017. (DNR 2023f)

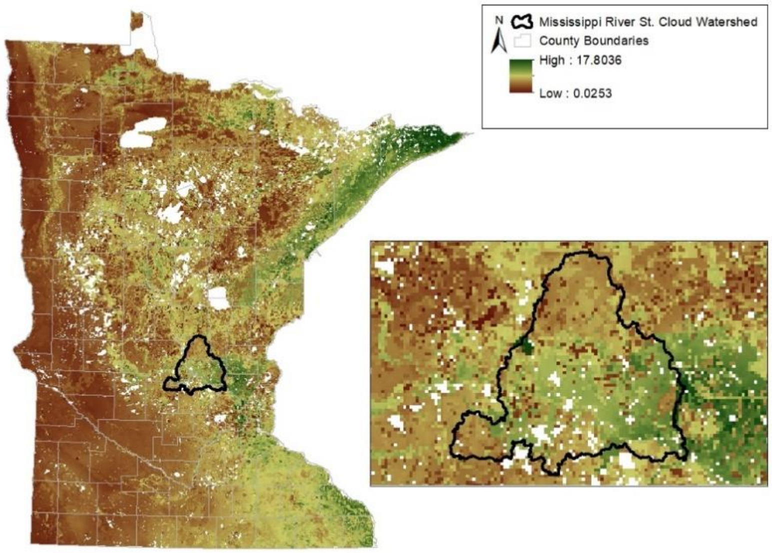


Groundwater potential recharge

Groundwater recharge is one of the most important parameters in the calculation of water budgets, which are used in general hydrologic assessments, aquifer recharge studies, groundwater models, and water quality protection. Recharge is a highly variable parameter, both spatially and temporally, making accurate estimates at a regional scale difficult to produce. The MPCA contracted the US Geological Survey to develop a statewide estimate of recharge using the Soil-Water-Balance Code (SWB). The result is a gridded data structure of spatially distributed recharge estimates that can be easily integrated into regional groundwater studies. The full report of the project as well as the gridded data files are available at: https://gisdata.mn.gov/dataset/geos-gw-recharge-1996-2010-mean.

Recharge of these aquifers is important and limited to areas located at topographic highs, those with surficial sand and gravel deposits, and those along the bedrock-surficial deposit interface. Typically, recharge rates in unconfined aquifers are estimated at 20% to 25% of precipitation received but can be less than 10% of precipitation where glacial clays or till are present (USGS 2007). For the MRSCW, the average annual potential recharge rate to surficial materials ranges from 1.5 to 16.0 inches per year, with an average of 6.5 inches per year. The statewide average potential recharge is estimated to be four inches per year with 85% of all recharge rates ranging from three to eight inches per year. When compared to the statewide average potential recharge, this watershed receives a greater average potential recharge (Figure 58).

Figure 58. Groundwater recharge potential within the MRSCW (USGS 2007)



Groundwater quality

Approximately 75% of Minnesota's population receives their drinking water from groundwater, undoubtedly indicating that clean groundwater is essential to the health of its residents. The MPCA's Ambient Groundwater Monitoring Program monitors trends in statewide groundwater quality by sampling for a comprehensive suite of chemicals including nutrients, metals, and volatile organic compounds. These Ambient Groundwater wells represent a mix of deeper domestic wells and shallow monitoring wells. The shallow wells interact with surface waters and exhibit impacts from human activities more rapidly.

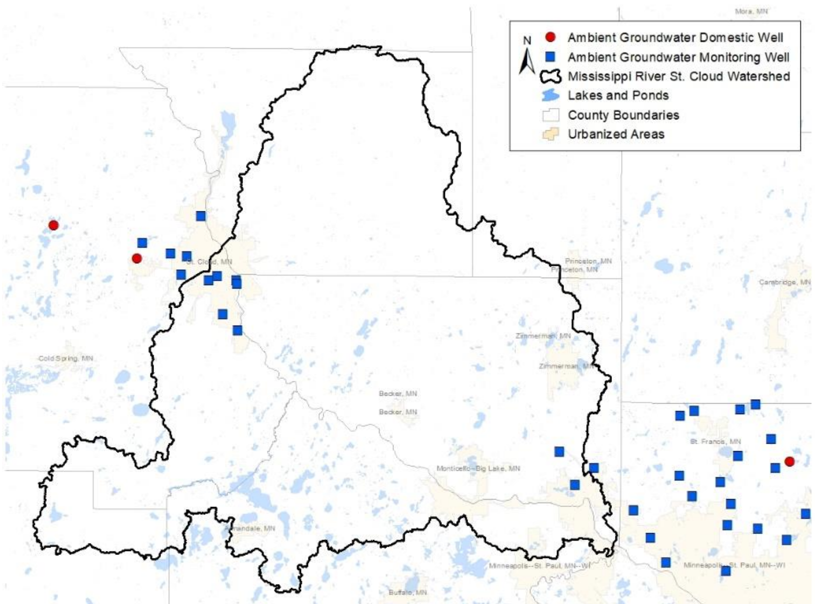
There are currently eight MPCA Ambient Groundwater Monitoring wells within the MRSCW (Figure 59). Data collection for these wells ranges from 1996 to 2021. The most commonly detected analytes within this watershed were naturally occurring and released into the groundwater as the mineral dissolves over time. The majority of detections were below water quality standards set by MDH and EPA. There were exceedances of some contaminants identified in these wells. The most common exceedances found were iron, inorganic nitrogen (nitrate and nitrite), and manganese.

Iron has a secondary maximum contaminant level (SMCL) of 300 µg/L, where exceedances can lead to noticeable nuisance affects (taste, color, odor), but are not considered to be a threat to human health (EPA 2023). These effects may include rusty color, metallic taste, pipe clogging and staining clothes and appliances. Within this watershed, 45.4% of samples had detections of iron while 33.1% of samples exceeded the SMCL. Conventional treatments, such as coagulation, flocculation, filtration, aeration, and granular activated carbon filters, are effective ways of removing color and odor associated with secondary contaminants (EPA 2023).

Inorganic nitrogen included nitrate and nitrite that may contaminate water sources through excess fertilizer runoff, leakage from septic tanks and sewage, and erosion of natural deposits (EPA 2023). The maximum contaminant level (MCL) is 10 mg/L for nitrate and 1 mg/L for nitrite. For this analysis, 10 mg/L was used as the exceedance benchmark, since nitrate is the dominant form typically found in groundwater. Nitrate levels that exceed the MCL are considered dangerous for infants younger than six months due to the risk of methemoglobinemia (blue-baby syndrome), which could potentially be life threatening if untreated. Although detections of inorganic nitrogen occurred at 75.9% of all samples, there were only two monitoring well that had exceedances to the MCL, which is not a source of drinking water.

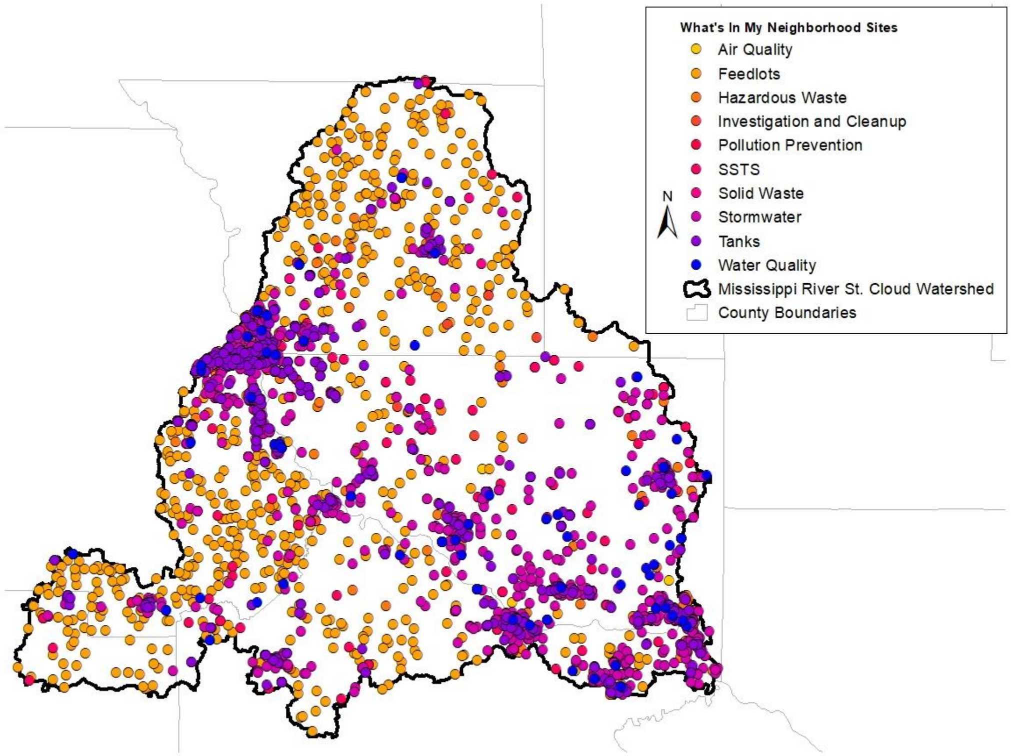
Manganese has a Health-Related Value and Health Based Value (HRL, HBV) of 100 µg/L and was detected 50.4% and exceeded the HRL 33.1% of the time. Manganese is naturally occurring and commonly found in groundwater across the state. High concentrations of manganese give water a black to brown color, a bitter metallic taste, and may be unsafe for human consumption when concentrations are over the HBV, especially for infants. At low levels, manganese is considered beneficial, but high exposures can cause harm to the nervous system and issues with memory, attention and motor skills (MDH 2023b). If their drinking water exceeds the HRL, individuals are advised by the MDH to utilize a carbon filter or bottled water, especially with infants and nursing mothers (MDH 2023b). These occurrences were also in monitoring wells that are not drinking water sources.

Figure 59. MPCA Ambient Groundwater Monitoring wells within the MRSCW (MPCA 2021)



A statewide dataset of potentially contaminated sites and facilities with environmental permits and registrations is available at the MPCA’s website, through a web-based application called, "What's in My Neighborhood" (WIMN). This MPCA resource provides the public with a method to access a wide variety of environmental information about communities across the state. The data is divided into two groups. The first is potentially contaminated sites, and includes contaminated properties, formerly contaminated sites, and those that are being investigated for suspicion of being contaminated. The second category is made up of businesses that have applied for and received different types of environmental permits and registrations from the MPCA. An example of an environmental permit would be for a business acquiring a permit for a stormwater or wastewater discharge, requiring it to operate within limits established by the MPCA. In the MRSCW, there are currently 3,645 active sites identified by WIMN (Figure 60). By MPCA program, there are 1361 stormwater sites, 643 feedlots, 642 hazardous waste, 547 tanks (above and belowground), 192 SSTS, 67 water quality, 64 air quality sites, 62 investigation and cleanup, 56 solid waste, and 11 pollution prevention sites. For more information refer to the MPCA webpage at "What's in My Neighborhood".

Figure 60. MPCA WIMN in the MRSCW (MPCA 2023l)



3.4 Targeting of geographic areas

During the course of the MRSCW Cycle 2 WRAPS and TMDL process several key informational products were created, communicated, evaluated and/or considered for use in helping to prioritize and target areas within the MRSCW for future water quality implementation actions. This information includes the following sources and processes, which can be used to guide targeting efforts in forthcoming planning efforts, such as the ongoing MRSCW 1W1P, which is a comprehensive local water planning process that is described below.

3.4.1 MRSC WRAPS Cycle 2 Phase I – WRAPS Cycle 1 Strategy Table Evaluation

A large component of the MRSC WRAPS (Cycle 1) document was focused on the development of strategies to implement in the MRSC subwatersheds in order to address pollution sources or to initiate protective measures. The WRAPS team felt it was important to examine the Cycle I strategy tables and reflect upon the work that has been done using these tables as a guide. In Cycle 1 the WRAPS strategy tables listed impairments and strategies for mitigation/protection on a subwatershed basis. Evaluation of these strategies was done on a subwatershed basis with each LGU team member focusing on activities within their jurisdiction and collaborating when watersheds overlapped county/district boundaries. The WRAPS team evaluated a total of 338 strategies listed within the strategy table of the Cycle 1 WRAPS. The results of this progress evaluation process are shown below in Table 12.

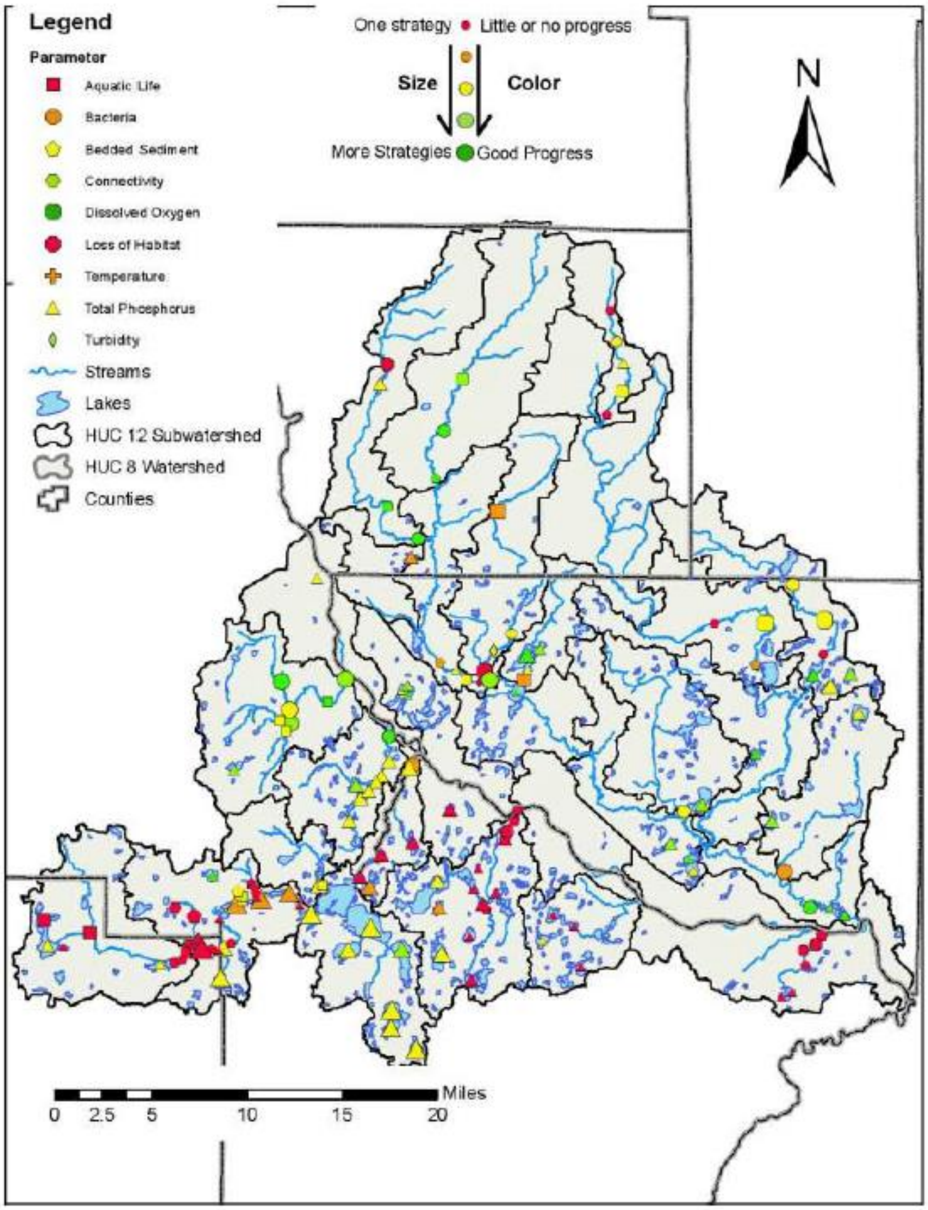
Table 12. Evaluation of WRAPS Cycle 1 Strategy Table goal progress

Description of Progress Towards Strategies	Progress Category	Number of Strategies	Percentage
No work or minimal work completed (red)	0-25%	125	37.0
Some work or accomplishments completed (yellow)	25-50%	131	38.8
Large amount of work or accomplishments completed (green)	50+%	82	24.3
	Total	338	

Multiple methods were discussed and the team ultimately decided to evaluate each strategy component by documenting the practices that had occurred in that subwatershed, compared to the number of practices projected, and giving each component a “stoplight rating” of red, yellow or green. For example, in a subwatershed that called for 250 acres of cover crops to be planted on agricultural fields, if 250 acres of cover crops were achieved this would be a success and a “green” rating would be applied. Activities that met some but not all expectations would be rated “yellow” and activities with little or no activity would be rated “red”. Assessment of conservation records, along with some professional judgement, were used to make this determination. Once the database of ratings was completed, a GIS derived “heatmap” was created (Figure 61) showing the stoplight rating system overlaying the subwatersheds.This provided a visual representation of how many of the activities had been completed in the various subwatersheds over the past 5 to 10 years, while the database serves as a more in-depth resource of this work and is available if a more detailed investigation is needed.

One challenge of this study was that the Cycle 1 WRAPS strategy tables were developed on a HUC-11 basis, where now the state is focused on evaluating on a HUC-12 basis. Therefore, some of the subwatershed lines were not consistent between HUC-11 and HUC-12 resulting in a deeper dive in some areas during the analysis.

Figure 61. Heat Map indicating progress - Cycle 1 Strategy Table



3.4.2 Microbial Source Tracking (MST)

During early project discussions, the partnership identified several field data gaps within the watershed. The first gap was knowledge on sources of *E. coli* within the MRSCW. There are numerous impairments in the watershed but the specific sources of *E. coli* to these streams is unknown. Discussions were had with MPCA staff who are developing a source tracking methodology. Insufficient funds existed to complete source tracking studies as a part of this project, however the partners identified that this could be an exercise to complete later using funds from the future Comprehensive Watershed Management Plan (BWSR 2023b). More information on the considerations with the MST process is available on the EPA website linked here: [Microbial Source Tracking: How did that get in there? | US EPA].

3.4.3 Culvert Inventory

A second field data gap identified was the location of culverts in the watershed. Identifying culvert locations is helpful to develop hydro-conditioning GIS layers, essentially for predicting the flow of water through environmental modeling software. The partnership did not have the funds or time to complete a full watershed-wide culvert inventory. However, through the WRAPS program this element was researched and a local protocol was developed which could be used in the future. A template geodatabase, ArcGIS Collector mobile application procedure, and data conversion flowchart were created. These tools will help to take existing culvert data or new field-collected data and enter it into the DNR Culvert Inventory Application Suite. The partnership is hopeful that a centralized database of culvert data can aid in catchment basin determinations and modeling efforts. Figure 62 illustrates a fish passage barrier noted in the MPCA 2023 SID report (MPCA 2022b).

Figure 62. Perched culvert on Rice Creek off 57th St. SE, Sherburne County

3.4.4 MRSCW One Watershed One Plan

Narrative provided by Dan Cibulka – Sherburne SWCD. As of September 2023, the MRSCW 1W1P Collaborative began to interactively develop the framework for restoration and protection implementation planning for the MRSCW. The 1W1P will significantly and comprehensively guide the future implementation efforts within the MRSCW. At the time of the completion of the MRSCW 1W1P (anticipated December 2024), a link to the plan will be available for public viewing. Within the 1W1P project, the MRSCW Collaborative team identified seven priority natural resource restoration and protection issues:

- Surface Water – Pollutant Runoff
- Surface Water – Altered Hydrology
- Surface Water – Internal Load Processes

- Groundwater – Quantity
- Groundwater – Quality
- Habitat and Natural Resources – Restoration, Protection + Preservation
- Landscape Resiliency – Soil Health

3.4.5 DNR Watershed Health Assessment Framework

The Watershed Health Assessment Framework (WHAF) tool provides an organized approach for understanding natural resource conditions and challenges, and for identifying opportunities to improve the health and resilience of Minnesota's watersheds. The WHAF provides an excellent visual representation of the priority water resources identified by the State of Minnesota and its partners. Utilizing the WHAF to support water resource planning decisions in the MRSCW is recommended where appropriate. Read more about the WHAF. Other WHAF specific web site examples include the following:

Explore Watershed Lakes: Minnesota Department of Natural Resources (state.mn.us)
Explore Watershed Health: Minnesota Department of Natural Resources (state.mn.us)

3.4.6 MPCA's Watershed Pollutant Load Reduction Calculator

The Watershed Pollutant Load Reduction Calculator | Tableau Public can be used as a quick and simple way to approximate nitrogen, phosphorus and sediment load reductions resulting from BMPs in watersheds throughout most of Minnesota. The purpose of the tool is high level watershed planning where averages over a watershed area are acceptable for the intended purposes. The calculator provides HSPF model derived load reduction estimates that are based on user entered BMPs for the selected watershed. The tool uses modeled loading rates for different pollutant pathways (surface runoff, tile drainage, and groundwater base flow), and calculates pollutant reductions based on typical pollutant reduction percentages from researched BMPs.

3.4.7 Climate protection co-benefit of strategies

Many agricultural BMPs that reduce the load of nutrients and sediment to receiving waters also act to decrease emissions of greenhouse gases (GHGs) to the air. Agriculture is the third largest emitting sector of GHGs in Minnesota. Important sources of GHGs from crop production include the application of manure and nitrogen fertilizer to cropland, soil organic carbon oxidation resulting from cropland tillage, and carbon dioxide (CO_2) emissions from fossil fuel used to power agricultural machinery or in the production of agricultural chemicals. Reduction in the application of nitrogen to cropland through optimized fertilizer application rates, timing, and placement is a source reduction strategy; while conservation cover, riparian buffers, vegetative filter strips, field borders, and cover crops reduce GHG emissions as compared to cropland with conventional tillage.

The USDA Natural Resources Conservation Service (NRCS) has developed a ranking tool for cropland BMPs that can be used by local units of government to consider ancillary GHG effects when selecting BMPs for nutrient and sediment control. Practices with a *high potential* for GHG avoidance include:

- Conservation cover
- Forage and biomass planting
- No-till and strip-till tillage

- Multi-story cropping
- Nutrient management
- Silvopasture establishment
- Shelterbelt Establishment
- Other tree and shrub establishment

Practices with a *medium-high potential* to mitigate GHG emissions include:

- Contour buffer strips
- Riparian forest buffers
- Vegetative buffers
- Shelterbelt renovation.

A longer, more detailed assessment of cropland BMP effects on GHG emission can be found at NRCS COMET-Planner.

4. Public Participation

Public participation and engagement refer to education, outreach, marketing, training, technical assistance, and other methods of working with stakeholders to achieve water resource management goals. Public participation efforts vary greatly depending on the water quality topic and location in the state. It is important in any public participation effort to clarify public participation goals, and all efforts should have some evaluative component to show progress towards reaching the goals.

The local partner team along with other MRSCW stakeholders met, communicated and/or participated in WRAPS related events throughout the WRAPS/TMDL process. The public outreach events noted below help encourage overall public interest in water quality, restoration, and protection activities. These project related communication and public outreach efforts included the following:

- 05/14/19 – WRAPS Update Kick off Meeting in Becker, Minnesota
- 08/27/19 – WRAPS Update Phase I Team Meeting in Becker, Minnesota
- 11/18/19 – Conference call to discuss project updates with local partner team (LPT)
- 01/16/20 – Conference call with LPT
- 01/30/20 – Water quality/WRAPS presentation at Stearns County Shoreland Training workshop, College of St. Benedict, St. Joseph Minnesota

Figure 63. Amanda Guertin (Benton SWCD) and Phil Votruba (MPCA) discuss water quality efforts in the MRSCW at the Stearns County Shoreland workshop, which was well attended by contractors/stakeholders throughout the area. Photo Credit – Sherburne SWCD

- 02/25 - 02/26/20 – Water quality/WRAPS display at Central Minnesota Farm Show, St. Cloud Minnesota

Figure 64. MRSCW partners booth display at the Central Minnesota Farm Show, St. Cloud MN. Photo Credit - Sherburne SWCD

- 07/16/20 – Conference call with LPT
- 10/22/20 – Virtual Meeting via Zoom with LPT to discuss project updates
- 05/11/21 – Professional Judgment Group meeting on MRSCW assessments with LPT and other partners
- 08/17/21 – Interview of Consultants with LPT for the development of TMDLs for the MRSCW
- 01/13/22 – Virtual meeting via Microsoft Teams (MT) with LPT to discuss project/provide updates
- 03/28/22 – Virtual meeting via MT with LPT to discuss project updates including lake protection considerations

- 08/24/22 – Virtual meeting via MT with LPT to discuss project updates including lake protection, MRSCW supporting reports and WRAPS template discussions
- 01/19/23 – Virtual meeting via MT with MRSCW stakeholders/LPT to discuss project updates including TMDL effort to date and presentations from MDH and DNR on their supporting efforts/reports
- 05/25/23 – Virtual meeting via MT to discuss project updates including lake protection, TMDLs, 1W1P and WRAPS goals
- March-July 2023 – "We Are Water" display and events, Becker, Minnesota (see below for more information)
- 09/25/23 – Virtual meeting via MT to discuss project update including the preliminary draft of MRSCW TMDL

4.1 "We Are Water" exhibit and activities

The MRSCW Collaborative hosted a traveling exhibit "We Are Water MN" to connect and engage with the community during the development of the WRAPS and TMDL for this watershed. We Are Water MN is a program led by the Minnesota Humanities Center in partnership with the MPCA, The Minnesota Historical Society, the Minnesota Departments of Agriculture, Health, and Natural Resources, and the University of Minnesota Extension Water Resources Center. It is funded in part by the National Endowment for the Humanities and with money from the Clean Water Fund and Arts and Cultural Heritage Fund that was created with the vote of the people of Minnesota on November 4, 2008. In addition to featuring a traveling exhibit with displays about water topics prominent to the State of Minnesota and the local region, We Are Water is a program that encourages its hosts to develop events to draw community members together to share stories and information about the importance of water in our everyday lives.

From March 2023 to July 2023, the MRSCW Collaborative hosted several events:

- Opening Ceremony (March 2, 2023): The We Are Water Exhibit opened at the Sherburne History Center in Becker, Minnesota. Staff from the collaborative facilitated tours of the exhibit, offered free samples at a Water Bar, and encouraged attendees to share a story about their experience with water.
- World Water Day (March 22, 2023): Along with tours of the exhibit, attendees again were offered samples of water from three different locations at a Water Bar, were provided a presentation of local water quality trends, and had access to free well water nitrate testing.
- Harmful Algae Blooms (April 20, 2023): Steve McComas, "The Lake Detective" was a guest speaker to shed light on the mysterious circumstances surrounding blue-green algae and toxic algae blooms, which is a growing concern. Following the presentation, guests asked questions and shared their experiences with algae blooms and ways they felt they could, as individuals, protect their local lakes and streams.

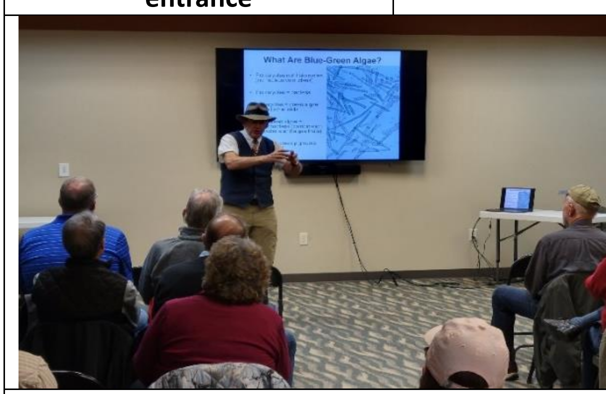
- Youth Water Festival (April 24, 2023): Youth of all ages visited the exhibit and stayed to enjoy interactive experiences learning how watersheds work, a theatrical performance on aquatic invasive species, learning about soil health, and creating “butterfly bombs”.
- Agricultural Conservation Field Day (July 13, 2023): The Kaschmitter brothers hosted this event on their farm to showcase conservation practices that help to improve water quality including conservation tillage, irrigation technology, and other soil health practices. Specialty equipment was available for display and guest speakers from the Irrigators Association of Minnesota and Natural Resource Conservation Service spoke about the importance of water conservation.

The events ranged between 30 to 45 attendees while the Sherburne History Center saw a two-fold increase in walk-in traffic during the timeline of the exhibit (March through April 2023). The MRSCW Collaborative enjoyed engaging with the community through the We Are Water MN program and views this effort not only as successful on its own accord, but as a valuable companion piece to the development of the MRSCW Cycle II WRAPS and TMDLs. *Narrative in this section provided by Dan Cibulka – Sherburne SWCD and photos below of the exhibit and the various We Are Water MN activities were provided courtesy of the MRSCW Collaborative.*

We Are Water MN exhibit entrance

We Are Water exhibit pieces

We Are Water visitor “Water Story” submissions



Steve McComas, “The Lake Detective”, speaks on harmful algal blooms

Water Bar sample being poured

Water Bar taste testing samples

Youth learning about how a watershed works

CLIMB Theater helps the youth audience learn about aquatic invasive species

Youth experiencing the Stearns SWCD Watershed Model

Rainfall runoff simulation at the Agriculture Conservation Field Day

Conservation tillage equipment demonstration

4.2 MRSCW Local Partner organizations

The local partners within the MRSCW are highly committed to providing education and outreach through their natural resource conservation efforts serving the public and/or residents within their jurisdictional boundaries. Ongoing local comprehensive water resource planning processes (e.g., 1W1P) will greatly help in defining and adapting public outreach goals going forward. The MRSCW local partner group has a strong history of success in engaging with public and the various stakeholders throughout the MRSCW and beyond. Through their exemplary outreach efforts, numerous conservation practices have been implemented over the past decade resulting in many noteworthy water quality restoration and protection accomplishments. Maintaining an organizational website and/or Facebook page is an important measure and tool in effectively providing information and outreach to the public. Below are links to websites of key local partner organizations within the MRSCW.

Benton County Soil and Water Conservation District

Clearwater River Watershed District

Meeker Soil & Water Conservation District

Mille Lacs Soil & Water Conservation District

Environment | Sherburne County, MN

Sherburne Soil & Water Conservation District

Environmental Services | Stearns County, MN

Stearns County Soil & Water Conservation District

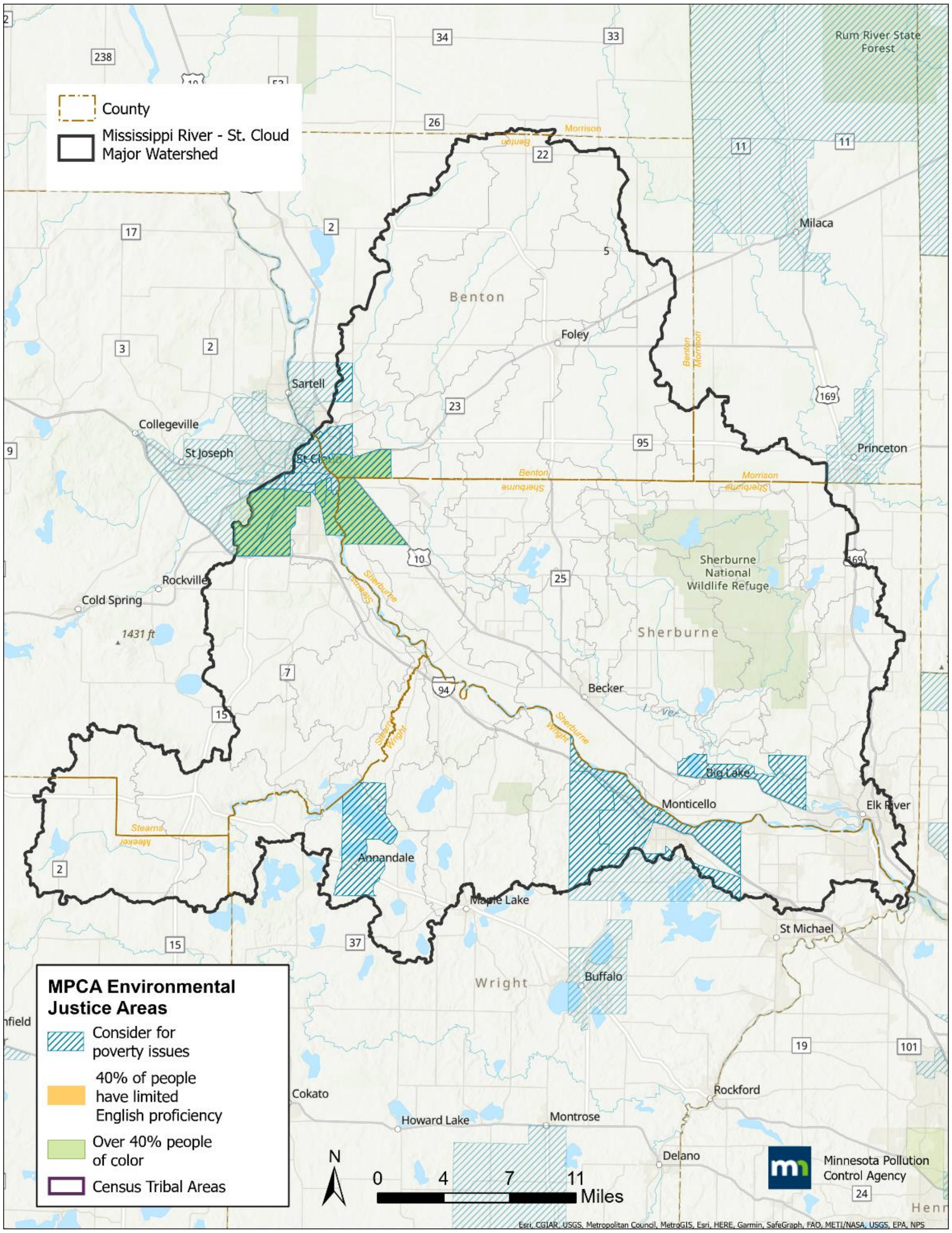
Wright Soil and Water Conservation District

4.3 Environmental Justice

The MPCA is committed to making sure that pollution does not have a disproportionate impact on any group of people — the principle of environmental justice (EJ). This means that all people — regardless of their race, color, national origin or income — benefit from equal levels of environmental protection and have opportunities to participate in decisions that may affect their environment or health. There are a number of tools available to determine where underserved communities could receive the most benefit from watershed work in the MRSCW. Using these tools, the MPCA staff can identify areas of the watershed where low income, linguistically isolated, or minority people are most likely to benefit from the work done in the watershed approach and 1W1P process. The MPCA will work with partners to look for opportunities to engage and offer our assistance in these areas.

Implementing water quality restoration and protection practices that provide benefits available to all the citizens within the MRSCW and beyond is an effective strategy in working towards meeting EJ goals. This would include addressing the impaired resources within the MRSCW through the implementation of strategic BMPs. These resources not only provide important public recreational opportunities but also contribute to the drinking water supply (via tributaries to the Mississippi River) to around 900,000 Minnesotans. More information on EJ can be found on the MPCA website at Environmental justice | Minnesota Pollution Control Agency (state.mn.us). EJ areas in the MRSCW include considerations for poverty issues and for existing populations consisting of over 40% people of color. In the MRSCW this includes low-income communities in and around the municipalities of St. Cloud, Sauk Rapids and Waite Park along the West Central edge of the watershed. These EJ communities primarily exist closely to the Mississippi River and like other communities, benefit from the significant water quality work completed over the years within the MRSCW and in the watersheds situated above in the UMRB. See Figure 65 for an illustration of EJ focus areas within the MRSCW.

Figure 65. Environmental Justice Areas within the MRSCW (information from EPA EJ Screen tool)



4.4 Future Plans

Through the efforts of various MRSCW partnering organizations, there are several other important water quality restoration and protection plans that are being developed concurrently with the WRAPS update and/or MRSC TMDL process. In addition, there are plans scheduled to intensively monitor the MRSCW again in 2029, which will help determine the overall water quality status, associated trends, successes and the subsequent needs for the surface water and related resources of the MRSCW. These plans include the following:

- One Watershed, One Plan | MN Board of Water, Soil Resources – *Narrative provided by Dan Cibulka, Sherburne SWCD*. During the WRAPS project, the MRSCW Collaborative began several other planning projects simultaneously to combine and share resources from each effort. The Collaborative began a 1W1P planning effort in late November of 2022 and anticipate concluding this project in December of 2024. The State of Minnesota's 1W1P program is designed to develop comprehensive watershed management plans that align local water planning along watershed boundaries to create a systematic, watershed-wide, science-based approach to watershed management. The program builds upon local government structure and capacity, incorporates existing resources and data, solicits input from a variety of stakeholder groups, and ultimately serves as a substitute for comprehensive local plans. Within the 1W1P project, the MRSC Watershed Collaborative team identified seven priority issues:

- Surface Water – Pollutant Runoff
- Surface Water – Altered Hydrology
- Surface Water – Internal Load Processes
- Groundwater – Quantity
- Groundwater – Quality
- Habitat and Natural Resources – Restoration, Protection + Preservation
- Landscape Resiliency – Soil Health

Landscape Stewardship Planning – *Narrative provided by Dan Cibulka, Sherburne SWCD*. In September of 2023 the Collaborative also began developing a Landscape Stewardship Plan (LSP) for the watershed. A LSP is a planning effort that examines forestry restoration/protection at the subwatershed level. Local staff and collaborators evaluated subwatershed land use characteristics and identified areas that are suitable for private forest management and working forestland protection efforts. Through this effort, current forestland protection acreage is calculated, a forestland protection goal established, and tools identified to achieve those goals. The LSP is a mechanism to accelerate funding and technical opportunities to increase forestland protection in the watershed, which in turn helps to protect water quality of area lakes and streams (SWCD 2023). See Minnesota Board of Water and Soil Resources (BWSR's) websites Forest Land | MN Board of Water, Soil Resources and Private Forest Management Framework fact sheet for more information on this process.

- Groundwater Restoration and Protection Strategies (GRAPS) Clean Water Fund - MN Dept. of Health – GRAPS reports contain maps and data describing groundwater conditions in the watershed. The reports identify local groundwater concerns and outline strategies and programs to address them. Local organizations can use GRAPS reports to develop their water management plans. It is anticipated this plan will be completed in later 2023/early 2024 for the MRSCW.

- Watershed approach to water quality | Minnesota Pollution Control Agency – The MPCA and its partners systematically evaluate waters in each major watershed in Minnesota every 10 years. This process begins with comprehensive lake and stream water quality and biological monitoring. Once completed, the MPCA and its partners assess the monitoring data to determine if the water bodies meet state water quality standards. Cycle 3 of this watershed approach is planned to begin in 2029 for the MRSCW.

Public notice for comments

An opportunity for public comment on the draft WRAPS report was provided via a public notice in the *State Register* from May 13, 2024 through June 12, 2024. There were [xx] comments received and responded to as a result of the public comment period.

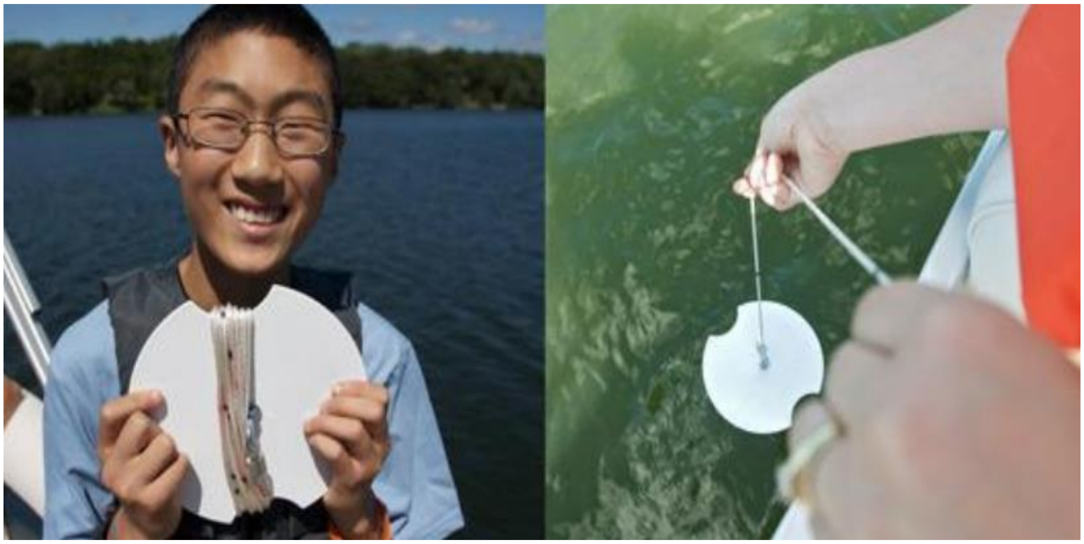
5. Monitoring plan

There are many monitoring efforts in place in the MRSCW. Several key monitoring programs will continue to provide, subject to state and local resource availability and priorities, the information to track trends in water quality and evaluate compliance with TMDLs and milestones for WRAPS and/or comprehensive local water planning (e.g., 1W1P) implementation. Data from these monitoring programs will continue to be collected and analyzed for the MRSCW as part of Minnesota's Water Quality Monitoring Strategy 2021 to 2031.

- IWM and assessment at the HUC-8 watershed scale associated with Minnesota's Watershed approach to water quality. This monitoring effort is conducted approximately every 10 years for each HUC-8. An outcome of this monitoring effort is the identification of waters that are impaired (i.e., do not meet standards and need restoration) and waters in need of protection to prevent impairment. Over time, condition monitoring can also identify trends in water quality. This helps determine whether water quality conditions are improving or declining, and it identifies how management actions are improving the state's waters overall. The second cycle of IWM for the MRSCW was completed in 2019 and 2020. A third cycle of IWM would occur in 2029-2030. These data provide a periodic but intensive snapshot of water quality throughout the watershed. In addition to the monitoring conducted in association with this process, other watershed partner organizations (e.g., local, state, federal, tribal) within the watershed may request monitoring through the Surface Water Monitoring Request process and/or may have their own monitoring activities. All of the data collected locally should be submitted regularly to the MPCA for entry into the Environmental Quality Information System (EQuIS) database for ultimate use in water quality assessments.
- The MPCA's WPLMN measures and compares data on pollutant loads from Minnesota's rivers and streams and tracks water quality trends. WPLMN data will be used to assist with assessing impaired waters, watershed modeling, determining pollutant source contributions, developing watershed and water quality reports, and measuring the effectiveness of water quality restoration efforts. Data are collected along major river main stems, at major watershed (i.e., HUC-8) outlets to major rivers, and in several subwatersheds. This long-term monitoring program began in 2007. Three subwatershed sites exist within the MRSCW. See Section 2.2.2 for additional information.
- Implementation monitoring is conducted by both BWSR (e.g., eLINK) and the United States Department of Agriculture (USDA). Both agencies track the locations of BMP installations. Data is displayed on the MPCA's "Healthier Watersheds" webpage.
- Discharges from permitted municipal and industrial wastewater sources are reported through discharge monitoring records; these records are used to evaluate compliance with NPDES/SDS

permits. The MPCA's "Healthier Watersheds" webpage also contains a link to information on wastewater discharges through MPCA's tableau public Wastewater loading by facility site.

- Volunteer water monitoring is a network of volunteers who make monthly lake and river transparency readings. Several dozen data collection locations exist within the MRSW. This data provides a continuous record of one water quality parameter (transparency/turbidity) throughout much of the watershed and can be found at the following webpage: Volunteer monitoring reports and data.



Lake monitoring volunteers using Secchi Disks to measure lake clarity.

- Minnesota's large rivers — the Mississippi, Minnesota, Rainy, Red, and St. Croix — are prized for recreation, and serve as water supplies and engines of commerce. They also connect us to other states and countries, flowing south in the Mississippi to the Gulf of Mexico and north in the Rainy and Red rivers to Lake of the Woods and Hudson Bay.

  Because they receive pollutants from their tributaries and the surrounding watersheds, their health is a reflection of how well we are protecting overall water quality. The MPCA began Large river monitoring in 2013, starting with the Mississippi River from its headwaters to St. Anthony Falls in Minneapolis. The work

A fisherman uses a kayak to pursue gamefish on the Mississippi River near Clearwater, MN. - Photo Courtesy of Clear Waters Outfitters & Northwest Canoe

provides insight into both the challenges to the rivers' health and reasons to protect them. The Mississippi River serves as the main artery of the MRSCW bisecting the watershed on its way towards the Twin City metropolitan area and beyond eventually to the Gulf of Mexico. The next cycle of large river monitoring for the Upper Mississippi River is scheduled to begin in 2024, and for the first time ever will also include the rest of the Mississippi River in Minnesota all the way to the Iowa border.

- Wetland monitoring and assessment - Wetlands are an important part of Minnesota's surface waters, and the MPCA has been increasing its capacity to monitor their quality. The agency's goal is to help ensure Minnesota's wetlands are protected by providing information to make informed policy and management decisions.
- Reducing nutrients in waters - nutrients, particularly phosphorus and nitrogen, pose a significant problem for Minnesota's lakes and rivers, as well as downstream waters including the Great Lakes, Lake Winnipeg, and the Gulf of Mexico. Nutrients are important for human and AQL. However, when levels exceed normal conditions, they can cause excessive algae growth, low levels of oxygen, toxicity to AQL, and unhealthy drinking water. Nutrients come into lakes and rivers primarily from agricultural and urban lands, and in discharges from WWTF. The Minnesota Nutrient Reduction Strategy (NRS) outlines how Minnesota will reduce nutrient pollution in its lakes and streams and limit impacts downstream. The NRS is being revised and will be re-issued in 2025.

A Sandhill Crane stalks in a wetland within the Sherburne NWR. Photo Courtesy -Bruce Ellingson/USFWS.

- Contaminants and Minnesota Fish - MDH Statewide Safe-Eating Guidelines are based on mercury and PCB levels measured in fish throughout Minnesota and on levels of mercury found in commercial fish. They also take into account findings of low levels of Perfluorooctane Sulfonate (PFOS) in fish throughout Minnesota. Not all waters in Minnesota have been tested for contaminants in fish.

6. References and further information

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7. Appendices

A – MRSCW Lakes – IWM Cycle 1 & Cycle 2 comparisons

B – MRSCW Streams – IWM Cycle 1 & Cycle 2 comparisons

C – MRSCW DNR Fish IBI Stressor ID Summary

D – MRSCW NPDES – permitted facilities

E – Johnson Creek TMDL 4A Request Form

F – MRSCW HUC-12 Altered Water Course Table

G – MRSCW Lakes – Biological Significance Table

H – MRSCW Lakes – Phosphorus Sensitivity Table

I – MRSCW – Priority Streams, based on water quality assessment results

MRSCW Lakes – IWM Cycle 1 & Cycle 2

		Chl-a				P				Secchi				Fish IBI		Sulfate	
		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 2		Cycle 2	
Lake ID (WID)	Waterbody Name	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment
05-0004-02	Donovan (main bay)	53	AQR=Inc Chl-a=Inc			137.1	AQR=Inc P=Inc			1.02	AQR=Inc Secchi=Inc						
05-0007-00	Mayhew	62	AQR=Inc Chl-a=Inc	13.1	AQR=NS Chl-a=IF	170.9	AQR=Inc P=Inc	87.8	AQR=NS P=IF	2.45	AQR=Inc Secchi=Inc						
47-0042-00	Betty	37	AQR=Inc Chl-a=Inc	32.2	AQR=NS Chl-a=EXS	225.9	AQR=Inc P=Inc	192.3	AQR=NS P=EXS	.95	AQR=Inc Secchi=Inc	1.8	AQR=NS Secchi=MTS	-	AQL=NS Fish BI=EXS		
47-0089-00	Round					219	AQR=Inc P=Inc			.38	AQR=Inc Secchi=Inc						
47-0095-00	Clear	82	AQR=Inc Chl-a=Inc	46	AQR=NS Chl-a=EXS	202.7	AQR=Inc P=Inc	109.3	AQR=NS P=EXS	.5	AQR=Inc Secchi=Inc	1.3	AQR=NS Secchi=IC				
47-0096-00	Little Mud	7	AQR=Inc Chl-a=Inc	7.3	AQR=FS Chl-a=MTS	34.4	AQR=Inc P=Inc	26.1	AQR=FS P=MTS	2.97	AQR=Inc Secchi=Inc	2.4	AQR=FS Secchi=MTS				
47-0100-00	Rohrbeck					374	AQR=Inc P=Inc			.29	AQR=Inc Secchi=Inc						
48-0010-00	Rice			6.9	AQR=NA Chl-a=NA			341	AQR=NA P=NA								
71-0013-01	Upper Orono	21	AQR=Inc Chl-a=Inc	14.4	AQR=NA Chl-a=NA	128.4	AQR=Inc P=Inc	102	AQR=NA P=NA	.82	AQR=Inc Secchi=Inc	1.2	AQR=NA Secchi=NA				
71-0013-02	Lower Orono	27	AQR=Inc Chl-a=Inc	28.1	AQR=NA Chl-a=NA	100.5	AQR=Inc P=Inc	104.2	AQR=NA P=NA	.82	AQR=Inc Secchi=Inc	1	AQR=NA Secchi=NA				
71-0016-00	Fremont	94	AQR=Inc Chl-a=Inc	17.9	AQR=IC Chl-a=MTS	166.2	AQR=Inc P=Inc	41.6	AQR=IC P=MTS	.58	AQR=Inc Secchi=Inc	1.5	AQR=IC Secchi=MTS				
71-0041-00	Cantlin	10	AQR=Inc Chl-a=Inc			25.5	AQR=Inc P=Inc			2.46	AQR=Inc Secchi=Inc	3.1	AQR=IF Secchi=MTS				
71-0044-00	Little Diamond	4	AQR=Inc Chl-a=Inc	3.6	AQR=IF Chl-a=IF	10	AQR=Inc P=Inc	10	AQR=IF P=IF	1.2	AQR=Inc Secchi=Inc	1.2	AQR=IF Secchi=IF				
71-0046-00	Diann	32	AQR=Inc Chl-a=Inc			66.3	AQR=Inc P=Inc			1.1	AQR=Inc Secchi=Inc						
71-0055-00	Elk	31	AQR=Inc Chl-a=Inc	47.5	AQR=NS Chl-a=EXS	73.1	AQR=Inc P=Inc	89.1	AQR=NS P=EXS	.72	AQR=Inc Secchi=Inc	.9	AQR=NS Secchi=IC	-	AQL=IC Fish IBI=IC		
71-0057-00	Birch	19	AQR=Inc Chl-a=Inc	15.8	AQR=FS Chl-a=IC	36	AQR=Inc P=Inc	24.8	AQR=FS P=MTS	1.53	AQR=Inc Secchi=Inc	2.5	AQR=FS Secchi=MTS	-	AQL=FS Fish BI=MTS		
71-0067-00	Eagle	21	AQR=Inc Chl-a=Inc	36.9	AQR=NS Chl-a=EXS	51.4	AQR=Inc P=Inc	54.3	AQR=NS P=IC	.85	AQR=Inc Secchi=Inc	2.6	AQR=NS Secchi=MTS	-	AQL=FS Fish BI=MTS		
71-0069-00	Ann	5	AQR=Inc Chl-a=Inc			23	AQR=Inc P=Inc			3.14	AQR=Inc Secchi=Inc	3.7	AQR=IF Secchi=MTS	-	AQL=IC Fish IBI=IC		
71-0081-00	Mitchell	6	AQR=Inc Chl-a=Inc	5	AQR=FS Chl-a=MTS	20.3	AQR=Inc P=Inc	17.6	AQR=FS P=MTS	2.81	AQR=Inc Secchi=Inc	3.1	AQR=FS Secchi=MTS	-	AQL=NS Fish BI=EXS		
71-0082-00	Big	6	AQR=Inc Chl-a=Inc	3.9	AQR=FS Chl-a=MTS	18.2	AQR=Inc P=Inc	14.2	AQR=FS P=MTS	2.93	AQR=Inc Secchi=Inc	3.7	AQR=FS Secchi=MTS	-	AQL=NS Fish BI=EXS		
71-0085-00	Big Mud							11	AQR=IF P=IF			.7	AQR=IF Secchi=IF				WR=IF Sulfate=IF
71-0096-00	Thompson	6	AQR=Inc Chl-a=Inc			18.7	AQR=Inc P=Inc			2.46	AQR=Inc Secchi=Inc	2.6	AQR=IF Secchi=IF				
71-0123-00	Camp	5	AQR=Inc Chl-a=Inc			16.5	AQR=Inc P=Inc			3.1	AQR=Inc Secchi=Inc	3.5	AQR=IF Secchi=MTS				

MRSCW Lakes – IWM Cycle 1 & Cycle 2

		Chl-a				P				Secchi				Fish IBI		Sulfate	
		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 2		Cycle 2	
Lake ID (WID)	Waterbody Name	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment
71-0141-00	Elk	63	AQR=Inc Chl-a=Inc	50.4	AQR=NS Chl-a=EXS	155	AQR=Inc P=Inc	122.8	AQR=NS P=EXS	.56	AQR=Inc Secchi=Inc	.7	AQR=NS Secchi=EXS	-	AQL=FS Fish 3I=MTS		
71-0142-00	Rice																WR=NS Sulfate=EXS
71-0145-00	Julia	26	AQR=Inc Chl-a=Inc	24.5	AQR=IC Chl-a=EXS	58.7	AQR=Inc P=Inc	60.3	AQR=IC P=IC	.64	AQR=Inc Secchi=Inc	.8	AQR=IC Secchi=EXS	-	AQL=FS Fish 3I=MTS		
71-0146-00	Briggs	48	AQR=Inc Chl-a=Inc	38.3	AQR=NS Chl-a=EXS	89.6	AQR=Inc P=Inc	82.6	AQR=NS P=EXS	.93	AQR=Inc Secchi=Inc	1	AQR=NS Secchi=EXS	-	AQL=NS Fish BI=EXS		
71-0147-00	Rush	59	AQR=Inc Chl-a=Inc	47	AQR=NS Chl-a=EXS	100.8	AQR=Inc P=Inc	98.7	AQR=NS P=EXS	.53	AQR=Inc Secchi=Inc	.7	AQR=NS Secchi=EXS	-	AQL=FS Fish 3I=MTS		
71-0158-00	Pickerel	7	AQR=Inc Chl-a=Inc			24.6	AQR=Inc P=Inc			2.54	AQR=Inc Secchi=Inc	3	AQR=IF Secchi=MTS				
71-0159-00	Long	7	AQR=Inc Chl-a=Inc			26.2	AQR=Inc P=Inc			2.27	AQR=Inc Secchi=Inc	2.5	AQR=IF Secchi=MTS				
71-0167-00	Round	8	AQR=Inc Chl-a=Inc			26.1	AQR=Inc P=Inc			3.24	AQR=Inc Secchi=Inc	4.2	AQR=IF Secchi=MTS				
73-0001-00	Dallas	7	AQR=Inc Chl-a=Inc			25	AQR=Inc P=Inc			3.27	AQR=Inc Secchi=Inc						
73-0002-00	Feldges	10	AQR=Inc Chl-a=Inc			30	AQR=Inc P=Inc			2.5	AQR=Inc Secchi=Inc						
73-0003-00	Maria	13	AQR=Inc Chl-a=Inc			32.4	AQR=Inc P=Inc			2.25	AQR=Inc Secchi=Inc						
73-0004-00	Long	8	AQR=Inc Chl-a=Inc			23.6	AQR=Inc P=Inc			3.79	AQR=Inc Secchi=Inc	3.7	AQR=IF Secchi=MTS				
73-0006-00	Crooked	4	AQR=Inc Chl-a=Inc			15.4	AQR=Inc P=Inc			3.81	AQR=Inc Secchi=Inc	3.9	AQR=IF Secchi=MTS				
73-0007-00	Quinn	7	AQR=Inc Chl-a=Inc			23.9	AQR=Inc P=Inc			4.04	AQR=Inc Secchi=Inc						
73-0010-00	Bunt	13	AQR=Inc Chl-a=Inc			51.8	AQR=Inc P=Inc			1.23	AQR=Inc Secchi=Inc						
73-0011-00	Warner	16	AQR=Inc Chl-a=Inc			20.9	AQR=Inc P=Inc			1.79	AQR=Inc Secchi=Inc	1.8	AQR=IF Secchi=MTS				
73-0014-00	Marie	58	AQR=Inc Chl-a=Inc	31.8	AQR=NS Chl-a=EXS	83	AQR=Inc P=Inc	212.7	AQR=NS P=EXS	1.42	AQR=Inc Secchi=Inc	1.4	AQR=NS Secchi=IC	-	AQL=FS Fish 3I=MTS		
73-0015-00	Otter	6	AQR=Inc Chl-a=Inc	6.4	AQR=FS Chl-a=MTS	20.2	AQR=Inc P=Inc	17.3	AQR=FS P=MTS	2.79	AQR=Inc Secchi=Inc	2.9	AQR=FS Secchi=MTS				
73-0020-00	Laura	4	AQR=Inc Chl-a=Inc			20.1	AQR=Inc P=Inc			1.5	AQR=Inc Secchi=Inc						
73-0023-00	Beaver	5	AQR=Inc Chl-a=Inc			17.3	AQR=Inc P=Inc			3.91	AQR=Inc Secchi=Inc	3.7	AQR=IF Secchi=MTS	-	AQL=FS Fish 3I=MTS		
73-0035-00	School Section	3	AQR=Inc Chl-a=Inc	3	AQR=FS Chl-a=MTS	24.2	AQR=Inc P=Inc	16.6	AQR=FS P=MTS	2.25	AQR=Inc Secchi=Inc	3.6	AQR=FS Secchi=MTS	-	AQL=IF Fish IBI=IF		
73-0042-00	Island	3	AQR=Inc Chl-a=Inc			28.5	AQR=Inc P=Inc			2.98	AQR=Inc Secchi=Inc						
73-0611-00	George	24	AQR=Inc Chl-a=Inc	10.9	AQR=FS Chl-a=MTS	44.8	AQR=Inc P=Inc	23.5	AQR=FS P=MTS	1.77	AQR=Inc Secchi=Inc	2.4	AQR=FS Secchi=MTS				

<u>MRSCW Lakes – IWM Cycle 1 & Cycle 2</u>

		Chl-a				P				Secchi				Fish IBI		Sulfate	
		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 2		Cycle 2	
Lake ID (WID)	Waterbody Name	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment
73-0701-00	Melrose Deep Quarry									3.91	AQR=Inc Secchi=Inc	3.9	AQR=IF Secchi=MTS				
86-0065-00	Unnamed	6	AQR=Inc Chl-a=Inc	4.8	AQR=IF Chl-a=IF	38	AQR=Inc P=Inc	38	AQR=IF P=IF	1	AQR=Inc Secchi=Inc	1.5	AQR=IF Secchi=IF				
86-0066-00	Birch	5	AQR=Inc Chl-a=Inc	4.4	AQR=FS Chl-a=MTS	19.2	AQR=Inc P=Inc	19.5	AQR=FS P=MTS	4.04	AQR=Inc Secchi=Inc	4.1	AQR=FS Secchi=MTS				
86-0067-00	First									1.8	AQR=Inc Secchi=Inc						
86-0068-00	Mud									1.64	AQR=Inc Secchi=Inc						
86-0069-00	Long	5	AQR=IF Chl-a=Inc			22	AQR=IF P=Inc			1.79	AQR=IF Secchi=Inc						
86-0070-00	Bertram	13	AQR=Inc Chl-a=Inc			31.8	AQR=Inc P=Inc			1.54	AQR=Inc Secchi=Inc						
86-0073-00	Cedar	4	AQR=Inc Chl-a=Inc	4	AQR=IF Chl-a=IF	17.4	AQR=Inc P=Inc	18	AQR=IF P=IF	4.9	AQR=Inc Secchi=Inc	4.7	AQR=IF Secchi=MTS				
86-0073-02	Little Cedar											4.7	AQR=IF Secchi=IF				
86-0139-01	Little Mary (South Bay)	56	AQR=Inc Chl-a=Inc			106.5	AQR=Inc P=Inc			.76	AQR=Inc Secchi=Inc						
86-0139-02	Little Mary (North Bay)	80	AQR=Inc Chl-a=Inc			163.2	AQR=Inc P=Inc			.48	AQR=Inc Secchi=Inc	3.5	AQR=IF Secchi=IF				
86-0140-00	Silver	52	AQR=Inc Chl-a=Inc			79.4	AQR=Inc P=Inc			1.02	AQR=Inc Secchi=Inc						
86-0146-00	Ida	5	AQR=Inc Chl-a=Inc	3.7	AQR=FS Chl-a=MTS	14.9	AQR=Inc P=Inc	13.9	AQR=FS P=MTS	3.93	AQR=Inc Secchi=Inc	4	AQR=FS Secchi=MTS	-	AQL=IF Fish IBI=IF		
86-0148-00	Eagle	14	AQR=Inc Chl-a=Inc	11.4	AQR=FS Chl-a=MTS	31.2	AQR=Inc P=Inc	27.5	AQR=FS P=MTS	1.97	AQR=Inc Secchi=Inc	2.3	AQR=FS Secchi=MTS	-	AQL=NS Fish BI=EXS		
86-0152-00	Millstone	119	AQR=Inc Chl-a=Inc	20.3	AQR=IF Chl-a=IF	357	AQR=Inc P=Inc	73	AQR=IF P=IF	1.28	AQR=Inc Secchi=Inc	2.4	AQR=IF Secchi=IF				
86-0156-00	Mary	13	AQR=Inc Chl-a=Inc			34.8	AQR=Inc P=Inc			2.25	AQR=Inc Secchi=Inc	1.9	AQR=IF Secchi=MTS	-	AQL=NS Fish BI=EXS		
86-0163-00	Limestone	10	AQR=Inc Chl-a=Inc			23.5	AQR=Inc P=Inc			2.43	AQR=Inc Secchi=Inc	3.1	AQR=IF Secchi=MTS	-	AQL=FS Fish BI=MTS		
86-0168-00	Locke	35	AQR=Inc Chl-a=Inc	27.2	AQR=NS Chl-a=EXS	60.2	AQR=Inc P=Inc	54.1	AQR=NS P=EXS	.89	AQR=Inc Secchi=Inc	1.1	AQR=NS Secchi=EXS	-	AQL=NS Fish BI=EXS		
86-0171-00	Ember	5	AQR=Inc Chl-a=Inc	4.8	AQR=FS Chl-a=MTS	23.7	AQR=Inc P=Inc	27.5	AQR=FS P=MTS	4.04	AQR=Inc Secchi=Inc	4.2	AQR=FS Secchi=MTS				
86-0183-00	Fish	25	AQR=Inc Chl-a=Inc	27.7	AQR=NS Chl-a=EXS	48.6	AQR=Inc P=Inc	50.9	AQR=NS P=EXS	1.24	AQR=Inc Secchi=Inc	1.1	AQR=NS Secchi=EXS				
86-0208-00	Swartout	237	AQR=Inc Chl-a=Inc	56.4	AQR=NS Chl-a=EXS	349.3	AQR=Inc P=Inc	319	AQR=NS P=EXS	.73	AQR=Inc Secchi=Inc	1.4	AQR=NS Secchi=IC				
86-0211-00	Edward					235	AQR=Inc P=Inc			.23	AQR=Inc Secchi=Inc						
86-0212-00	Albion	110	AQR=Inc Chl-a=Inc	62.5	AQR=NS Chl-a=EXS	229.1	AQR=Inc P=Inc	123.6	AQR=NS P=EXS	1	AQR=Inc Secchi=Inc	.5	AQR=NS Secchi=EXS				

<u>MRSCW Lakes – IWM Cycle 1 & Cycle 2</u>

		Chl-a				P				Secchi				Fish IBI		Sulfate	
		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 2		Cycle 2	
Lake ID (WID)	Waterbody Name	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment	Mean Value	Assessment
86-0213-00	Henshaw	155	AQR=Inc Chl-a=Inc	80.8	AQR=NS Chl-a=EXS	235.7	AQR=Inc P=Inc	119.1	AQR=NS P=EXS	.65	AQR=Inc Secchi=Inc	.5	AQR=NS Secchi=EXS				
86-0223-00	Indian	28	AQR=Inc Chl-a=Inc	7.1	AQR=IF Chl-a=IF	47.8	AQR=Inc P=Inc	31	AQR=IF P=IF	1.26	AQR=Inc Secchi=Inc	2.3	AQR=IF Secchi=IF	-	AQL=IC Fish IBI=IC		
86-0224-00	Sandy			1.5	AQR=IF Chl-a=IF	23	AQR=Inc P=Inc	16	AQR=IF P=IF	.98	AQR=Inc Secchi=Inc						WR=IF Sulfate=IF
86-0227-00	Cedar	13	AQR=Inc Chl-a=Inc	10.1	AQR=FS Chl-a=MTS	32.8	AQR=Inc P=Inc	24.7	AQR=FS P=MTS	2.04	AQR=Inc Secchi=Inc	2.3	AQR=FS Secchi=MTS	-	AQL=FS Fish BI=MTS		
86-0229-00	Mink	82	AQR=Inc Chl-a=Inc	50.4	AQR=NS Chl-a=EXS	131.5	AQR=Inc P=Inc	125.3	AQR=NS P=EXS	.87	AQR=Inc Secchi=Inc	1.1	AQR=NS Secchi=EXS	-	AQL=FS Fish BI=MTS		
86-0230-00	Somers	46	AQR=Inc Chl-a=Inc	38.1	AQR=NS Chl-a=EXS	81.1	AQR=Inc P=Inc	65.7	AQR=NS P=EXS	1.06	AQR=Inc Secchi=Inc	1.3	AQR=NS Secchi=IC	-	AQL=IC Fish IBI=IC		
86-0233-00	Sugar	7	AQR=Inc Chl-a=Inc	4.7	AQR=FS Chl-a=MTS	18	AQR=Inc P=Inc	16.1	AQR=FS P=MTS	2.93	AQR=Inc Secchi=Inc	3.6	AQR=FS Secchi=MTS	-	AQL=FS Fish BI=MTS		
86-0234-00	Bass	4	AQR=Inc Chl-a=Inc	2.9	AQR=FS Chl-a=MTS	16.1	AQR=Inc P=Inc	16.6	AQR=FS P=MTS	4.23	AQR=Inc Secchi=Inc	4.2	AQR=FS Secchi=MTS	-	AQL=FS Fish BI=MTS		
86-0237-00	Unnamed							10	AQR=IF P=IF			1.1	AQR=IF Secchi=IF				
86-0238-00	Nixon	4	AQR=Inc Chl-a=Inc	2.9	AQR=FS Chl-a=MTS	16	AQR=Inc P=Inc	14.5	AQR=FS P=MTS	3.33	AQR=Inc Secchi=Inc	3.7	AQR=FS Secchi=MTS				
86-0242-00	Wiegand	4	AQR=Inc Chl-a=Inc			28.4	AQR=Inc P=Inc			2.85	AQR=Inc Secchi=Inc						
86-0243-00	Grass	5	AQR=Inc Chl-a=Inc	5.7	AQR=FS Chl-a=MTS	22.1	AQR=Inc P=Inc	22.8	AQR=FS P=MTS	3.02	AQR=Inc Secchi=Inc	2.6	AQR=FS Secchi=MTS				
86-0246-00	Long			3.4	AQR=IF Chl-a=IF	56	AQR=Inc P=Inc	20	AQR=IF P=IF	.98	AQR=Inc Secchi=Inc						
86-0251-00	Pleasant	12	AQR=Inc Chl-a=Inc	6.3	AQR=FS Chl-a=MTS	28.4	AQR=Inc P=Inc	21.3	AQR=FS P=MTS	2.39	AQR=Inc Secchi=Inc	2.7	AQR=FS Secchi=MTS	-	AQL=IC Fish IBI=IC		
86-0252-01	Clearwater (East)	7	AQR=Inc Chl-a=Inc	5.2	AQR=FS Chl-a=MTS	26.2	AQR=Inc P=Inc	17	AQR=FS P=MTS	2.08	AQR=Inc Secchi=Inc	2.8	AQR=FS Secchi=MTS	-	AQL=FS Fish BI=MTS		WR=IC Sulfate=IC
86-0252-02	Clearwater (West)	14	AQR=Inc Chl-a=Inc	6	AQR=FS Chl-a=MTS	29.5	AQR=Inc P=Inc	23.4	AQR=FS P=MTS	2.37	AQR=Inc Secchi=Inc	2.5	AQR=FS Secchi=MTS	-	AQL=FS Fish BI=MTS		WR=IC Sulfate=IC
86-0281-00	Caroline	31	AQR=Inc Chl-a=Inc	24.2	AQR=NS Chl-a=EXS	53.4	AQR=Inc P=Inc	72.4	AQR=NS P=EXS	1.62	AQR=Inc Secchi=Inc	1.5	AQR=NS Secchi=MTS	-	AQL=FS Fish BI=MTS		
86-0282-00	Louisa	54	AQR=Inc Chl-a=Inc	22.7	AQR=NS Chl-a=EXS	75.3	AQR=Inc P=Inc	130.5	AQR=NS P=EXS	1.22	AQR=Inc Secchi=Inc	1.8	AQR=NS Secchi=MTS	-	AQL=IC Fish IBI=IC		
86-0284-00	Augusta	18	AQR=Inc Chl-a=Inc	11.5	AQR=FS Chl-a=MTS	36.2	AQR=Inc P=Inc	44.8	AQR=FS P=MTS	1.96	AQR=Inc Secchi=Inc	2.1	AQR=FS Secchi=MTS	-	AQL=IC Fish IBI=IC		
86-0297-00	Scott	60	AQR=Inc Chl-a=Inc	39.1	AQR=NS Chl-a=EXS	164.6	AQR=Inc P=Inc	124.6	AQR=NS P=EXS	.83	AQR=Inc Secchi=Inc	1.6	AQR=NS Secchi=IC				
86-0298-00	Union	13	AQR=Inc Chl-a=Inc	11.6	AQR=FS Chl-a=MTS	41.4	AQR=Inc P=Inc	39.6	AQR=FS P=MTS	1.75	AQR=Inc Secchi=Inc	1.7	AQR=FS Secchi=MTS				
86-0498-00	Unnamed									1.67	AQR=Inc Secchi=Inc						

MRSCW Lakes – IWM Cycle 1 & Cycle 2

FS = Full Support
NS = Not Supporting
IF = Insufficient Data
NA = Not Assessed
Chl-a = Chlorophyll-a
P = Phosphorus
IC = Inconclusive
Incomp- Incomplete Assessment, more data likely needed

MRSCW Streams – IWM Cycle 1 & Cycle 2

		Chl-a AQL		Chloride AQL				DO AQL				E.coli AQR				F-IBI-S AQL				M-IBI-S AQL				P AQL		STUBE AQL		TSS AQL	
		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 2		Cycle 2		Cycle 2	
Stream ID	Waterbody Name	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment
07010203-503	Mississippi River											31.72	AQR=IF E.coli=IF																
07010203-505	St Francis River							6.72	AQL=NA DO=EXP																				
07010203-507	Elk River							7.22	AQL=FS DO=IF	7.61	AQL=FS DO=IF	262.84	AQR=NS E.coli=EXS	273.20	AQR=NS E.coli=EXS	59.00	AQL=FS -IBI-S=MTS	61.67	AQL=FS -IBI-S=MTS	75.00	AQL=FS -IBI-S=MT	61.00	AQL=FS -IBI-S=MT	85.25	AQL=FS P=IF	91.17	AQL=FS TUBE=MTS	2.33	AQL=FS TSS=IF
07010203-508	Elk River	1.00	AQL=NS Chl-a=IF					7.32	AQL=NS DO=IF	6.96	AQL=NS DO=IC	418.73	AQR=NS E.coli=EXS	2,574.57	AQR=NS E.coli=EXS	43.33	AQL=NS F-IBI-S=EXS	48.67	AQL=NS F-IBI-S=EXS	48.83	AQL=NS M-IBI-S=EXS	55.33	AQL=NS M-IBI-S=EXS	144.50	AQL=NS P=EXS	88.39	AQL=NS TUBE=MTS	8.03	AQL=NS TSS=MTS
07010203-509	Mayhew Creek							8.56	AQL=NS DO=EXP			1,126.47	AQR=NS E.coli=EXS			38.00	AQL=NS F-IBI-S=EXP			35.00	AQL=NS M-IBI-S=EXS								
07010203-510	Mississippi River			11.72	AQL=Inc Cl=MTS			8.08	AQL=Inc DO=IF			103.96	AQR=NS E.coli=MTS																
07010203-511	Clearwater River	2.73	AQL=NS Chl-a=IF	22.36	AQL=NS Cl=MTS			7.78	AQL=NS DO=EXP	6.85	AQL=NS DO=MTS	70.60	AQR=FS E.coli=MTS	77.25	AQR=IC E.coli=IC	36.00	AQL=NS F-IBI-S=EXP	35.50	AQL=NS F-IBI-S=EXS	41.00	AQL=NS -IBI-S=MT	41.50	AQL=NS -IBI-S=MT	23.26	AQL=NS P=MTS	98.94	AQL=NS TUBE=MTS	4.47	AQL=NS TSS=MTS
07010203-512	Rice Creek			24.38	AQL=NS Cl=MTS	22.65	AQL=IC Cl=IF	6.20	AQL=NS DO=EXP	6.33	AQL=IC DO=IC	1,028.87	AQR=NS E.coli=EXS	290.94	AQR=NS E.coli=EXS	56.00	AQL=NS -IBI-S=MTS	56.00	AQL=IC -IBI-S=MTS	66.00	AQL=NS -IBI-S=MT	67.00	AQL=IC -IBI-S=MT	93.12	AQL=IC P=IC	88.76	AQL=IC TUBE=MTS	5.24	AQL=IC TSS=MTS
07010203-514	Clearwater River			22.16	AQL=NA Cl=MTS			5.87	AQL=NA DO=IF							34.00	AQL=NA F-IBI-S=EXS			22.00	AQL=NA M-IBI-S=EXS								
07010203-515	Willow Creek									4.34	AQL=IC DO=IC													127.19	AQL=IC P=IC			4.46	AQL=IC TSS=MTS
07010203-517	Unnamed stream					31.30	AQL=NA Cl=IF			7.68	AQL=NA DO=NA													64.56	AQL=NA P=NA			10.05	AQL=NA TSS=NA
07010203-522	Tibbets Brook							8.49	AQL=IF DO=IF			203.13	AQR=NS E.coli=EXS																
07010203-525	Elk River									8.60	AQL=NA DO=NA			50.69	AQR=NA E.coli=NA											66.55	AQL=NA STUBE=NA		
07010203-528	Unnamed creek									4.97	AQL=NS DO=IF	1,470.48	AQR=IF E.coli=IF	1,949.51	AQR=IF E.coli=IF	0.00	AQL=NS F-IBI-S=EXS	7.00	AQL=NS F-IBI-S=EXS	8.00	AQL=NS M-IBI-S=EXS	6.00	AQL=NS M-IBI-S=EXS	515.00	AQL=NS P=IF	25.54	AQL=NS STUBE=IF	33.20	AQL=NS TSS=IF
07010203-529	Snake River							9.50	AQL=IF DO=IF	9.57	AQL=NS DO=IF	417.39	AQR=NS E.coli=EXS	546.50	AQR=NS E.coli=EXS			20.00	AQL=NS F-IBI-S=EXS			41.00	AQL=NS -IBI-S=MT	77.13	AQL=NS P=IF	80.56	AQL=NS STUBE=IC	10.38	AQL=NS TSS=IC
07010203-532	County Ditch 20									4.66	AQL=IC DO=IC			1,055.67	AQR=IF E.coli=IF									177.47	AQL=IC P=EXS	24.00	AQL=IC STUBE=IF	15.00	AQL=IC TSS=MTS
07010203-533	County Ditch 20			48.06	AQL=IF Cl=MTS																								
07010203-535	Battle Brook	3.69	AQL=IC Chl-a=IF			15.80	AQL=IC Cl=IF	6.92	AQL=NS DO=IF	5.61	AQL=IC DO=NA	341.87	AQR=NS E.coli=EXS	238.75	AQR=NS E.coli=EXS	17.50	AQL=NS F-IBI-S=EXS			41.00	AQL=NS M-IBI-S=EXS			71.53	AQL=IC P=IC	94.42	AQL=IC TUBE=MTS	5.10	AQL=IC TSS=MTS
07010203-538	Briggs Creek															69.00	AQL=IF -IBI-S=MTS	66.00	AQL=FS -IBI-S=MTS	51.00	AQL=IF -IBI-S=MT	65.00	AQL=FS -IBI-S=MT	29.00	AQL=FS P=IF	73.65	AQL=FS STUBE=IC	0.33	AQL=FS TSS=IF
07010203-541	Lilly Creek																									40.55	AQL=NA STUBE=NA		
07010203-544	Threemile Creek			15.90	AQL=IF Cl=MTS			10.26	AQL=IF DO=IF			253.95	AQR=IF E.coli=IF																
07010203-545	Threemile Creek									8.46	AQL=NS DO=IF					12.50	AQL=IF F-IBI-S=EXS	10.00	AQL=NS F-IBI-S=EXS	82.00	AQL=IF -IBI-S=MT	59.00	AQL=NS -IBI-S=MT	21.33	AQL=NS P=IF	103.77	AQL=NS STUBE=IF	3.27	AQL=NS TSS=IF
07010203-546	Stony Brook					18.60	AQL=IF Cl=IF									40.00	AQL=FS -IBI-S=MTS			51.00	AQL=FS -IBI-S=MT			122.00	AQL=IF P=IF	64.05	AQL=IF STUBE=IF	6.40	AQL=IF TSS=IF
07010203-548	Elk River	15.86	AQL=FS Chl-a=IC	20.17	AQL=FS Cl=MTS			8.16	AQL=FS DO=MTS	8.23	AQL=FS DO=MTS	228.33	AQR=NS E.coli=EXS	134.15	AQR=NS E.coli=EXS	47.00	AQL=FS -IBI-S=MTS	57.00	AQL=FS -IBI-S=MTS	46.00	AQL=FS -IBI-S=MT	81.00	AQL=FS -IBI-S=MT	100.43	AQL=FS P=IC	76.27	AQL=FS TUBE=MTS	9.96	AQL=FS TSS=MTS
07010203-549	Clearwater River	10.88	AQL=NS Chl-a=IC	25.58	AQL=NS Cl=MTS	14.40	AQL=NS Cl=IF	5.08		4.80	AQL=NS DO=MTS			888.11	AQR=NS E.coli=EXS			47.50	AQL=NS -IBI-S=MTS			46.75	AQL=NS -IBI-S=MT	285.89	AQL=NS P=EXS	62.33	AQL=NS STUBE=IF	29.95	AQL=NS TSS=EXS
07010203-550	County Ditch 44			32.16	AQL=IF Cl=MTS					3.81	AQL=IF DO=IF			106.92	AQR=IF E.coli=IF														
07010203-552	Fish Creek																									83.80	AQL=NA STUBE=NA		
07010203-554	Fish Creek																									60.45	AQL=NA STUBE=NA		
07010203-555	Silver Creek																	42.00	AQL=FS -IBI-S=MTS			50.00	AQL=FS -IBI-S=MT	81.00	AQL=FS P=IF	86.53	AQL=FS TUBE=MTS	8.60	AQL=FS TSS=IF
07010203-557	Silver Creek							4.77	AQL=NS DO=EXS	4.53	AQL=NS DO=NA	132.57	AQR=NS E.coli=EXS	117.20	AQR=NS E.coli=IC	14.50	AQL=NS F-IBI-S=EXS			24.00	AQL=NS M-IBI-S=EXS			82.71	AQL=NS P=NA	72.86	AQL=NS STUBE=NA	5.03	AQL=NS TSS=NA
07010203-558	Snake River																	26.00	AQL=NS F-IBI-S=EXS	66.00	AQL=NA M-IBI-S=NA	62.50	AQL=NS -IBI-S=MT	65.00	AQL=NS P=IF	96.57	AQL=NS STUBE=IF	9.00	AQL=NS TSS=IF
07010203-559	Battle Brook	5.22	AQL=IF Chl-a=IF			10.70	AQL=IF Cl=IF																	432.00	AQL=IF P=IF			10.00	AQL=IF TSS=IF

MRSCW Streams – IWM Cycle 1 & Cycle 2

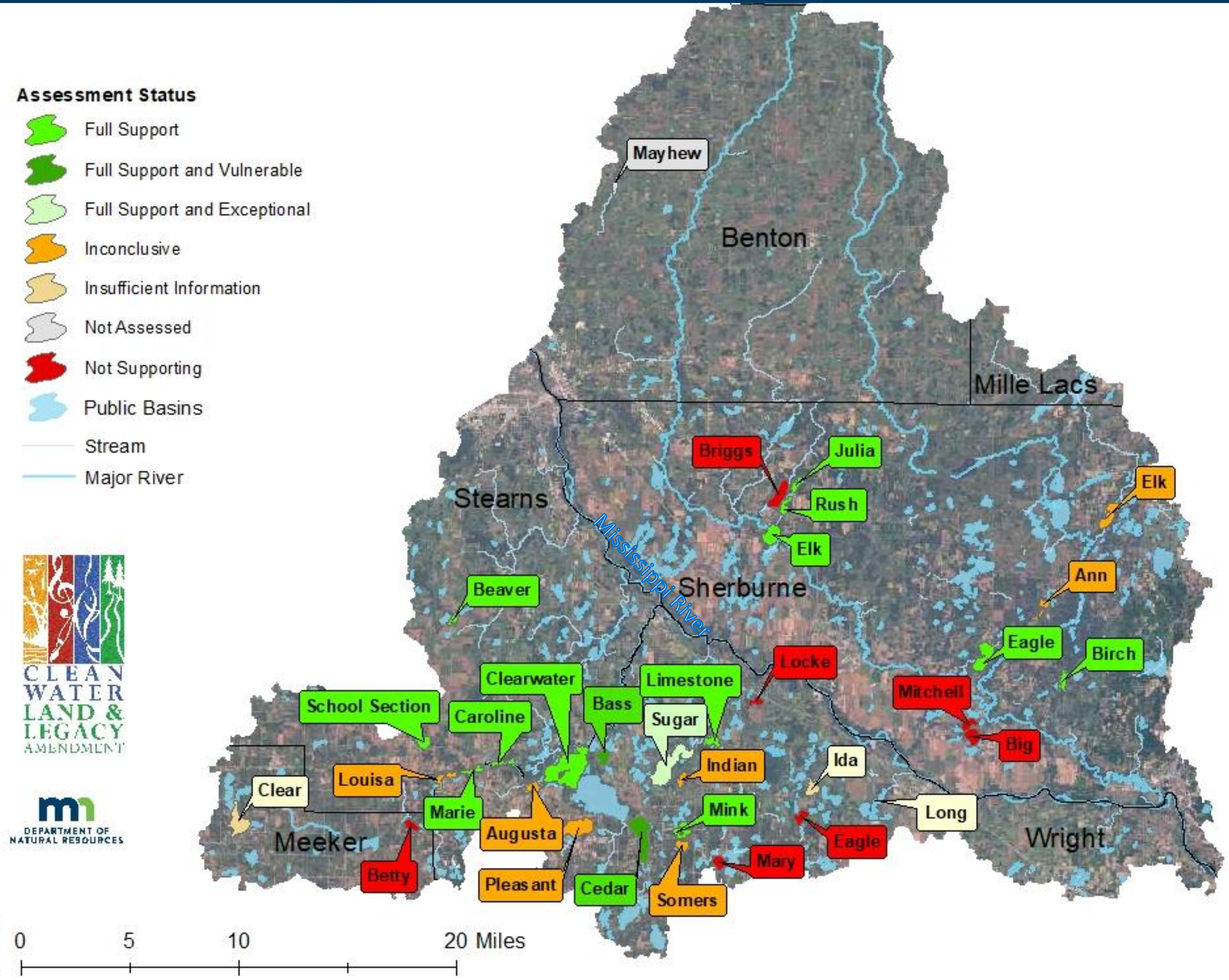
		Chl-a AQL		Chloride AQL				DO AQL				E.coli AQR				F-IBI-S AQL				M-IBI-S AQL				P AQL		STUBE AQL		TSS AQL	
		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 2		Cycle 2		Cycle 2	
Stream ID	Waterbody Name	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment
07010203-560	Unnamed creek (Robinson Hill Creek)			40.62	AQL=NA Cl=MTS			8.19	AQL=NA DO=EXP			451.41	AQR=Inc E.coli=EXS																
07010203-561	Unnamed creek (Luxemburg Creek)			27.04	AQL=FS Cl=MTS			9.59	AQL=FS DO=IF	9.54	AQL=FS DO=IF	525.23	AQR=NS E.coli=EXS			57.00	AQL=FS -IBI-S=MTS	39.00	AQL=FS -IBI-S=MTS	83.00	AQL=FS -IBI-S=MT	58.00	AQL=FS -IBI-S=MT	37.67	AQL=FS P=IF	107.54	AQL=FS STUBE=IF	5.50	AQL=FS TSS=IF
07010203-564	Threemile Creek (Hanson Brook)									7.12	AQL=NS DO=IF							18.00	AQL=NS F-IBI-S=EXS			30.00	AQL=NS M-IBI-S=EXS	62.00	AQL=NS P=IF	100.00	AQL=NS STUBE=IF	14.00	AQL=NS TSS=IF
07010203-565	Unnamed creek (Fairhaven Creek)			13.78	AQL=IF Cl=MTS			9.27	AQL=IF DO=IF	8.68	AQL=IF DO=IF	368.41	AQR=NS E.coli=EXS											85.00	AQL=IF P=IF			38.32	AQL=IF TSS=IF
07010203-566	Unnamed creek (Thiel Creek)									8.20	AQL=FS DO=IF							48.00	AQL=FS -IBI-S=MTS			69.00	AQL=FS -IBI-S=MT	33.58	AQL=FS P=IF			4.20	AQL=FS TSS=IF
07010203-570	Unnamed creek (Warner Creek)									2.37	AQL=NA DO=NA													187.67	AQL=NA P=NA			9.67	AQL=NA TSS=NA
07010203-572	Plum Creek			15.37	AQL=IF Cl=MTS			8.28	AQL=IF DO=IF	8.58	AQL=FS DO=IF	304.77	AQR=NS E.coli=EXS	88.05	AQR=FS E.coli=MTS			59.00	AQL=FS -IBI-S=MTS			62.00	AQL=FS -IBI-S=MT	22.00	AQL=FS P=IF	82.84	AQL=FS TUBE=MTS	3.40	AQL=FS TSS=IF
07010203-574	Mississippi River			9.57	AQL=IF Cl=MTS			8.39	AQL=IF DO=IF			46.56	AQR=NS E.coli=IF																
07010203-577	Unnamed creek									2.94	AQL=NA DO=NA													771.60	AQL=NA P=NA			25.20	AQL=NA TSS=NA
07010203-579	Elk River	66.76	AQL=IC Chl-a=IF					8.02		7.11	AQL=IC DO=IC	398.67	AQR=NS E.coli=IF	210.05	AQR=NS E.coli=EXS	43.00	AQL=NS F-IBI-S=EXP	48.50	AQL=IC -IBI-S=MTS	51.83	AQL=NS -IBI-S=MT	55.50	AQL=IC -IBI-S=MT	107.00	AQL=IC P=IF	66.66	AQL=IC TUBE=MTS	20.97	AQL=IC TSS=IC
07010203-581	Elk River																									81.90	AQL=IF TUBE=MTS		
07010203-585	Unnamed creek																									77.70	AQL=NA STUBE=NA		
07010203-587	Unnamed creek									7.55	AQL=NA DO=NA							0.00	AQL=NA F-IBI-S=NA			25.50	AQL=NA M-IBI-S=NA	227.13	AQL=NA P=NA	79.49	AQL=NA STUBE=NA	5.70	AQL=NA TSS=NA
07010203-588	Unnamed creek									3.71	AQL=IF DO=IF			958.67	AQR=IF E.coli=IF														
07010203-589	Unnamed creek									3.56	AQL=NA DO=NA			776.00	AQR=IF E.coli=IF														
07010203-593	Unnamed creek	3.03	AQL=NA Chl-a=NA							7.95	AQL=NA DO=NA													152.06	AQL=NA P=NA			30.35	AQL=NA TSS=NA
07010203-595	Unnamed creek	1.04	AQL=NA Chl-a=NA							5.33	AQL=NA DO=NA													209.44	AQL=NA P=NA			4.88	AQL=NA TSS=NA
07010203-597	Unnamed creek	1.00	AQL=NA Chl-a=NA							9.16	AQL=NA DO=NA													273.00	AQL=NA P=NA			155.00	AQL=NA TSS=NA
07010203-598	Unnamed creek	2.08	AQL=NA Chl-a=NA							8.82	AQL=NA DO=NA													136.66	AQL=NA P=NA	100.00	AQL=NA STUBE=NA	8.22	AQL=NA TSS=NA
07010203-604	Unnamed creek									8.31	AQL=NA DO=NA													26.83	AQL=NA P=NA			4.03	AQL=NA TSS=NA
07010203-611	Unnamed creek			13.70	AQL=IF Cl=MTS																								
07010203-619	Unnamed creek (Thiel Creek Tributary)									5.50	AQL=IF DO=IF													53.33	AQL=IF P=IF			2.53	AQL=IF TSS=IF
07010203-633	Johnson Creek (Meyer Creek)									9.01	AQL=IF DO=IF			1,895.50	AQR=NS E.coli=EXS	39.00	AQL=FS -IBI-S=MTS			67.00	AQL=FS -IBI-S=MT					81.25	AQL=IF STUBE=IF		
07010203-635	Johnson Creek (Meyer Creek)			25.27	AQL=IF Cl=MTS			8.89	AQL=IF DO=IF	8.60	AQL=IF DO=IC	676.83	AQR=NS E.coli=EXS	698.44	AQR=NS E.coli=EXS											79.72	AQL=IF TUBE=MTS		
07010203-639	Johnson Creek (Meyer Creek)			29.32	AQL=NS Cl=MTS			8.41	AQL=NS DO=IF	8.44	AQL=IC DO=MTS	2,425.58	AQR=NS E.coli=EXS	1,589.37	AQR=NS E.coli=EXS	31.00	AQL=NS F-IBI-S=EXS	53.29	AQL=IC F-IBI-S=IC	48.00	AQL=NS -IBI-S=MT	64.17	AQL=IC -IBI-S=MT	53.86	AQL=IC P=MTS	75.47	AQL=IC TUBE=MTS	15.10	AQL=IC TSS=IC
07010203-662	Silver Creek															0.00	AQL=NS F-IBI-S=EXS			37.00	AQL=NS M-IBI-S=EXP								
07010203-674	Mayhew Creek									3.97	AQL=IF DO=IF																		
07010203-675	Mayhew Creek									2.22	AQL=IF DO=IF					24.00	AQL=NS F-IBI-S=EXS			38.00	AQL=NS M-IBI-S=EXS								
07010203-684	Unnamed creek																	46.00	AQL=FS -IBI-S=MTS			65.00	AQL=FS -IBI-S=MT	87.00	AQL=FS P=IF	97.67	AQL=FS STUBE=IF	5.60	AQL=FS TSS=IF
07010203-688	Unnamed creek							8.06	AQL=IF DO=IF			518.11	AQR=IF E.coli=IF																
07010203-689	Unnamed creek							8.80	AQL=IF DO=IF			426.11	AQR=IF E.coli=IF																
07010203-690	Otter Creek																	72.00	AQL=FS -IBI-S=MTS			52.00	AQL=FS -IBI-S=MT	25.00	AQL=FS P=IF	107.54	AQL=FS STUBE=IF	5.00	AQL=FS TSS=IF

MRSCW Streams – IWM Cycle 1 & Cycle 2

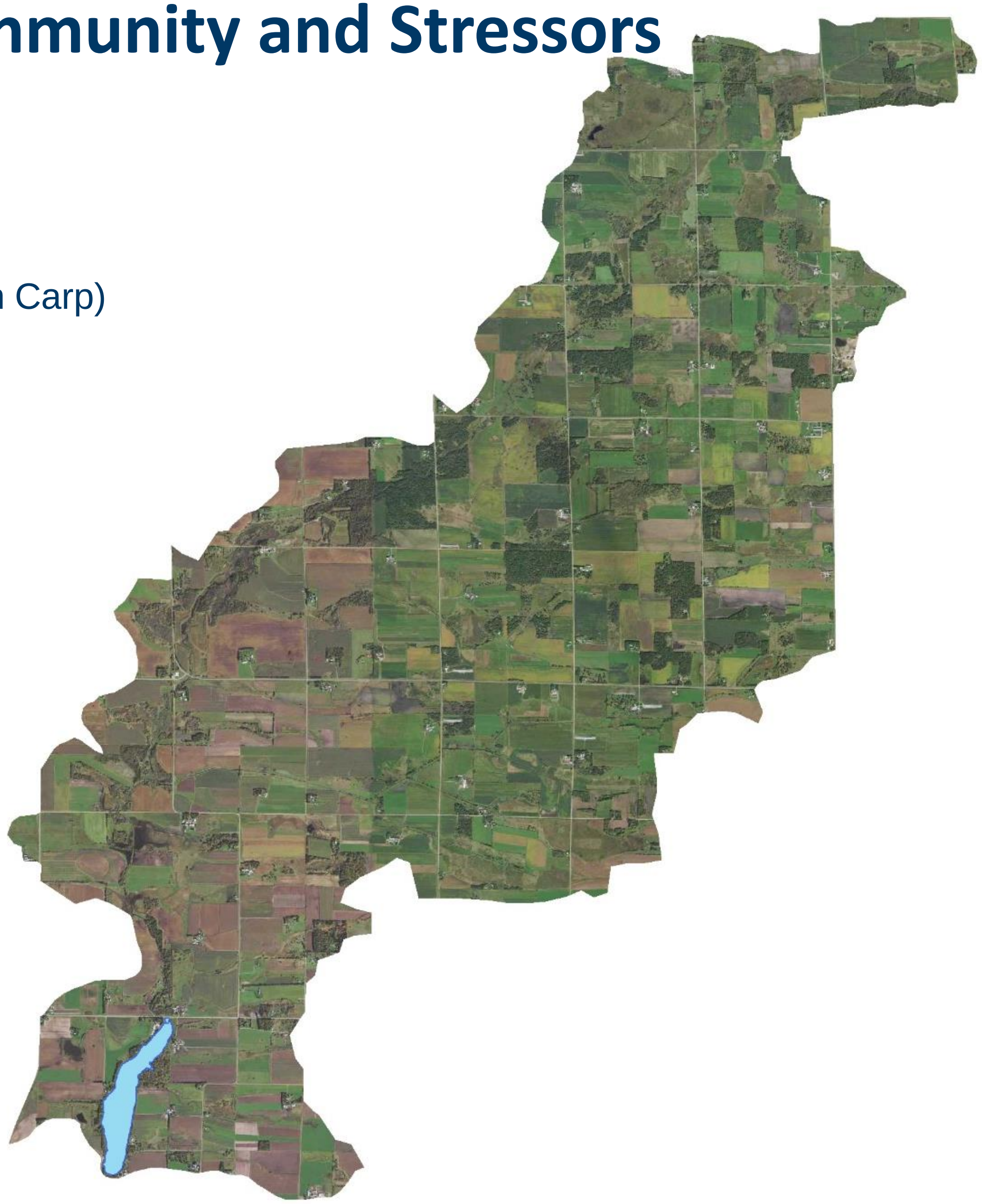
		Chl-a		Chloride				DO				E.coli				F-IBI-S				M-IBI-S				P		STUBE		TSS	
		AQL		AQL				AQL				AQR				AQL				AQL				AQL		AQL		AQL	
		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 1		Cycle 2		Cycle 2		Cycle 2		Cycle 2	
Stream ID	Waterbody Name	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment	Mean Value	Assess-ment
07010203-692	Unnamed creek (Eagle Lake Outlet)							9.10	AQL=IF DO=IF			132.00	AQR=Inc E.coli=NA																
07010203-693	West Branch (St Francis River, West Branch)																	43.00	AQL=NS F-IBI-S=EXS			52.00	AQL=NS M-IBI-S=EXS	97.50	AQL=NS P=IF	107.54	AQL=NS STUBE=IF	2.67	AQL=NS TSS=IF
07010203-700	St Francis River							6.93	AQL=NS DO=IF	7.23	AQL=NS DO=IC	249.47	AQR=NS E.coli=EXS	455.31	AQR=NS E.coli=EXS	39.00	AQL=NS F-IBI-S=EXP	46.00	AQL=NS F-IBI-S=EXS	44.33	AQL=NS M-IBI-S=EXP	59.75	AQL=NS -IBI-S=MT	116.00	AQL=NS P=IC	84.93	AQL=NS TUBE=MTS	7.27	AQL=NS TSS=MTS
07010203-702	St Francis River							5.64	AQL=NS DO=IF	5.48	AQL=NS DO=NA	105.67	AQR=FS E.coli=MTS			28.50	AQL=NS F-IBI-S=EXP	37.50	AQL=NS F-IBI-S=EXS	72.00	AQL=NS -IBI-S=MT	50.50	AQL=NS -IBI-S=MT	85.42	AQL=NS P=MTS	97.80	AQL=NS TUBE=MTS	4.91	AQL=NS TSS=MTS
07010203-704	St Francis River									5.21	AQL=NS DO=IC					41.25	AQL=NS F-IBI-S=EXP	44.50	AQL=NS F-IBI-S=EXS	44.67	AQL=NS -IBI-S=MT	58.00	AQL=NS -IBI-S=MT	48.50	AQL=NS P=IF	86.21	AQL=NS TUBE=MTS	2.17	AQL=NS TSS=IF
07010203-705	County Ditch 44					18.70	AQL=NA Cl=NA			3.48	AQL=NA DO=NA													299.72	AQL=NA P=NA	100.00	AQL=NA STUBE=NA	11.51	AQL=NA TSS=NA
07010203-708	Unnamed creek					22.20	AQL=IF Cl=IF			1.94	AQL=IF DO=NA													374.50	AQL=IF P=NA			4.58	AQL=IF TSS=NA
07010203-710	Unnamed creek									7.99	AQL=NA DO=NA													366.13	AQL=NA P=NA			31.83	AQL=NA TSS=NA
07010203-712	Unnamed creek									1.39	AQL=NA DO=NA													428.50	AQL=NA P=NA			4.63	AQL=NA TSS=NA
07010203-717	Clearwater River			22.66	AQL=NS Cl=MTS											35.00	AQL=NS F-IBI-S=EXS	46.00	AQL=NS F-IBI-S=EXS	22.00	AQL=NS M-IBI-S=EXS	38.00	AQL=NS -IBI-S=MT	83.00	AQL=NS P=IF	107.54	AQL=NS STUBE=IF	6.80	AQL=NS TSS=IF
07010203-721	Clearwater River																							44.75	AQL=IF P=IF				
07010203-724	Unnamed creek (Robinson Hill Creek)			40.62	AQL=IF Cl=MTS			7.92	AQL=IF DO=IF	7.67	AQL=IF DO=IF	478.49	AQR=NS E.coli=EXS	452.00	AQR=NS E.coli=EXS											88.30	AQL=IF TUBE=MTS		
07010203-726	Mayhew Creek									4.30	AQL=IF DO=IF															107.54	AQL=IF STUBE=IF		
07010203-731	Unnamed creek									4.07	AQL=NA DO=NA													89.00	AQL=NA P=NA			13.50	AQL=NA TSS=NA
07010203-732	Unnamed creek (County Ditch 39)									7.30	AQL=IF DO=IF			787.27	AQR=NA E.coli=NA											68.14	AQL=IF TUBE=MTS		
07010203-733	Unnamed creek					7.35	AQL=IC Cl=IF			1.16	AQL=IC DO=IC													532.04	AQL=IC P=EXS	100.00	AQL=IC STUBE=IC	11.81	AQL=IC TSS=IC
07010203-734	Unnamed creek									2.55	AQL=NA DO=NA													286.75	AQL=NA P=NA			12.63	AQL=NA TSS=NA
07010203-736	Tibbits Brook									9.47	AQL=FS DO=IC			252.25	AQR=NS E.coli=EXS			70.00	AQL=FS -IBI-S=MTS			66.00	AQL=FS -IBI-S=MT	123.00	AQL=FS P=IF	89.71	AQL=FS TUBE=MTS	3.75	AQL=FS TSS=IF
07010203-737	County Ditch 20					27.00	AQL=IC Cl=IF			6.54	AQL=IC DO=IC			789.00	AQR=IF E.coli=IF									340.95	AQL=IC P=EXS	24.50	AQL=IC STUBE=IF	14.37	AQL=IC TSS=IC
07010203-738	County Ditch 20					33.30	AQL=IC Cl=IF			5.08	AQL=IC DO=IC			1,353.33	AQR=IF E.coli=IF									625.04	AQL=IC P=EXS	100.00	AQL=IC STUBE=IF	19.53	AQL=IC TSS=MTS
07010203-749	Mayhew Creek									1.12	AQL=IC DO=IC							41.00	AQL=IC -IBI-S=MTS			46.00	AQL=IC -IBI-S=MT	208.50	AQL=IC P=IF	72.57	AQL=IC TUBE=MTS	11.60	AQL=IC TSS=IF
07010203-750	Mayhew Creek	2.70	AQL=NS Chl-a=IF							5.66	AQL=NS DO=EXS			3,130.07	AQR=NS E.coli=EXS							41.00	AQL=NS -IBI-S=MT	243.24	AQL=NS P=EXS	91.37	AQL=NS TUBE=MTS	5.84	AQL=NS TSS=MTS
07010203-900	Unnamed inlet																									76.83	AQL=NA STUBE=NA		
07010203-902	Unnamed creek																							147.57	AQL=NA P=NA	71.83	AQL=NA STUBE=NA	6.14	AQL=NA TSS=NA

FS = Full Support
NS = Not Supporting
IF = Insufficient Data
NA = Not Assessed
Chl-a = Chlorophyll-a
P = Phosphorus
IC = Inconclusive
Incomp- Incomplete Assessment, more data likely needed

Appendix C - Mississippi River – St. Cloud Watershed DNR Fish IBI Stressor ID



Summary of Mayhew Lake 05-0007-00 Fish Community and Stressors



Fish IBI Scores: Not Assessable (Winterkill)

- Tool 5, General Use Threshold = 24
- 4 tolerant species (Black Bullhead, Fathead Minnow, Green sunfish, Common Carp)
- 0 intolerant species
- Positive Influences: No strong positive influences
- Negative Influences:
  - ↑ Number of tolerant species present
  - ↓ Biomass from insectivores in TN
  - ↑ Biomass from omnivores in TN
  - ↓ Biomass from top carnivores in the GN

Stressors:

- **Candidate Cause:**
  - Eutrophication (excess nutrients): 267 ppb mean total phosphorus,
  81% of contributing watershed is classified as unnatural land cover.
  Not supporting aquatic plant eutrophication IBI (low diversity and FQI)

- **Inconclusive Cause:**
  - Altered interspecific Competition: Curly-leaf Pondweed, and Common Carp.
  - Watershed:Lake – 140:1

- **Eliminated Cause:**
  - Physical habitat alteration: Low dock density of 4 docks per mile of shoreline.

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover.

Summary of Long Lake 86-0069-00 Fish Community

Not Assessable (less than 100 acres)

- Lake Stats
  - 96 acres
  - Max depth 35 ft.
  - Lake class 30
  - 67% Littoral

- Potential Stressors:
  - Watershed:Lake = 124:1
  - Avg seasonal TP = 22 ppb
  - 48% Watershed Disturbance
  - Score the Shore = n/a

Summary of Lake Mitchell 71-0081-00 Fish Community and Stressors

- **Fish Community: Not Supporting**
  - Fish IBI Scores: 43 (2019), 39 (2017) - Tool 2, Threshold 45
  - Negative Influences: 2 tolerant species (Green Sunfish, Fathead Minnow)
    - ↓ Relative abundance of small benthic dwelling species
    - ↓ Relative abundance of intolerant species
  - Positive Influences: 2 intolerant species (Blacknose Shiner, Iowa Darter)
    - ↑ Biomass insectivores

- **Candidate Cause:**
  - Physical habitat alteration: Low lake wide Score the Shore of 53.
  - High Dock density of 47.6 docks/mile.

- **Inconclusive Cause:**
  - Eutrophication (Excess nutrients). A low Watershed:Lake ratio of 12:1 with high Watershed Disturbance of 69%. High urban development of 46%, followed by cultivated crops 18.2% and 3.8% pasture/hay.
  - Potentially lower availability of natural habitat diversity

- **Recommendations:**
  - Promote the restoration of natural shoreline buffers at developed sites.
  - Encourage the protection and restoration of floating-leaf and emergent aquatic vegetation.
  - Limit removal of native aquatic plant communities (submerged, floating leaved and emergent).

Summary of Big Lake 71-0082-00 Fish Community and Stressors

- **Fish Community: Not Supporting**
    - Fish IBI Scores: 30 (2017) – Tool 2, Threshold 45
    - Positive Influences:
        - 3 intolerant species (Blacknose Shiner, Iowa Darter, Mimic Shiner)
        - ↑ Number Cyprinid species sampled
    - Negative Influences:
        - 3 tolerant species (Common Carp, Green Sunfish, Fathead Minnow)
        - ↑ Biomass from tolerant species in TN
        - ↑ Number omnivore species sampled
        - ↑ Biomass from omnivores in TN

- **Candidate Cause:**
    - Physical habitat alteration: Very Low lakewide Score the Shore of 49.
    - High dock density of 44.3 docks/mile

- **Inconclusive Cause:**
    - Eutrophication (Excess nutrients): A low Watershed:Lake ratio of 6:1 with high Watershed Disturbance of 71%, consisting of High urban development of 43.1%, followed by cultivated crops 23.0% and 4.5% pasture/hay.
    - Average seasonal TP is 16 ppb, which is good considering the development pressure.
    - Potentially lower availability of natural habitat diversity

- **Recommendations:**
    - Promote the restoration of natural shoreline buffers at developed sites.
    - Encourage the protection and restoration of floating-leaf and emergent aquatic vegetation.
    - Limit removal of native aquatic plant communities (submerged, floating leaved and emergent).

Summary of Briggs Lake 71-0146-00 Fish Community and Stressors

- **Fish Community:** **Not Supporting**
  - **Fish IBI Scores:** 24 (2016), 23 (1999) - Tool 2, Threshold = 45

  Positive Influences:
    - ↑ Number of small benthic dwelling species
    - 4 intolerant species (Smallmouth Bass, Iowa Darter, Log Perch, Rock Bass)

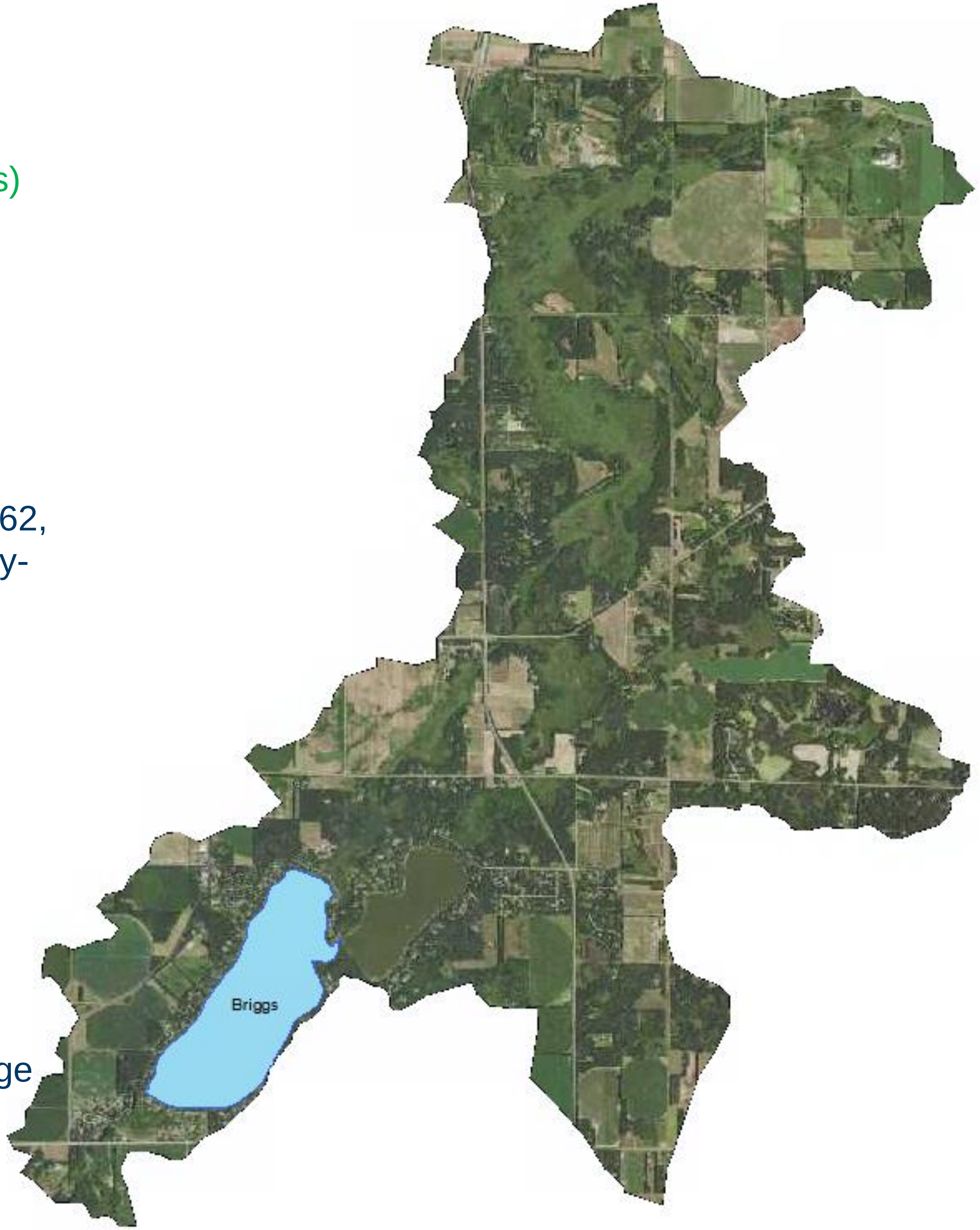
  Negative Influences:
    - 3 tolerant species (Common Carp, Black Bullhead, Green Sunfish)
    - ↓ Biomass from insectivores
    - ↑ Biomass from tolerant species
    - ↓ Biomass from top carnivores

- **Candidate Cause:**
  - Physical habitat alteration: Low lakewide Score the Shore (StS) habitat score of 62, and high dock density of 42 docks per mile of shoreline, Common Carp and Curly-leaf Pondweed present.

  - Eutrophication (excess nutrients): 94 ppb mean total phosphorus, 49% of contributing watershed is classified as unnatural land cover consisting of 30% cultivated cropland, 6% urban, and 13% hay / pastureland.

- **Inconclusive Cause:**
  - Altered intraspecific competition: Curley-leaf pondweed and Common Carp are present.

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover
  - Promote the restoration of natural shoreline buffers at developed sites and encourage the protection of floating-leaf and emergent aquatic vegetation.



Summary of Eagle Lake 86-0148-00 Fish Community and Stressors

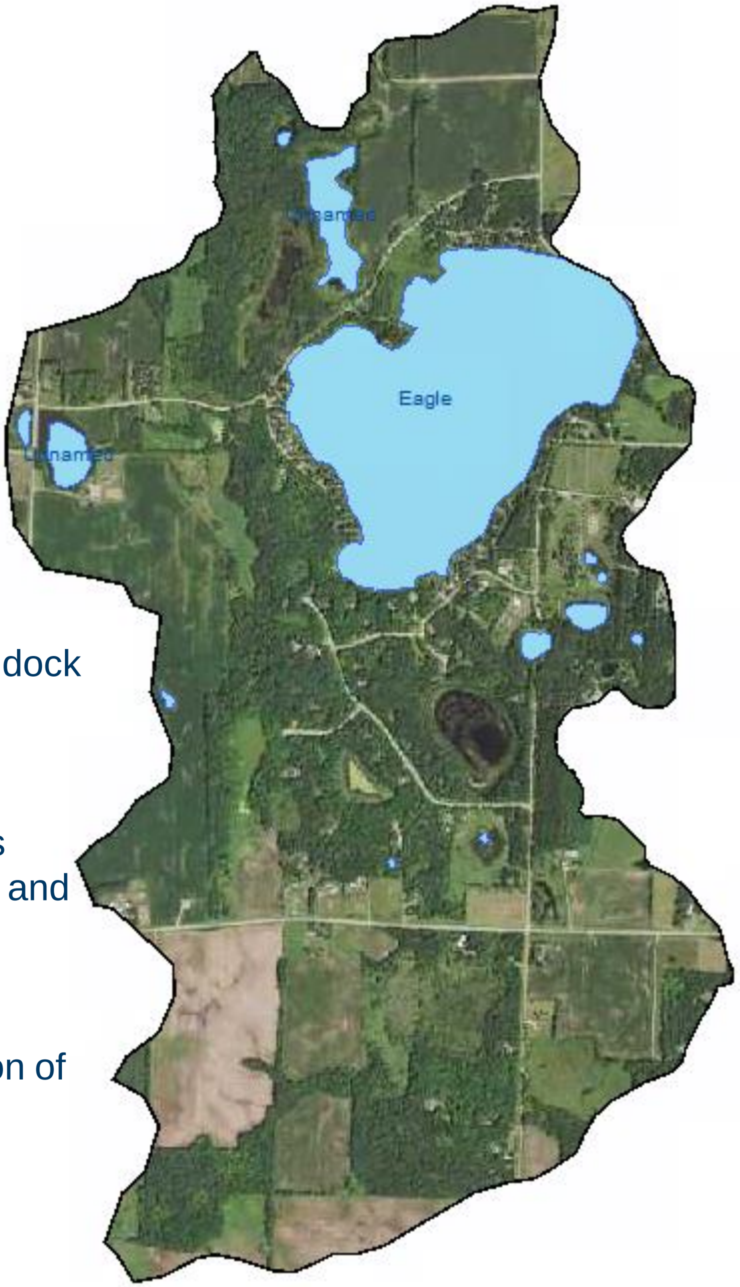
- **Fish Community: Not Supporting**
  - **Fish IBI Scores:** 31 (2016), Tool 2, Threshold = 45
  - 4 tolerant species (Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish)
  - 4 intolerant species (Banded Killifish, Blackchin Shiner, Blacknose Shiner, Iowa Darter)
  - Positive Influences:
    - ↑ Number Cyprinid species sampled
  - Negative Influences:
    - ↓ Biomass from top carnivores
    - ↑ Number of omnivore species
    - ↓ Relative abundance of small benthic dwelling species

Stressors:

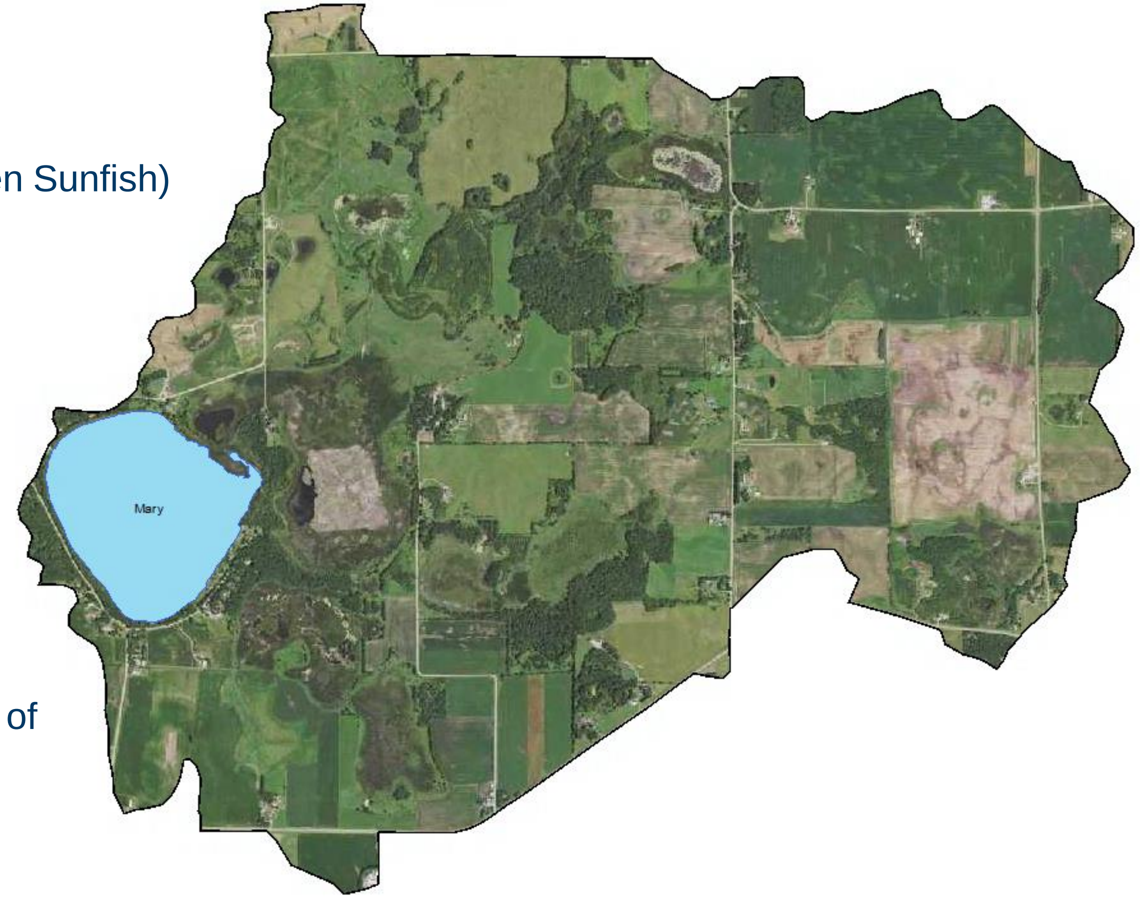
- **Candidate Cause:**
  - Physical habitat alteration: Low lakewide Score the Shore (StS) habitat score of 59, and moderate dock density of 26.9 docks per mile of shoreline.

- **Inconclusive Cause:**
  - Eutrophication (excess nutrients): 29 ppb mean total phosphorus, 48% of contributing watershed is classified as unnatural land cover consisting of 34% cultivated cropland, and 7% hay / pastureland and 7% developed.

- **Recommendations:**
  - Promote the restoration of natural shoreline buffers at developed sites and encourage the protection of floating-leaf and emergent aquatic vegetation.
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover.



Summary of Mary Lake 86-0156-00 Fish Community and Stressors



- **Fish Community: Not Supporting**
  - **<u>Fish IBI Scores:</u>** 15 (2017), Tool 2, Threshold = 45
  - 4 tolerant species (Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish)
  - 0 intolerant species
  - Positive Influences:
    - No strong positive influences
  - Negative Influences:
    - ↑ Biomass from tolerant species in TN
    - ↓ Relative abundance of intolerant species in NS
    - ↑ Number of tolerant species sampled

<u>Stressors:</u>

- **Candidate Cause:**
  - <u>Eutrophication (excess nutrients):</u> 21 ppb mean total phosphorus, 69% of contributing watershed is classified as unnatural land cover consisting of 54% cultivated cropland, and 11% hay/pastureland and 4% developed.
  - Not supporting aquatic plant eutrophication IBI (low diversity and FQI)

- **Inconclusive Cause:**
  - <u>Altered interspecific Competition</u>: Curly-leaf Pondweed, Eurasian watermilfoil, and Common Carp are present.

- **Eliminated Cause:**
  - <u>Physical habitat alteration:</u> High lakewide Score the Shore (StS) habitat score of 85, and low dock density of 7.1 docks per mile of shoreline.

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover.

Summary of Locke Lake 86-0168-00 Fish Community and Stressors

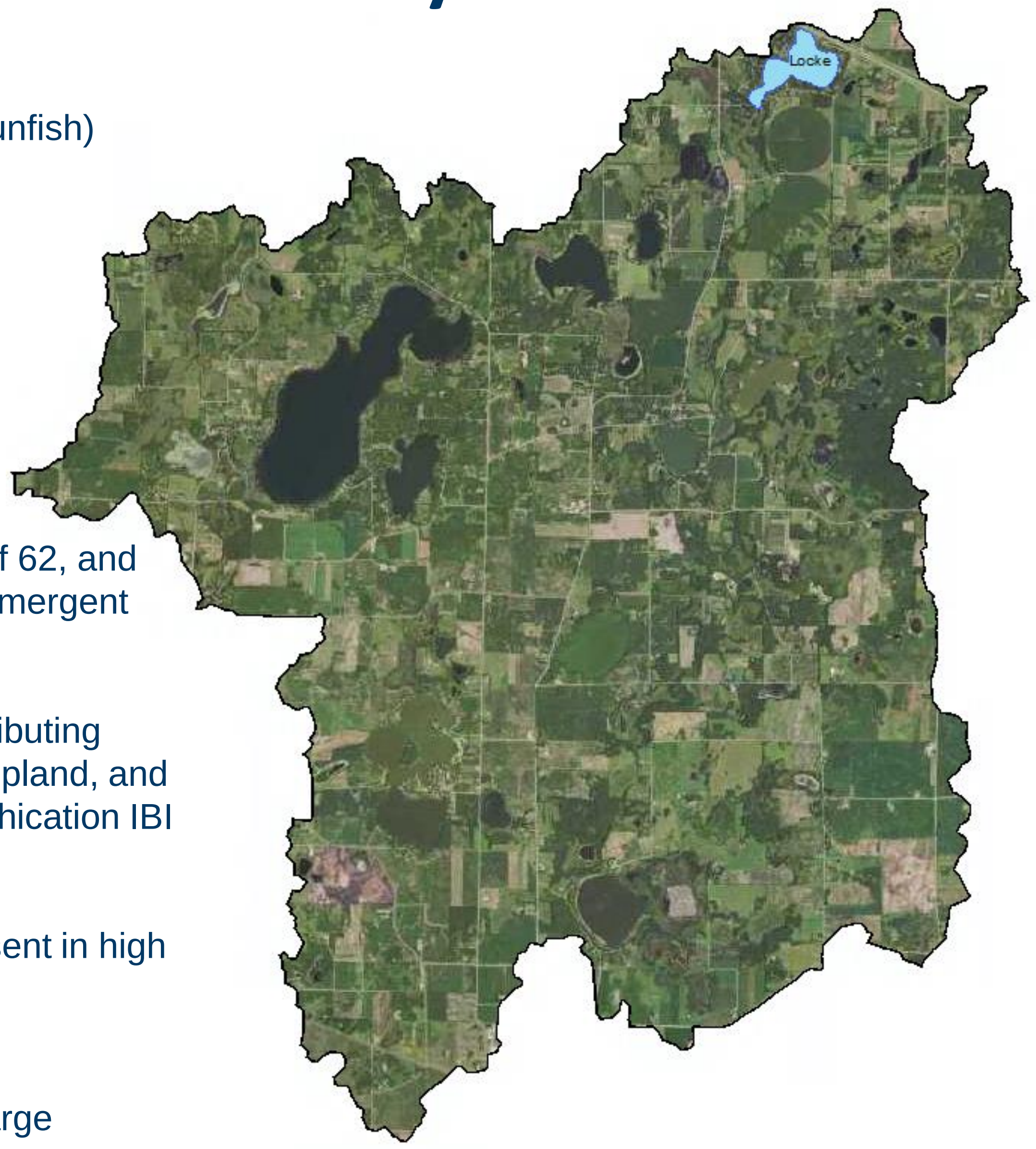
- **Fish Community:** **Not Supporting**
- **<u>Fish IBI Scores:</u>** 27 (2016), - Tool 2, Threshold = 45
  - 4 tolerant species (Bigmouth Buffalo, Black Bullhead, Common Carp, Green Sunfish)
  - 1 intolerant species (Smallmouth Bass)
  - Positive Influences:
    - Presence of intolerant species in the GN
  - Negative Influences:
    - ↑ Biomass from tolerant species in TN
    - ↑ Number of tolerant species sampled
    - ↓ Number of vegetation dwelling species sampled

- **Candidate Cause:**
  - Physical habitat alteration: Low lakewide Score the Shore (StS) habitat score of 62, and high dock density of 33 docks per mile of shoreline. Very limited Floating and Emergent Vegetation

  - Eutrophication (excess nutrients): 57 ppb mean total phosphorus, 60% of contributing watershed is classified as unnatural land cover consisting of 43% cultivated cropland, and 11% hay / pastureland, and 6% developed. Not supporting aquatic plant eutrophication IBI (low diversity and FQI)

  - Altered interspecific Competition: Common Carp and Curly leaf pondweed present in high abundane. Previous history or large scale fish management.

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover
  - Promote the restoration of natural shoreline buffers at developed sites and encourage the protection of floating-leaf and emergent aquatic vegetation.



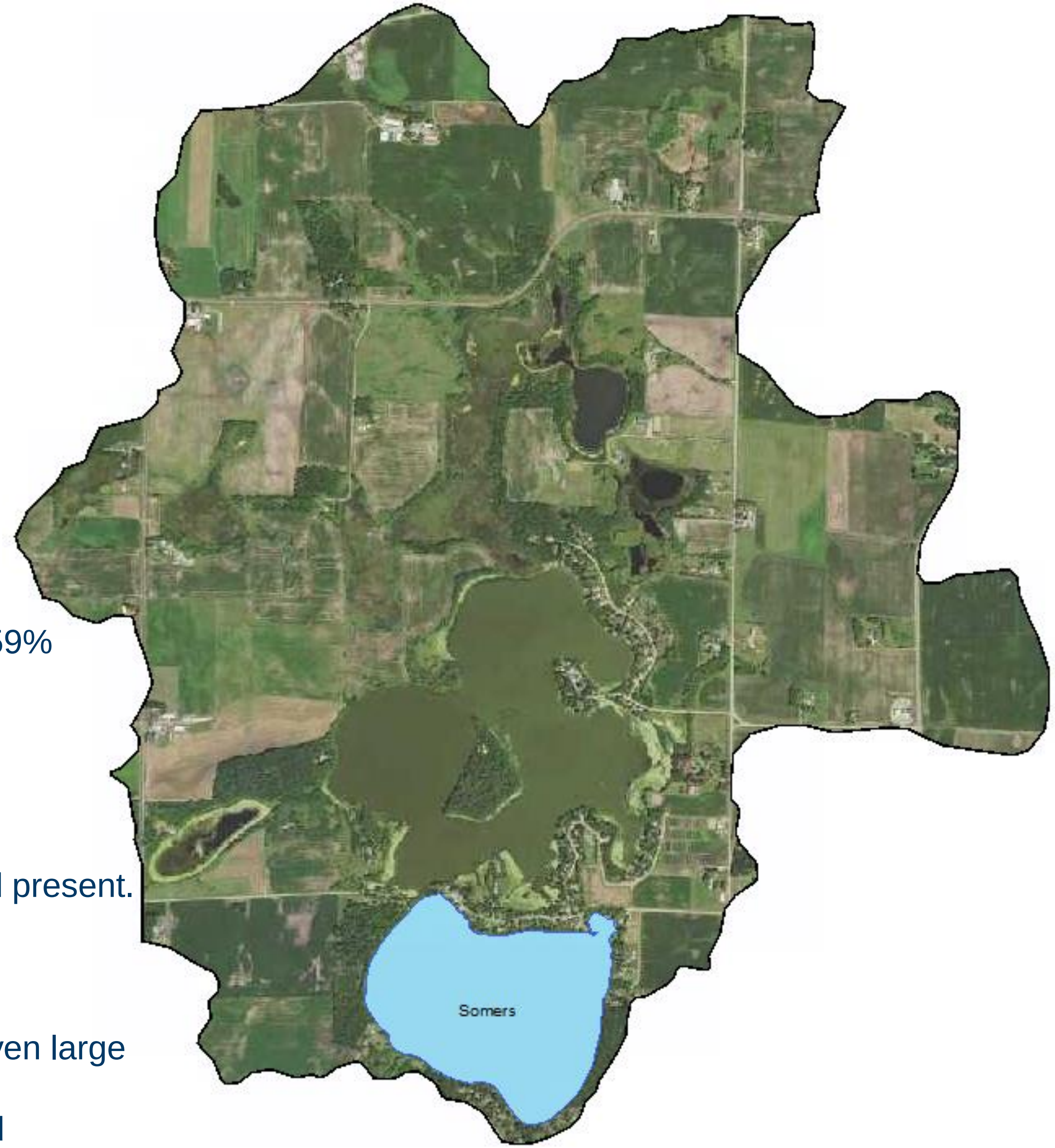
Summary of Somers Lake 86-0230-00 Fish Community and Stressors

- **Fish Community: Not Supporting**
- **<u>Fish IBI Scores:</u>** 35 (2016), 38 (2007) - Tool 7, Threshold = 36
  - 1 tolerant species (Common Carp)
  - 0 intolerant species ()
  - Positive Influences:
    - ↓ Number of omnivore species sampled
  - Negative Influences:
    - ↓ Number of small benthic dwelling species sampled
    - ↑ Biomass from tolerant species in TN

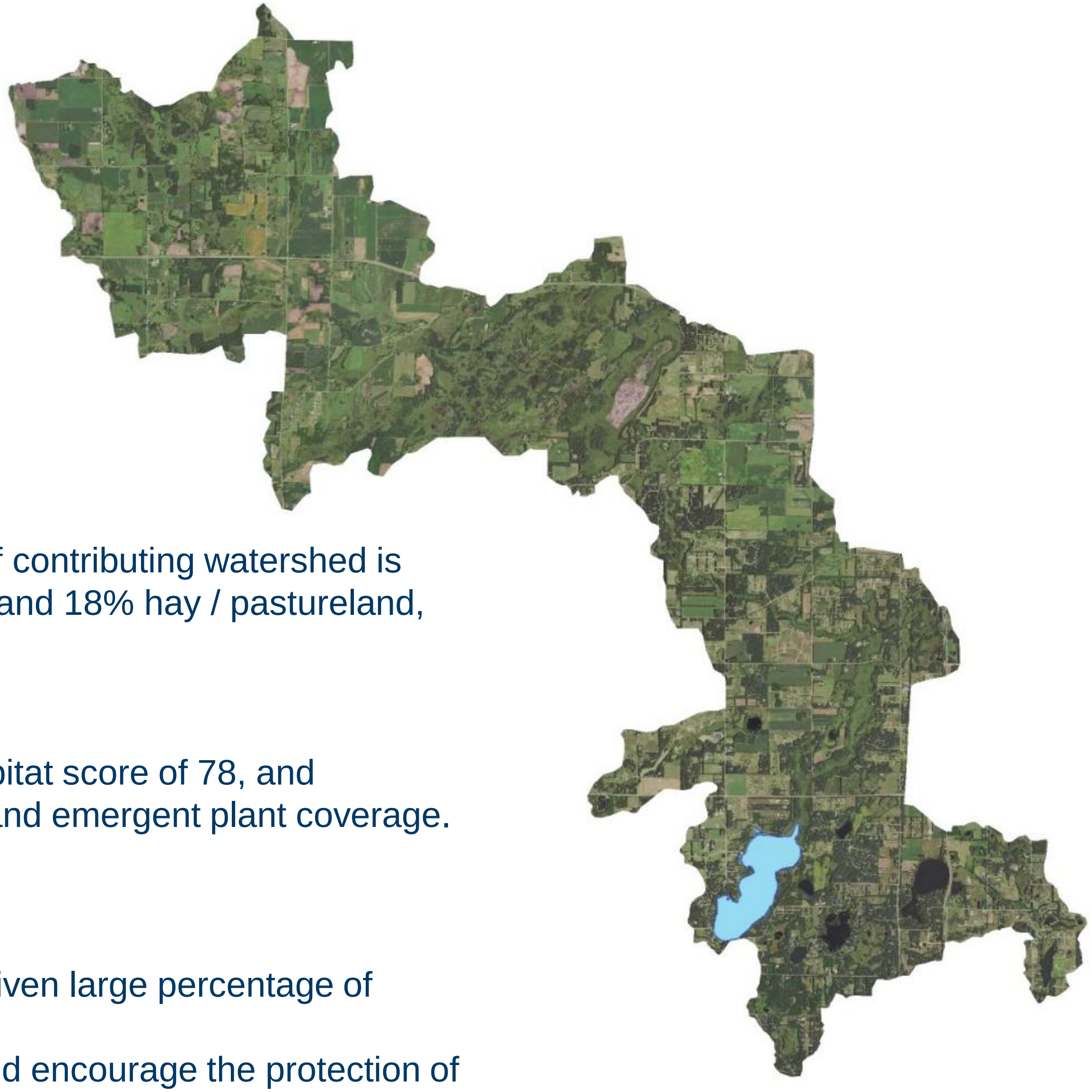
- **Candidate Cause:**
  - Eutrophication (excess nutrients): 77 ppb mean total phosphorus, 69% of contributing watershed is classified as unnatural land cover consisting of 59% cultivated cropland, and 5% hay / pastureland, and 5% developed.

- **Inconclusive Cause:**
  - <u>Physical habitat alteration</u>: Moderate lakewide Score the Shore (StS) habitat score of 75, and low dock density of 19 docks per mile of shoreline
  - <u>Altered interspecific Competition:</u> Common Carp and Curly leaf pondweed present. Previous history or large scale fish management.

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover
  - Promote the restoration of natural shoreline buffers at developed sites and encourage the protection of floating-leaf and emergent aquatic vegetation.



Summary of Elk Lake 71-0055-00 Fish Community and Stressors



- **Fish Community: INCONCLUSIVE (Scores on/near threshold)**
- **Fish IBI Scores:** 37 (2020), 34 (2017), 21 (2002) - Tool 7, Threshold = 36
  - 3 tolerant species (Black Bullhead, Common Carp, Green Sunfish)
  - 0 intolerant species ()
  - Positive Influences:
    - ↑ Biomass from top carnivores in the GN
  - Negative Influences:
    - ↑ Biomass from tolerant species in TN

- **Candidate Cause:**
  - Eutrophication (excess nutrients): 58 ppb mean total phosphorus, 57% of contributing watershed is classified as unnatural land cover consisting of 31% cultivated cropland, and 18% hay / pastureland, and 8% developed.

- **Inconclusive Cause:**
  - Physical habitat alteration: Moderate lakewide Score the Shore (StS) habitat score of 78, and moderate dock density of 26.5 docks per mile of shoreline. Low floating and emergent plant coverage.
  - High watershed:Lake ratio of 71:1

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover
  - Promote the restoration of natural shoreline buffers at developed sites and encourage the protection of floating-leaf and emergent aquatic vegetation.

Summary of Lake Ann 71-0069-00 Fish Community and Stressors

- **Fish Community: INCONCLUSIVE (Scores above and below threshold)**
- **Fish IBI Scores:** 30 (2019), 42 (2011) - Tool 4, Threshold = 38
  - 1 tolerant species (Black Bullhead)
  - 2 intolerant species (Banded Killifish, Blacknose Shiner)
  - Positive Influences:
    - ↑ Biomass insectivores in the TN
  - Negative Influences:
    - ↓ Number of small benthic dwelling species
    - ↓ Relative abundance of small benthic dwelling species in NS

- **Candidate Cause:**
  - None Identified

- **Inconclusive Cause:**
  - Physical habitat alteration: Moderate lakewide Score the Shore (StS) habitat score of 83, and low dock density of 11 docks per mile of shoreline.
  - Low watershed:Lake ratio of 6:1
  - Eutrophication (excess nutrients): 23 ppb mean total phosphorus, 37% of contributing watershed is classified as unnatural land cover consisting of 1% cultivated cropland, and 23% hay / pastureland, 13% developed.

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover

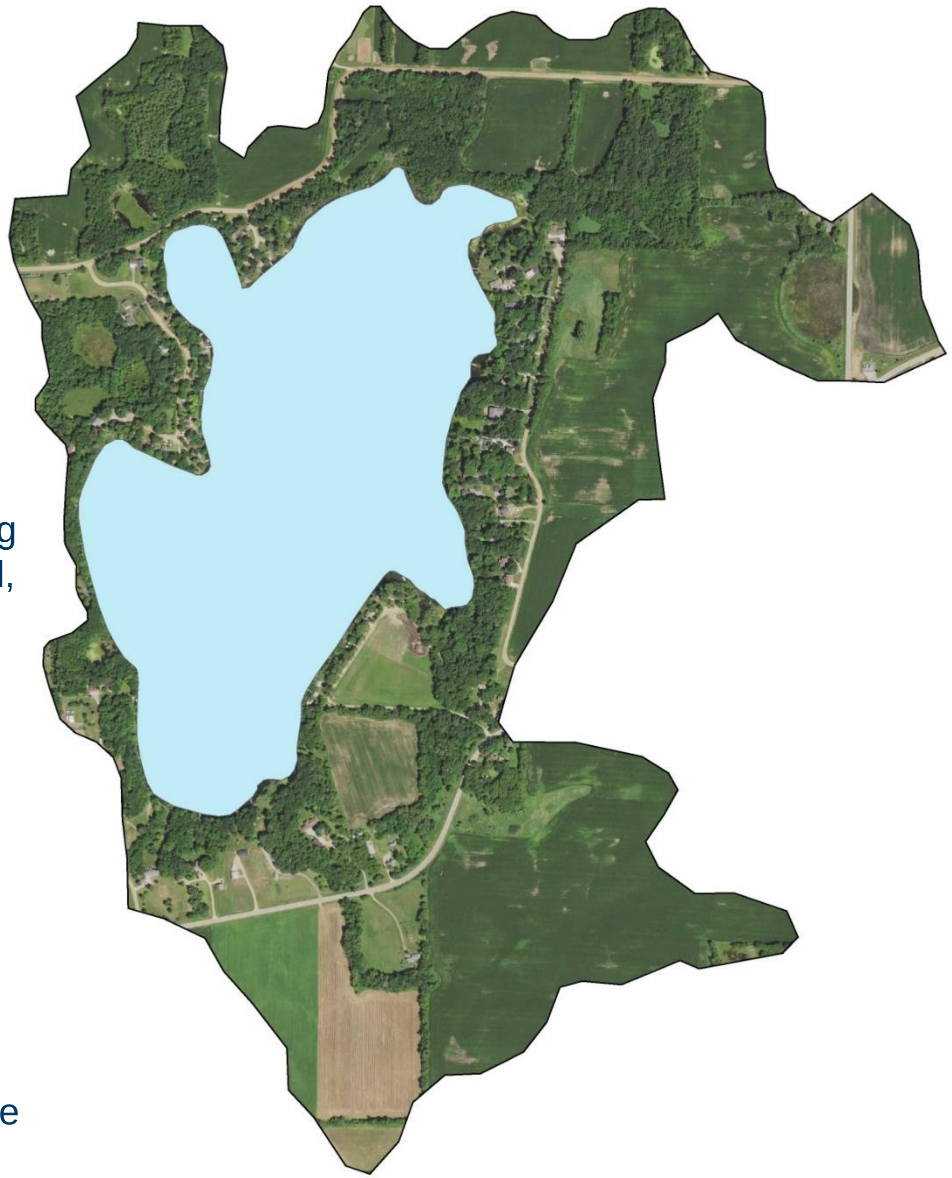
Summary of Indian Lake 86-0223-00 Fish Community and Stressors

- **Fish Community: INCONCLUSIVE (High water level during sampling)**
- **Fish IBI Scores:** 30 (2017), 26 (1999) - Tool 2, Threshold = 45
  - 2 tolerant species (Black Bullhead, Green Sunfish)
  - 0 intolerant species
  - Positive Influences:
    - ↑ Biomass insectivores in the TN
    - ↓ Number of omnivore species sampled
  - Negative Influences:
    - ↓ Relative abundance of small benthic dwelling species in NS
    - ↓ Relative abundance of intolerant species in NS

- **Candidate Cause:**
  - Eutrophication (excess nutrients): 42 ppb mean total phosphorus, 49% of contributing watershed is classified as unnatural land cover consisting of 37% cultivated cropland, and 4% hay / pastureland, and 8% developed.

- **Inconclusive Cause:**
  - Physical habitat alteration: Moderate lakewide Score the Shore (StS) habitat score of 76, and moderate dock density of 23.6 docks per mile of shoreline.
  - Low floating and emergent plant coverage.
  - Low watershed:Lake ratio of 4:1

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover.
  - Promote the restoration of natural shoreline buffers at developed sites and encourage the protection of floating-leaf and emergent aquatic vegetation.



Summary of Cedar Lake 86-0227-00 Fish Community and Stressors

- **Fish Community: INCONCLUSIVE (Scores on/near threshold)**
- **Fish IBI Scores:** 47 (2020), 45 (2019), 28 (2006) - Tool 2, Threshold = 45
  - 4 tolerant species (Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish)
  - 6 intolerant species (Banded Killifish, Blackchin Shiner, Blacknose Shiner, Iowa Darter, Least Darter, pugnose shiner)
  - Positive Influences:
    - ↑ Number of vegetation dwelling species sampled
    - ↑ Biomass from top carnivores in the GN
  - Negative Influences:
    - ↑ Number of omnivore species sampled
    - ↑ Number of tolerant species sampled

- **Candidate Cause:**
  - Physical habitat alteration: Low lakewide Score the Shore (StS) habitat score of 62, and moderate dock density of 23.6 docks per mile of shoreline
  - Eutrophication (excess nutrients): 33 ppb mean total phosphorus, 64% of contributing watershed is classified as unnatural land cover consisting of 46% cultivated cropland, and 10% hay / pastureland, and 8% developed.

- **Inconclusive Cause:**
  - Low watershed:Lake ratio of 12:1

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover

Summary of Pleasant Lake 86-0251-00 Fish Community and Stressors

- **Fish Community: INCONCLUSIVE (Scores on/near threshold)**
- **Fish IBI Scores:** 39 (2019), 48 (2018), 33 (2017) - Tool 2, Threshold = 45
  - Tool 2, General Use Threshold = 45
  - 2 tolerant species (Black Bullhead, Green Sunfish,)
  - 6 intolerant species (Banded Killifish, Blackchin Shiner, Blacknose Shiner, Iowa Darter, Rock Bass, Smallmouth Bass)
  - Positive Influences:
    - Presence of intolerant species in the GN
    - ↓ Biomass of tolerant species in TN
  - Negative Influences:
    - ↑ Biomass from omnivores in TN
    - ↓ Relative abundance of small benthic dwelling species in NS

- **Candidate Cause:**
  - Physical habitat alteration: Low lakewide Score the Shore (StS) habitat score of 52, and high dock density of 31.8 docks per mile of shoreline

- **Inconclusive Cause:**
  - Eutrophication (excess nutrients): 24 ppb mean total phosphorus, 64% of contributing watershed is classified as unnatural land cover consisting of 37% cultivated cropland, and 6% hay / pastureland, and 21% developed.
  - Low watershed:Lake ratio of 6:1

- **Recommendations:**
  - Promote the restoration of natural shoreline buffers at developed sites and encourage the protection of floating-leaf and emergent aquatic vegetation.
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover.

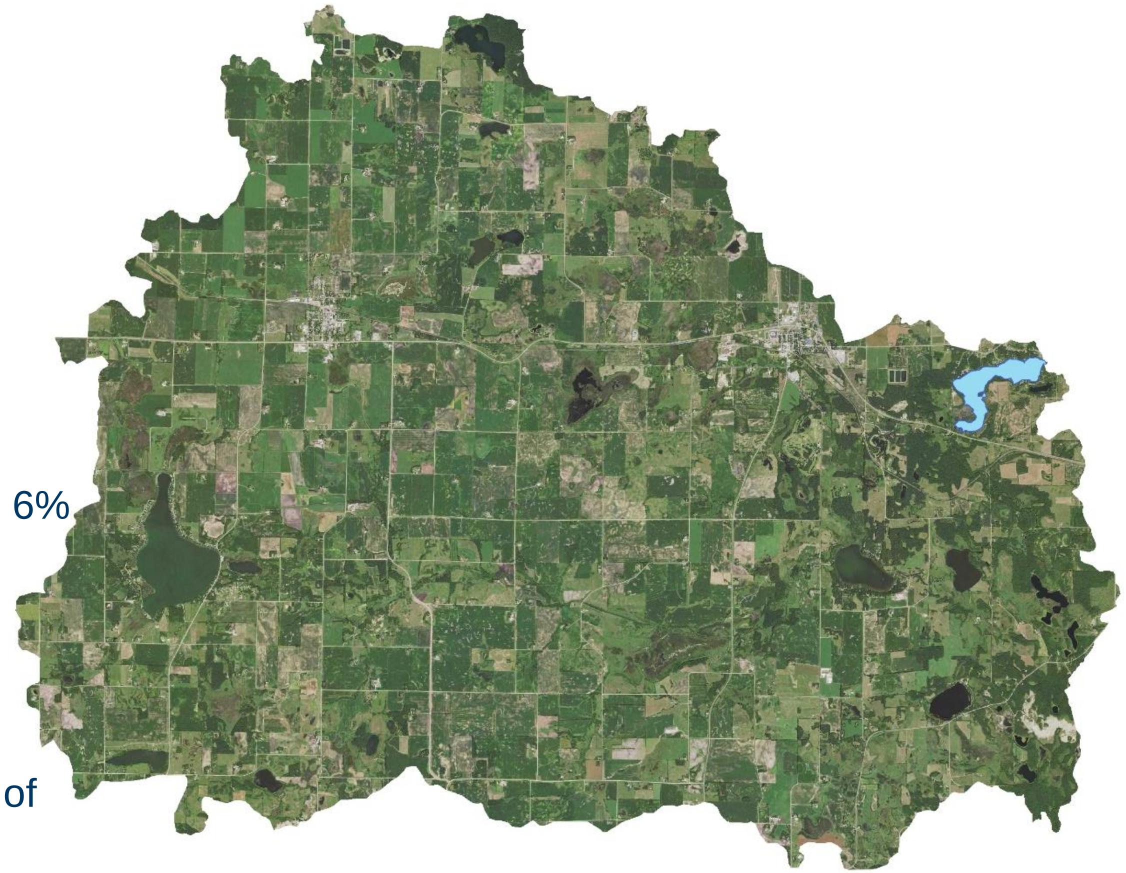
Summary of Lake Louisa 86-0282-00 Fish Community and Stressors

- **Fish Community: INCONCLUSIVE (Scores on/near threshold)**
- **Fish IBI Scores:** 47 (2019), 17 (2006) - Tool 2, Threshold = 45
  - 2 tolerant species (Black Bullhead, Green Sunfish)
  - 1 intolerant species (Iowa Darter)
  - Positive Influences:
    - ↑ Relative abundance of small benthic dwellers in NS
  - Negative Influences:
    - Absence of intolerant species in the GN

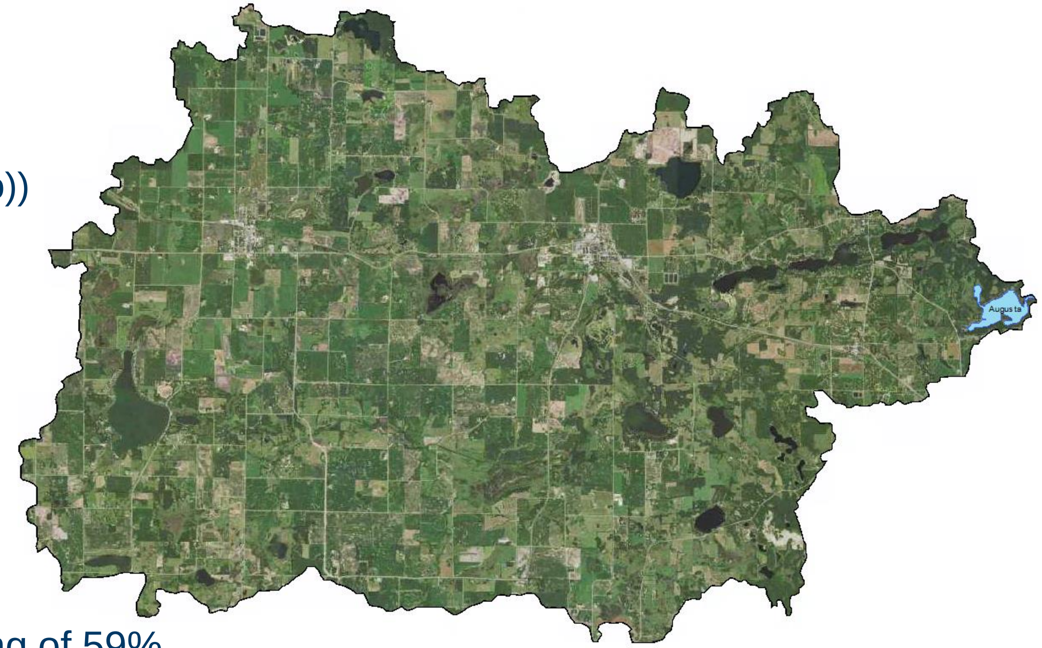
- **Candidate Cause:**
  - Eutrophication (excess nutrients): 75 ppb mean total phosphorus,
  - 79% of contributing watershed is classified as unnatural land cover consisting of 62% cultivated cropland, and 11% hay / pastureland, and 6% developed.
  - High watershed:Lake ratio of 280:1

- **Inconclusive Cause:**
  - Physical habitat alteration: Moderate lakewide Score the Shore (StS) habitat score of 78, and moderate dock density of 12.3 docks per mile of shoreline

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover



Summary of Lake Augusta 86-0284-00 Fish Community and Stressors



- **Fish Community: INCONCLUSIVE – Vulnerable (Scores on/near threshold)**
- **Fish IBI Scores:** 49 (2020), 38 (2019) - Tool 2, Threshold = 45
  - 3 tolerant species (Black Bullhead, Common Carp, Green Sunfish)
  - 4 intolerant species (Banded Killifish, Iowa Darter, pugnose shiner, Tullibee (Cisco))
  - Positive Influences:
    - Presence of intolerant species in the GN
  - Negative Influences:
    - ↑ Number of omnivore species sampled
    - ↑ Biomass from omnivores in TN
    - ↓ Relative abundance of intolerant species in NS

- **Candidate Cause:**
  - Eutrophication (excess nutrients): 58 ppb mean total phosphorus,
  - 76% of contributing watershed is classified as unnatural land cover consisting of 59% cultivated cropland, and 11% hay / pastureland, and 6% developed.
  - High watershed:Lake ratio of 342:1

- **Inconclusive Cause:**
  - Physical habitat alteration: Moderate lakewide Score the Shore (StS) habitat score of 68, and moderate dock density of 27.6 docks per mile of shoreline

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover, and high watershed ratio

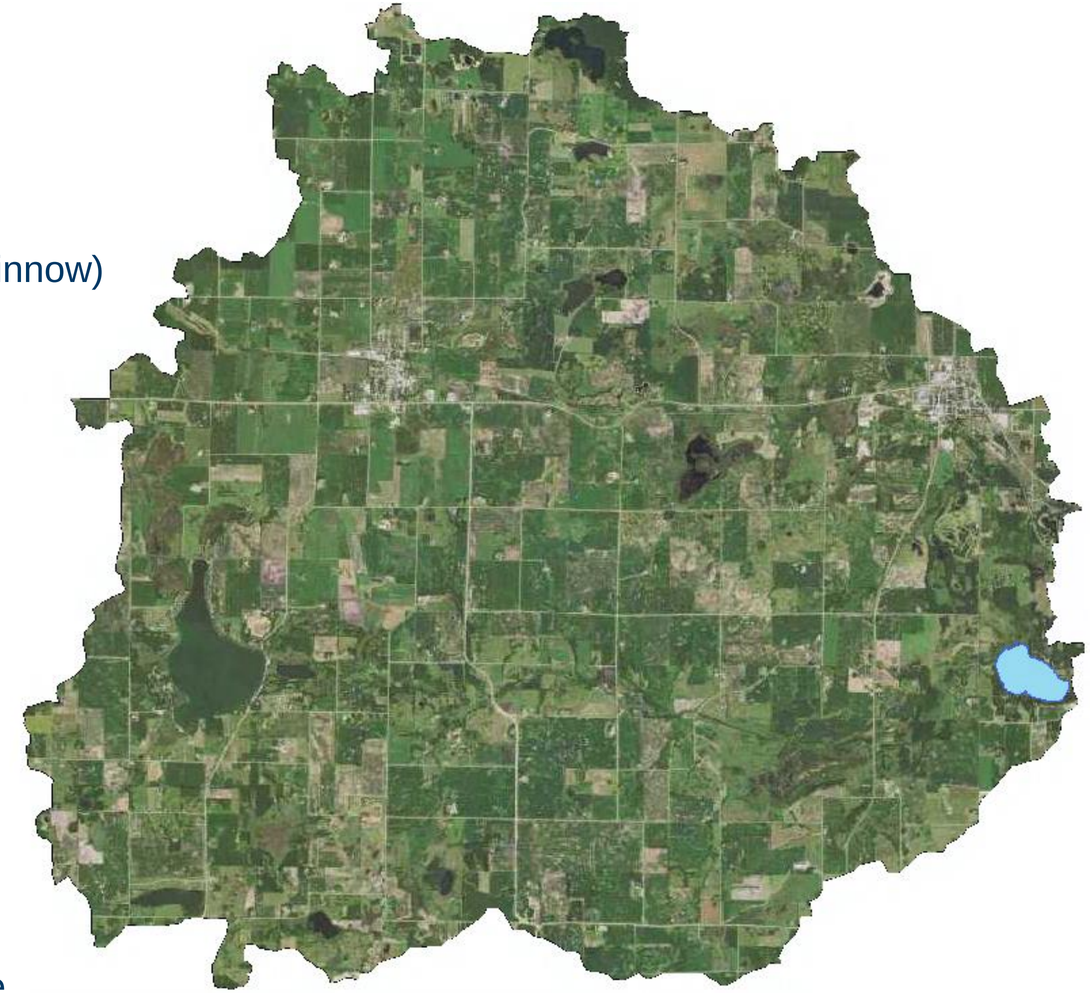
Summary of Lake Betty 47-0042-00 Fish Community and Stressors

- **Fish Community: INCONCLUSIVE – (Outside assessment window)**
- **Fish IBI Scores:** 16 (2012), 26 (2012) - Tool 2, Threshold = 45
    - 4 tolerant species (Black Bullhead, Common Carp, Common Carp, Fathead Minnow)
    - 1 intolerant species (Iowa Darter)
    - Positive Influences:
        - No strong positive influences
    - Negative Influences:
        - ↓ Biomass from insectivores in TN
        - ↑ Biomass from tolerant species in TN

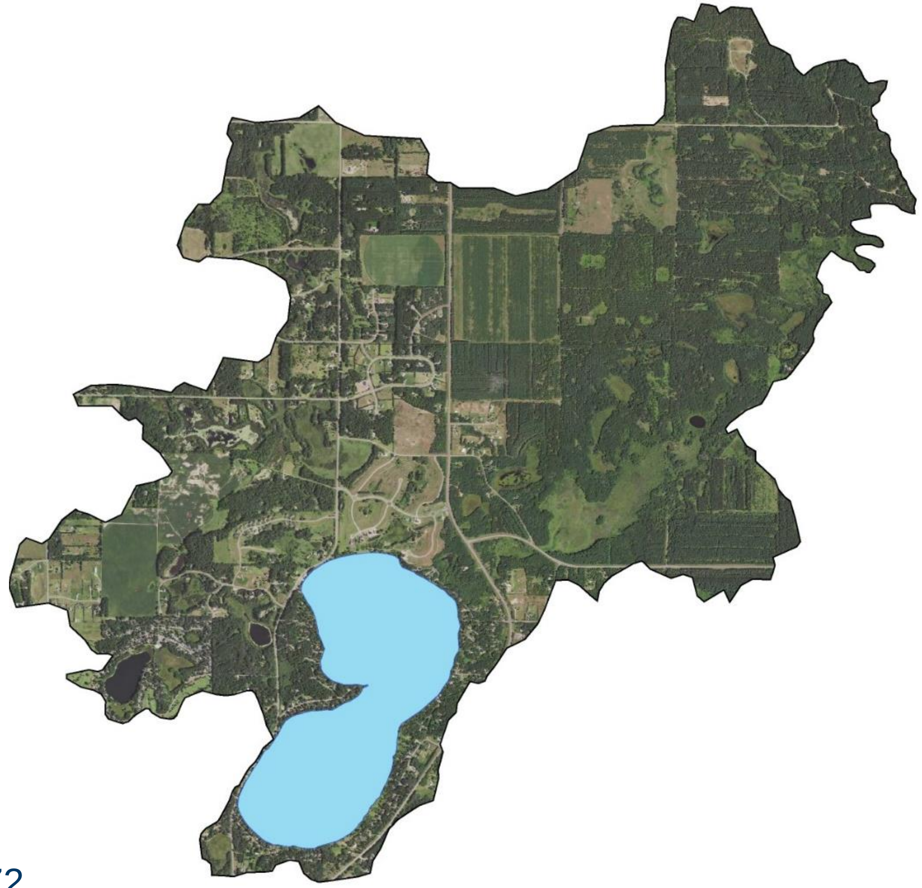
- **Candidate Cause:**
    - Eutrophication (excess nutrients): 226 ppb mean total phosphorus,
    - 84% of contributing watershed is classified as unnatural land cover
    - consisting of 69% cultivated cropland, and 9% hay / pastureland,
    - and 6% developed.
    - High watershed:Lake ratio of 285:1

- **Inconclusive Cause:**
    - Physical habitat alteration: low dock density of 12.2 docks per mile of shoreline

- **Recommendations:**
    - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover.



Summary of Eagle Lake 71-0067-00 Fish Community and Stressor



- **Fish Community: INCONCLUSIVE – (Outside assessment window)**
- **Fish IBI Scores:** 59 (2012), 29 (2002) - Tool 7, Threshold = 36
  - 4 tolerant species (Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish)
  - 3 intolerant species (Banded Killifish, Blacknose Shiner, Iowa Darter)
  - Positive Influences:
    - ↑ Relative abundance of vegetative dwellers in NS
    - ↑ Number of vegetation dwelling species sampled
    - ↑ Number of insectivorous species sampled
  - Negative Influences:
    - No strong negative influences

- **Candidate Cause:**
  - Eutrophication (excess nutrients): 51 ppb mean total phosphorus,32% of contributing watershed is classified as unnatural land cover consisting of 11% cultivated cropland, and 12% hay / pastureland, and 9% developed.
  - Low watershed:Lake ratio of 11:1

- **Inconclusive Cause:**
  - Physical habitat alteration: Moderate lakewide Score the Shore (StS) habitat score of 72, and high dock density of 34 docks per mile of shoreline. Low amount of floating leaf and emergent aquatic plant habitat

- **Recommendations:**
  - Promote the restoration of natural shoreline buffers at developed sites and encourage the protection of floating-leaf and emergent aquatic vegetation.
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover

Summary of Ida Lake 86-0146-00 Fish Community and Stressors

- **Fish Community: INCONCLUSIVE – (Outside assessment window)**
- **Fish IBI Scores:** 54 (2012), 49 (2012) - Tool 2, Threshold = 45
  - 2 tolerant species (Green Sunfish, Fathead Minnow)
  - 4 intolerant species (Banded killifish, least darter, Iowa darter, Blackchin shiner)
  - Positive Influences:
    - ↑ number of small benthic dwellers
    - ↑ number of vegetative dwellers
  - Negative Influences:
    - ↑ Biomass from omnivores in TN

- **Candidate Cause:**
  - None Identified

- **Inconclusive Cause:**
  - Physical habitat alteration: Moderate lakewide Score the Shore (StS) habitat score of 69, and high dock density of 26.4 docks per mile of shoreline.

  - Eutrophication (excess nutrients): 14 ppb mean total phosphorus, 38% of contributing watershed is classified as unnatural land cover consisting of 13% cultivated cropland, 18% hay / pastureland, and 6% developed.
  - Low watershed:Lake ratio of 8:1

- **Recommendations:**
  - Use best management practices to minimize inputs of excess nutrients given large percentage of watershed classified as unnatural land cover.
  - Promote the restoration of natural shoreline buffers at developed sites and encourage the protection of floating-leaf and emergent aquatic vegetation.

Appendix D - MRSCW NPDES – permitted facilities

HUC-12 subwatershed	Point Source		
	Type	Permit #	Name
Johnson Creek (HUC 07010203 01 01)	Industrial Stormwater	MNR0539SB	New Flyer of America
		MNR053DWT	Legacy Building Solutions
		MNR053F27	Arctic Cat Inc.
	Industrial Stormwater (No Discharge)	MNRNE38DV	RHEAUMES HOUSE OF LETTERING, INC.
		MNRNE395Y	Aubright, LLC
		MNRNE3CKD	FedEx Ground - St. Cloud
	Industrial Wastewater (WTP Subsurface Disposal)	MNG820013	Bel Clare Estates WTP
	Municipal Wastewater	MN0040878	Saint Cloud WWTP
Plum Creek (HUC 07010203 01 02)	Municipal Wastewater	MN0066664	Lakes of Fairhaven WWTP
City of Saint Cloud-Mississippi River (HUC 07010203 01 03)	Industrial Stormwater (No Discharge)	MNRNE3C8F	Pan-O-Gold Baking Co.
	Industrial Stormwater	MNR05386M	Woodcraft Industries Inc
		MNR0538V8	midway iron & metal co Inc
		MNR0539CK	Starrett Tru-Stone Technologies Division
		MNR0539QS	Spee Dee Delivery Svc In
		MNR0539S8	Northern Lines Railway
		MNR0539T5	Brown-Wilbert Inc - St. Cloud
		MNR053B4Z	Waste Management - St. Cloud Transfer Station
		MNR053BKX	Northern Metal Recycling - St Cloud
		MNR053C4Y	C4 Welding, Inc
		MNR053C9M	Python's of Saint Cloud Inc
		MNR053D64	BNSF Saint Cloud Yard
		MNR053F4Z	Wilkie Sanderson
		MNR053FB8	Spanier Bus Service, Inc.
		MNR053FF4	Wilkie Sanderson
	Industrial Stormwater (No Discharge)	MNRNE388K	X-cel Optical Co
		MNRNE396R	Wiman Corp

HUC-12 subwatershed	Point Source		
	Type	Permit #	Name
		MNRNE39ZF	Ron's Cabinets
		MNRNE3BYV	St. Augusta Sanitary Landfill
		MNRNE3D2J	Carfair Composites USA Inc
		MNRNE3DXR	International Precision Machining Inc
		MNRNE3F3K	FedEx Express STCA
		MNRNE3F6R	Rex Granite Company
		MNRNE3FC9	Spee Dee Delivery Service Inc Annex JBA
		MNRNE3FDQ	VSPOne St. Cloud
	Industrial Wastewater	MN0069001	Starrett Tru-Stone Division
	Industrial Wastewater (Nonmetallic Mining / Associated Activities)	MNG490385	Landwehr Construction, Inc.
	Municipal Stormwater	MS400052	Saint Cloud City MS4
		MS400067	Benton County MS4
		MS400118	Sauk Rapids City MS4
		MS400147	Minden Township MS4
		MS400153	Sauk Rapids Township MS4
		MS400155	Sherburne County MS4
		MS400180	MNDOT Outstate District MS4
Upper Clearwater River (HUC 07010203 02 01)	Feedlot	MNG441209	Schiefelbein Farm Sec 33
	Municipal Wastewater	MN0051365	Watkins WWTP
Middle Clearwater River (HUC 07010203 02 02)	Industrial Stormwater (No Discharge)	MNRNE38QV	Arfsten Transfer, Inc.
		MNRNE3FGB	Hendricks Gravel Pit
		MNRNE3FGH	Kimball Rod & Gun Club
	Municipal Wastewater	MN0052647	Kimball WWTP
		MN0064611	South Haven WWTP
Clearwater Lake (HUC 07010203 02 04)	Industrial Stormwater	MNR053B9G	M&M Bus Service Inc
		MNR053CJJ	R.M. Johnson Co., Inc
	Industrial Stormwater (No Discharge)	MNRNE38ZG	Creative Marble products

HUC-12 subwatershed	Point Source		
	Type	Permit #	Name
	Municipal Wastewater	MN0069582	Clearwater Forest LLC
Lower Clearwater River (HUC 07010203 02 05)	Industrial Stormwater	MNR053CZZ	TO Plastics Inc
		MNR053D8F	Larry's Auto Salvage
	Municipal Wastewater	MN0065226	Clearwater Harbor WWTF
Headwaters Elk River (HUC 07010203 03 01)	Feedlot	MNG442120	Michael Hess Farm
	Industrial Wastewater (Nonmetallic Mining / Associated Activities)	MNG490217	MTD Excavating LLC Gravel Pits
		MNG490244	Rock Solid Land Co LLC
	Municipal Stormwater	MS400147	Minden Township MS4
	Municipal Wastewater (Wastewater Pond)	MNG585021	Gilman WWTP
Mayhew Creek (HUC 07010203 03 02)	Industrial Stormwater (No Discharge)	MNRNE3BQL	Thermo Tech Windows LLC
	Industrial Wastewater (Nonmetallic Mining / Associated Activities)	MNG490003	Knife River Central Minnesota
	Municipal Stormwater	MS400052	Saint Cloud City MS4
		MS400067	Benton County MS4
		MS400118	Sauk Rapids City MS4
		MS400147	Minden Township MS4
		MS400153	Sauk Rapids Township MS4
		MS400161	Watab Township MS4
		MS400180	MNDOT Outstate District MS4
County Ditch No 3 (HUC 07010203 03 03)	Industrial Stormwater	MNR053B2M	Sauk Rapids Hauling
		MNR053B3C	North Central Auto Parts
		MNR053B5G	Minden Transfer Station
		MNR053BFX	LRS of Minnesota - St. Cloud
		MNR053BRK	Saint Cloud Regional Airport
		MNR053C7Y	Coborns Inc
		MNR053CBZ	Saint Cloud Army Aviation Support Facility
		MNR053CT3	STC Aviation Inc
		MNR053D4Z	Saint Cloud Auto Wrecking LLC
		MNR053F73	Tri County Pallet and Crate LLC

HUC-12 subwatershed	Point Source		
	Type	Permit #	Name
		MNR053FF9	Sysco Western Minnesota and Buckhead Meat of Minnesota
	Industrial Stormwater (No Discharge)	MNRNE37Z3	CustomEyes-Glass
		MNRNE385Y	Rapid Plating
		MNRNE38BT	Engineering Machining Fabricating Inc.
		MNRNE38NF	Integrated Recycling Technologies, Inc.
		MNRNE396K	National Vision Inc
		MNRNE3CLR	ABF Freight System Inc
		MNRNE3FFZ	UPS - St. Cloud
	Industrial Wastewater	MN0052728	Sysco Western Minnesota
	Municipal Stormwater	MS400052	Saint Cloud City MS4
		MS400067	Benton County MS4
		MS400118	Sauk Rapids City MS4
		MS400147	Minden Township MS4
		MS400153	Sauk Rapids Township MS4
		MS400155	Sherburne County MS4
		MS400179	Minnesota Correctional-St Cloud MS4
		MS400180	MNDOT Outstate District MS4
		MS400197	Saint Cloud State University MS4
Town of Parent-Elk River (HUC 07010203 03 04)	Municipal Stormwater	MS400052	Saint Cloud City MS4
		MS400147	Minden Township MS4
Headwaters Saint Francis River (HUC 07010203 04 01)	Industrial Stormwater (No Discharge)	MNRNE3CG7	A-1 Business Service, Inc.
	Industrial Wastewater (Nonmetallic Mining / Associated Activities)	MNG490166	Saldana Excavating & Aggregates Inc
Battle Brook (HUC 07010203 04 05)	Industrial Wastewater (Industrial By-Product)	MNG960065	United States Distilled Products
	Municipal Wastewater	MN0064459	Frontier Trails Homeowners Association
		MN0066583	Nordwall Estates
		MN0066982	Highland Farms WWTF

HUC-12 subwatershed	Point Source		
	Type	Permit #	Name
Saint Francis River (HUC 07010203 04 06)	Municipal Stormwater	MS400234	Big Lake Township MS4
	Municipal Wastewater	MN0065706	Savannah Meadows WWTP
	Municipal Wastewater	MN0065960	Rivercrest Farms WWTP
Rice Creek (HUC 07010203 05 01)	Feedlot	MNG441989	New Heights Dairy LLC
	Industrial Stormwater (No Discharge)	MNRNE3C8F	Pan-O-Gold Baking Co.
		MNRNE3CCD	Amax Industries Inc.
		MNRNE3DXK	PouchTec Industries LLC
	Municipal Stormwater	MS400147	Minden Township MS4
	Municipal Wastewater	MN0023451	Foley WWTP
		MN0063983	Eagle View Commons WWTP
Elk Lake-Elk River (HUC 07010203 05 03)	Feedlot	MNG440909	Eiler Bros Farm
	Industrial Stormwater (No Discharge)	MNRNE38FX	Oaklane Machining, LLC
Snake River (HUC 07010203 05 04)	Municipal Stormwater	MS400234	Big Lake Township MS4
	Municipal Wastewater	MN0065986	Hidden Haven WWTP
		MN0066354	Woods at Eagle Lake WWTP
		MN0067369	Shores of Eagle Lake Homeowners Association
Big Lake-Elk River (HUC 07010203 05 05)	Industrial Stormwater (No Discharge)	MNRNE3FCK	Becker city of WWTP
	Municipal Stormwater	MS400234	Big Lake Township MS4
		MS400249	Big Lake City MS4
	Municipal Wastewater	MN0025666	Becker WWTP - Municipal
Tibbets Brook (HUC 07010203 05 06)	Industrial Stormwater	MNR053C5S	Hans Foreign Auto and Truck Parts Inc
	Municipal Stormwater	MS400089	Elk River City MS4
		MS400155	Sherburne County MS4
		MS400170	MNDOT Metro District MS4
		MS400234	Big Lake Township MS4
	Municipal Wastewater	MN0042331	Zimmerman WWTP
		MN0065935	Ridges of Rice Lake Homeowner's Association
		MN0065978	Country Meadows WWTP
		MN0066028	Aspen Hills WWTF

HUC-12 subwatershed	Point Source		
	Type	Permit #	Name
		MN0066346	Windsor Park 3rd Addition Homeowners
		MN0067075	Whispering Ridge Homeowners Assoc of Zimmerman Inc
		MN0067768	Windsor Meadows WWTF
Elk River (HUC 07010203 05 07)	Industrial Stormwater	MNR053B9L	Vision of Elk River Inc.
		MNR053DV3	Lake State Recycling
	Industrial Stormwater (No Discharge)	MNRNE3863	Metal Craft
		MNRNE38KX	American Beverage Corporation
		MNRNE39WD	Tescom
		MNRNE3D7S	Elk River
	Industrial Wastewater	MNG120027	Tescom Corp - Industrial Controls
	Industrial Wastewater (Non-Contact Cooling Water)	MNG250016	Elk River Municipal Utilities
	Industrial Wastewater (WTP Subsurface Disposal)	MNG820027	Elk River Municipal Utilities WTP
	Municipal Stormwater	MS400089	Elk River City MS4
		MS400155	Sherburne County MS4
		MS400170	MNDOT Metro District MS4
		MS400234	Big Lake Township MS4
		MS400249	Big Lake City MS4
	Municipal Wastewater	MN0065412	Windsor Park Homeowner's Association
		MN0065781	Meadowwoods Village WWTP
Fish Creek-Mississippi River (HUC 07010203 06 01)	Industrial Stormwater	MNR0533H7	Central Appliance Recyclers
		MNR053B7X	Voigt's School Bus Services - Saint Cloud Terminal
	Industrial Stormwater (No Discharge)	MNRNE38VP	D & E TRANSPORT
	Industrial Wastewater (Nonmetallic Mining / Associated Activities)	MNG490582	Johnson Materials, Inc
	Municipal Stormwater	MS400052	Saint Cloud City MS4
		MS400155	Sherburne County MS4
		MS400180	MNDOT Outstate District MS4
	Municipal Wastewater	MN0047490	Clear Lake/Clearwater WWTP

HUC-12 subwatershed	Point Source		
	Type	Permit #	Name
Silver Creek (HUC 07010203 06 02)	Industrial Wastewater (Nonmetallic Mining / Associated Activities)	MNG490241	Kolles Sand & Gravel Inc
City of Becker-Mississippi River (HUC 07010203 06 03)	Industrial Stormwater	MNR0539CR	Liberty Paper Inc.
		MNR053BL5	GRE Becker Ash Disposal Facility
		MNR053BVZ	Vonco II, LLC
		MNR053DRT	Northern Metal Recycling - Becker
		MNR053DTC	Product Recovery Inc
	Industrial Stormwater (No Discharge)	MNRNE3842	Passive Components & Laser Works, Inc
	Industrial Wastewater	MN0000868	Xcel - Monticello Nuclear Generating Plt
		MN0002186	Xcel - Sherburne Generating Plant
Otter Creek (HUC 07010203 06 04)	Industrial Stormwater	MNR053CMH	AME Inc - Monticello Plant
		MNR053D69	Suburban Manufacturing Inc.
City of Elk River-Mississippi River (HUC 07010203 06 05)	Industrial Stormwater	MNR0533XX	Elk River Machine Co
		MNR0537MR	LeFebvre & Sons Inc
		MNR05399D	LISI Medical Remmele
		MNR0539NG	RTI Remmele Engineering - Big Lake
		MNR053B6L	JME of Monticello Inc
		MNR053BG2	Genereux Fine Wood Products
		MNR053BMP	Intex Corp
		MNR053CK6	Midwest Tank Company
		MNR053CNZ	Metro Transit - North Star Maintenance
		MNR053DC5	CW Metals
		MNR053DT4	b & e recycling station inc
		MNR053DXS	Cargill Kitchen Solutions Monticello
		MNR053F35	Cargill Feed & Nutrition Big Lake
		MNR053F45	Paragon Store Fixtures
	Industrial Stormwater (No Discharge)	MNRNE33HC	Rainbow Enterprises Inc
		MNRNE33SZ	Twin City Die Castings Co - Monticello

HUC-12 subwatershed	Point Source		
	Type	Permit #	Name
		MNRNE37W9	Preferred Powder Coating
		MNRNE37Z6	Elk River WWTP
		MNRNE38C6	Star News
		MNRNE38HF	Tire Service International
		MNRNE38RB	Monticello Wastewater Treatment Facility
		MNRNE38ZV	EDCO Products Inc
		MNRNE393D	Do-Rite Machining
		MNRNE394W	Sportech, Inc.
		MNRNE3959	Rengel Printing DBA Monticello Printing
		MNRNE395C	Industrial Molded Rubber Products
		MNRNE39PD	UMC
		MNRNE39TV	WSI Industries
		MNRNE39ZR	Special Timer Corporation
		MNRNE3BCH	Cargill Kitchen Solutions
		MNRNE3BTZ	Vonco I Demo Landfill
		MNRNE3DND	Sportech Inc
		MNRNE3DXC	Bondhus Corporation
		MNRNE3F8R	Weslund Distributing Center
	Municipal Stormwater	MS400170	MNDOT Metro District MS4
		MS400234	Big Lake Township MS4
		MS400243	Otsego City MS4
		MS400246	Saint Michael City MS4
		MS400249	Big Lake City MS4
		MS400281	Albertville City MS4
	Municipal Wastewater	MN0020567	Monticello WWTP
		MN0020788	Elk River WWTP
		MN0041076	Big Lake WWTP
		MN0050954	Albertville WWTP
		MN0066257	Otsego WWTP West
		MN0066613	Windsor Oaks of Elk River Homeowners Association

Appendix E: Impairment recategorization request. Category 4A – Approved TMDL

Table A – Impairments

WID (AUID)	Water body name	Description	Impairment(s)
07010203-633	Johnson Creek (Meyer Creek)	Unnamed cr to Unnamed cr	*E. coli*

Table B – TMDL information

Date	November 2014 and TMDL modification 2019
Requestor	Phil Votruba/Kaitlyn Taylor (MPCA)
Watershed	Upper Mississippi River Basin (portions of HUC8s: 07010201, 07010203, 07010206)
TMDL ID	PRJ06864-001
TMDL Report	2014 TMDL https://www.pca.state.mn.us/sites/default/files/wq-iw8-08e.pdf and 2019 modification https://www.pca.state.mn.us/sites/default/files/wq-iw8-08ac.pdf
Project manager	Phil Votruba

Table C – Stressor identification results
Include for biological impairments.

SID report	Not applicable - not a biological impairment
SID staff	Not applicable - not a biological impairment

Which pollutant stressors have been addressed by a TMDL (and are 4A)? Not applicable - not a biological impairment

Stressor	Check (X) if applicable	Comments
TSS/turbidity	Not applicable - not a biological impairment	
Temperature		
Chloride/hardness		
Nitrogen		
Phosphorus		

Ammonia	
Dissolved oxygen	
pH	
Other	

Table D - Justification

Summarize the conclusions reached in TMDL and Stressor ID reports to justify the recategorization to 4A.

Proposed action	*State the impairments you intend to categorize and the List year they will go into effect:* Categorize Johnson Creek (Meyer Creek) *WID* 07010203-633 as 4A for list year 2024
Rationale	*Lay out why a move to 4A is appropriate, e.g., "all pollutant stressors were addressed by this TMDL":* The *E. coli* impairment on Johnson Creek WID 07010203-633 is addressed by the existing *E. coli* TMDL for Johnson Creek WID 07010203-639. WID 07010203-633 is located upstream of WID 07010203-639 and is on the same stream. WID 07010203-633 is classified as a 1B, 2Ag stream and WID 07010203-639 is classified as a 2Bg stream. Both WIDs are held to the same *E. coli* standards for aquatic recreation (126 org/100 mL as a monthly geometric mean and 1,260 org/100 mL as a single value). The Upper Mississippi River Bacteria TMDL Implementation Plan (2016) lists the primary sources of *E. coli* to WIDs 07010203-639 and 07010203-635 (located in between WIDs 633 and 639) as unincorporated manure, runoff from feedlots, and pasture. These sources are also applicable to WID 07010203-633 as land cover in the subwatershed for WID 07010203-633 is predominantly agricultural and several feedlots are located near the reach. There are two MS4s with WLAs for *E. coli* for WID 07010203-639 (Figure 1). The 2014 TMDL established a WLA for St. Cloud and the 2019 TMDL modification transferred previous LA to WLA for the newly regulated MS4 St. Augusta. This transfer did not change the approved overall total loading capacities of the TMDL. These WLAs also apply to upstream WIDs 07010203-635 and 07010203-633. A reclassification request is not needed for WID 07010203-635 as it has an existing TMDL. No other NPDES permitted facilities would receive a WLA if a TMDL were to be developed for WID 07010203-633 and no changes to the existing MS4 WLAs would be needed.

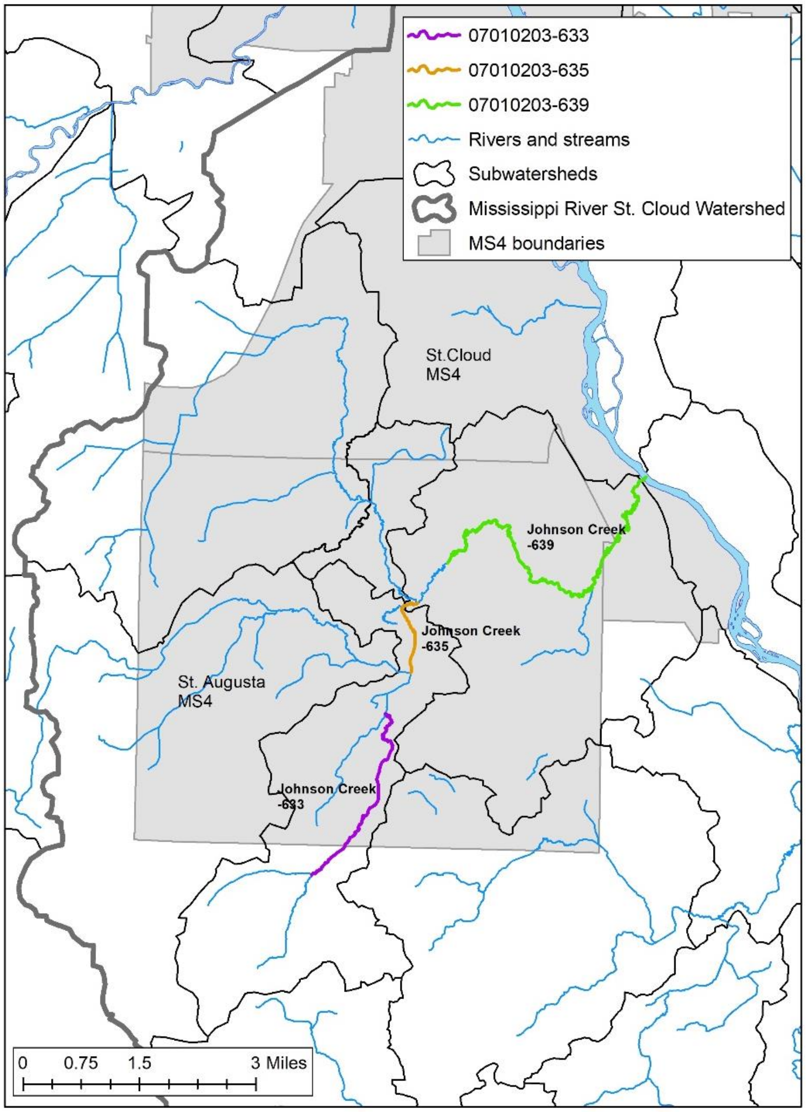


Figure 1. Map of applicable impaired reaches and MS4 boundaries

Background	*Any additional information, such as timing of listings and approved TMDLs:* Johnson Creek WID 07010203-633 was found to have *E. coli* levels above the standard for the aquatic recreation designated use and placed on the 2022 303(d) list as an EPA Category 5. WID 07010203-633 is a 2.98 mile segment located 2.86 miles upstream of WID 07010203-639 (6.56 mile segment) which has an existing TMDL for *E. coli* (Upper Mississippi River Bacteria TMDL Study & Protection Plan, 2014)

Appendix F - MRSCW HUC-12 Altered Water Course Table

Channel Condition Code	Channel Condition	Sum Length	Percent Channel Condition	HUC-12	HUC-12_Name
1	Altered	28.41405	51.25	**7.01E+10**	**Clear Lake-Clearwater River**
2	Natural	13.51717	23.72	**7.01E+10**	**Clear Lake-Clearwater River**
3	Impounded	2.733491	4.55	**7.01E+10**	**Clear Lake-Clearwater River**
4	No Definable Channel	11.59473	20.48	**7.01E+10**	**Clear Lake-Clearwater River**
1	Altered	1.827357	11.71	**7.01E+10**	**Grass Lake-Clearwater River**
2	Natural	10.3434	68.42	**7.01E+10**	**Grass Lake-Clearwater River**
3	Impounded	0.944911	5.95	**7.01E+10**	**Grass Lake-Clearwater River**
4	No Definable Channel	2.148979	13.91	**7.01E+10**	**Grass Lake-Clearwater River**
1	Altered	6.776074	31.47	**7.01E+10**	**Threemile Creek**
2	Natural	7.632353	35.43	**7.01E+10**	**Threemile Creek**
4	No Definable Channel	7.190078	33.09	**7.01E+10**	**Threemile Creek**
1	Altered	8.649276	21.51	**7.01E+10**	**Lake Louisa-Clearwater River**
2	Natural	15.22551	37.11	**7.01E+10**	**Lake Louisa-Clearwater River**
3	Impounded	4.011264	10.58	**7.01E+10**	**Lake Louisa-Clearwater River**
4	No Definable Channel	12.27493	30.8	**7.01E+10**	**Lake Louisa-Clearwater River**
1	Altered	56.07567	50.5	**7.01E+10**	**County Ditch Number Thirteen-Saint Francis River**
2	Natural	22.15615	19.6	**7.01E+10**	**County Ditch Number Thirteen-Saint Francis River**
4	No Definable Channel	32.56045	29.91	**7.01E+10**	**County Ditch Number Thirteen-Saint Francis River**
1	Altered	12.95596	32	**7.01E+10**	**Clearwater Lake-Clearwater River**
2	Natural	3.56406	8.68	**7.01E+10**	**Clearwater Lake-Clearwater River**
3	Impounded	3.638269	8.64	**7.01E+10**	**Clearwater Lake-Clearwater River**

Channel Condition Code	Channel Condition	Sum Length	Percent Channel Condition	HUC-12	HUC-12_Name
4	No Definable Channel	20.30666	50.67	**7.01E+10**	**Clearwater Lake-Clearwater River**
1	Altered	15.00945	74.77	**7.01E+10**	**County Ditch Number Three**
2	Natural	1.088326	5.39	**7.01E+10**	**County Ditch Number Three**
3	Impounded	0.285157	1.32	**7.01E+10**	**County Ditch Number Three**
4	No Definable Channel	3.57041	18.52	**7.01E+10**	**County Ditch Number Three**
1	Altered	19.91581	36.76	**7.01E+10**	**Town of Parent-Elk River**
2	Natural	22.9246	40.64	**7.01E+10**	**Town of Parent-Elk River**
3	Impounded	0.168925	0.31	**7.01E+10**	**Town of Parent-Elk River**
4	No Definable Channel	12.14507	22.29	**7.01E+10**	**Town of Parent-Elk River**
1	Altered	39.34215	83.34	**7.01E+10**	**Tibbits Brook**
2	Natural	3.652308	7.74	**7.01E+10**	**Tibbits Brook**
4	No Definable Channel	4.248354	8.92	**7.01E+10**	**Tibbits Brook**
1	Altered	26.70274	47.39	**7.01E+10**	**Johnson Creek**
2	Natural	25.8442	46.17	**7.01E+10**	**Johnson Creek**
4	No Definable Channel	3.620761	6.44	**7.01E+10**	**Johnson Creek**
1	Altered	3.099111	14.24	**7.01E+10**	**City of Saint Cloud-Mississippi River**
2	Natural	16.80425	68.52	**7.01E+10**	**City of Saint Cloud-Mississippi River**
3	Impounded	3.732241	14.6	**7.01E+10**	**City of Saint Cloud-Mississippi River**
4	No Definable Channel	0.624341	2.64	**7.01E+10**	**City of Saint Cloud-Mississippi River**
1	Altered	41.35634	53.2	**7.01E+10**	**Mayhew Creek**
2	Natural	13.88568	17.27	**7.01E+10**	**Mayhew Creek**
3	Impounded	1.99635	2.22	**7.01E+10**	**Mayhew Creek**

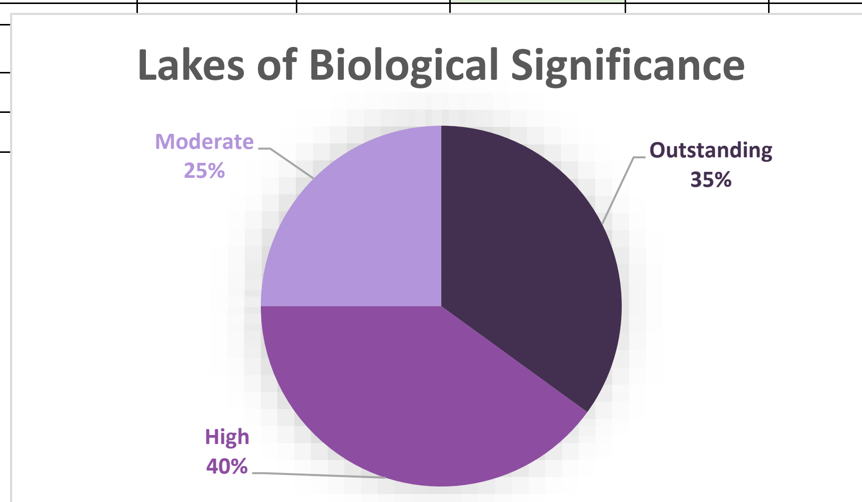
Channel Condition Code	Channel Condition	Sum Length	Percent Channel Condition	HUC-12	HUC-12_Name
4	No Definable Channel	20.83852	27.31	**7.01E+10**	**Mayhew Creek**
1	Altered	10.11633	36.86	**7.01E+10**	**Plum Creek**
2	Natural	9.767438	35.78	**7.01E+10**	**Plum Creek**
4	No Definable Channel	7.665559	27.36	**7.01E+10**	**Plum Creek**
1	Altered	46.21113	36.68	**7.01E+10**	**Headwaters Elk River**
2	Natural	35.50987	26.44	**7.01E+10**	**Headwaters Elk River**
4	No Definable Channel	46.20405	36.88	**7.01E+10**	**Headwaters Elk River**
2	Natural	11.76738	100	**7.01E+10**	**City of Becker-Mississippi River**
1	Altered	8.240823	52.91	**7.01E+10**	**Otter Creek**
2	Natural	1.684526	11.11	**7.01E+10**	**Otter Creek**
4	No Definable Channel	5.71406	35.98	**7.01E+10**	**Otter Creek**
1	Altered	24.52434	38.07	**7.01E+10**	**City of Elk River-Mississippi River**
2	Natural	26.40396	42.64	**7.01E+10**	**City of Elk River-Mississippi River**
4	No Definable Channel	12.14533	19.29	**7.01E+10**	**City of Elk River-Mississippi River**
1	Altered	1.077561	7.67	**7.01E+10**	**Fish Creek-Mississippi River**
2	Natural	8.771008	62.43	**7.01E+10**	**Fish Creek-Mississippi River**
4	No Definable Channel	4.452179	29.9	**7.01E+10**	**Fish Creek-Mississippi River**
1	Altered	12.95479	36.67	**7.01E+10**	**Silver Creek**
2	Natural	9.599247	27.46	**7.01E+10**	**Silver Creek**
3	Impounded	0.827758	2.36	**7.01E+10**	**Silver Creek**
4	No Definable Channel	11.613	33.51	**7.01E+10**	**Silver Creek**
1	Altered	17.0779	48.88	**7.01E+10**	**West Branch Saint Francis River**

Channel Condition Code	Channel Condition	Sum Length	Percent Channel Condition	HUC-12	HUC-12_Name
2	Natural	4.405832	11.33	**7.01E+10**	**West Branch Saint Francis River**
3	Impounded	0.240673	0.75	**7.01E+10**	**West Branch Saint Francis River**
4	No Definable Channel	13.92615	39.04	**7.01E+10**	**West Branch Saint Francis River**
1	Altered	34.78434	46.98	**7.01E+10**	**Rice Lake-Saint Francis River**
2	Natural	16.66546	22.65	**7.01E+10**	**Rice Lake-Saint Francis River**
3	Impounded	13.38034	18.21	**7.01E+10**	**Rice Lake-Saint Francis River**
4	No Definable Channel	8.924899	12.16	**7.01E+10**	**Rice Lake-Saint Francis River**
1	Altered	9.803755	30.66	**7.01E+10**	**Headwaters Saint Francis River**
2	Natural	8.567909	25.99	**7.01E+10**	**Headwaters Saint Francis River**
4	No Definable Channel	14.04285	43.35	**7.01E+10**	**Headwaters Saint Francis River**
1	Altered	21.44499	40.92	**7.01E+10**	**Battle Brook**
2	Natural	14.69325	27.62	**7.01E+10**	**Battle Brook**
3	Impounded	1.964195	3.53	**7.01E+10**	**Battle Brook**
4	No Definable Channel	14.88703	27.93	**7.01E+10**	**Battle Brook**
1	Altered	7.317136	17.12	**7.01E+10**	**Saint Francis River**
2	Natural	28.73663	63.78	**7.01E+10**	**Saint Francis River**
3	Impounded	2.68686	5.99	**7.01E+10**	**Saint Francis River**
4	No Definable Channel	5.52864	13.11	**7.01E+10**	**Saint Francis River**
1	Altered	40.08351	50.27	**7.01E+10**	**Rice Creek**
2	Natural	22.69184	27.48	**7.01E+10**	**Rice Creek**
4	No Definable Channel	17.71023	22.25	**7.01E+10**	**Rice Creek**
1	Altered	2.547151	14.58	**7.01E+10**	**Briggs Lake**

Channel Condition Code	Channel Condition	Sum Length	Percent Channel Condition	HUC-12	HUC-12_Name
2	Natural	8.659406	48.38	**7.01E+10**	**Briggs Lake**
3	Impounded	3.581711	20.46	**7.01E+10**	**Briggs Lake**
4	No Definable Channel	2.945426	16.58	**7.01E+10**	**Briggs Lake**
1	Altered	6.783198	28.65	**7.01E+10**	**Elk Lake-Elk River**
2	Natural	9.288239	36.67	**7.01E+10**	**Elk Lake-Elk River**
3	Impounded	1.59938	5.6	**7.01E+10**	**Elk Lake-Elk River**
4	No Definable Channel	7.472106	29.08	**7.01E+10**	**Elk Lake-Elk River**
1	Altered	28.40683	79.32	**7.01E+10**	**Snake River**
2	Natural	2.792149	8.13	**7.01E+10**	**Snake River**
3	Impounded	1.487258	4.12	**7.01E+10**	**Snake River**
4	No Definable Channel	2.995138	8.43	**7.01E+10**	**Snake River**
1	Altered	19.52827	48.47	**7.01E+10**	**Big Lake-Elk River**
2	Natural	17.57687	44.55	**7.01E+10**	**Big Lake-Elk River**
4	No Definable Channel	2.798896	6.98	**7.01E+10**	**Big Lake-Elk River**
1	Altered	5.886363	24.86	**7.01E+10**	**Elk River**
2	Natural	14.15367	61.46	**7.01E+10**	**Elk River**
3	Impounded	2.460681	11.18	**7.01E+10**	**Elk River**
4	No Definable Channel	0.609857	2.5	**7.01E+10**	**Elk River**

Appendix G - MRSCW Lakes – Biological Significance Table

Lake ID	Lake Name	Type	acres	shore miles	County	LBS Class	Fish Rank	Plant Rank	Amphibian	Bird Rank
86022700	Cedar	Lake or Pond	790.31	7.23	Wright	High	2	3	0	0
86007300	Cedar	Lake or Pond	206.37	4.60	Wright	High	0	3	0	2
71006800	Josephine	Lake or Pond	34.35	1.07	Sherburne	Outstanding	0	1	0	0
71006900	Ann	Lake or Pond	182.85	4.64	Sherburne	High	0	2	0	0
71007800	Rice	Lake or Pond	237.37	4.36	Sherburne	Outstanding	0	1	0	0
71011800	Boyd	Lake or Pond	101.79	2.82	Sherburne	Outstanding	0	1	0	0
86014600	Ida	Lake or Pond	225.53	2.83	Wright	High	3	2	0	0
86006600	Birch	Lake or Pond	99.82	2.00	Wright	High	0	2	0	0
86016100	West	Lake or Pond	67.83	3.66	Wright	Moderate	0	0	0	3
86016300	Limestone	Lake or Pond	233.86	4.96	Wright	Outstanding	1	0	0	0
71014100	Elk	Lake or Pond	356.89	3.47	Sherburne	Outstanding	1	0	0	0
86023300	Sugar	Lake or Pond	1014.21	8.69	Wright	Outstanding	1	2	0	0
86051300	Matala	Lake or Pond	3.25	0.32	Wright	High	0	2	0	2
73000400	Long	Lake or Pond	68.57	2.32	Stearns	Moderate	3	3	0	0
73000600	Crooked	Lake or Pond	77.08	2.34	Stearns	Moderate	3	3	0	0
86023800	Nixon	Lake or Pond	59.57	1.81	Wright	High	3	2	0	0
86024300	Grass	Lake or Pond	71.47	2.23	Wright	Moderate	0	3	0	0
86025200	Clearwater	Lake or Pond	3186.89	22.28	Wright	High	2	2	0	2
86022400	Sandy	Lake or Pond	69.19	1.71	Wright	Outstanding	0	1	0	0
73001500	Otter	Lake or Pond	91.75	1.95	Stearns	Moderate	0	3	0	0
Outstanding	7									
High	8									
Moderate	5									



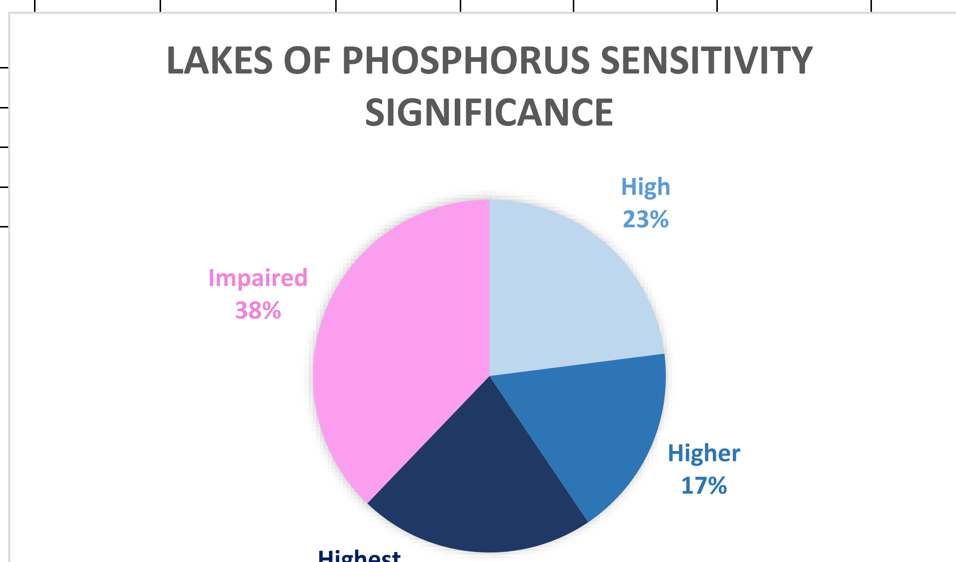
Appendix H - MRSCW Lakes – Phosphorus Sensitivity Table

Lake ID	Lake Name	Type	Acres	County Name	MEAN TP	MEAN SECCHi	TARGET TP	LPSS SCORE	LPSS CLASS
47010000	Rohrbeck	Lake or Pond	62.67	Meeker	374.00	0.30	313.06	0.00	High
86029800	Union	Lake or Pond	92.94	Wright	41.69	1.69	34.90	4.28	Higher
86021300	Henshaw	Lake or Pond	272.21	Wright	182.26	0.61	152.57	0.08	Impaired
86023000	Somers	Lake or Pond	151.35	Wright	73.45	1.32	61.49	0.47	Impaired
86022700	Cedar	Lake or Pond	790.31	Wright	28.20	2.40	23.60	18.80	Highest
86021200	Albion	Lake or Pond	249.04	Wright	178.86	0.75	149.72	20.20	Impaired
86015600	Mary	Lake or Pond	196.03	Wright	34.82	2.15	29.15	6.39	Higher
86020800	Swartout	Lake or Pond	292.87	Wright	328.46	1.05	274.94	0.00	Impaired
86021100	Edward	Lake or Pond	100.34	Wright	235.00	0.23	196.71	0.03	High
86007300	Cedar	Lake or Pond	206.37	Wright	17.25	4.80	14.44	18.33	Highest
71004100	Cantlin	Lake or Pond	123.74	Sherburne	25.87	2.64	21.65	12.20	Higher
71001600	Fremont	Lake or Pond	493.00	Sherburne	124.46	0.81	104.18	2.30	Impaired
71008100	Mitchell	Lake or Pond	169.50	Sherburne	18.30	2.77	15.31	55.42	Highest
48001000	Rice	Lake or Pond	52.53	Mille Lacs	341.00	0.00	285.44	0.00	High
71004600	Diann	Lake or Pond	61.96	Sherburne	59.32	1.01	49.65	0.80	Impaired
71006900	Ann	Lake or Pond	182.85	Sherburne	21.92	2.98	18.35	17.64	Highest
71006700	Eagle	Lake or Pond	462.42	Sherburne	88.62	1.02	74.18	1.82	Impaired
71005500	Elk	Lake or Pond	361.91	Sherburne	121.06	0.74	101.34	0.22	Impaired
71008200	Big	Lake or Pond	253.66	Sherburne	15.89	3.30	13.30	80.00	Highest
71005700	Birch	Lake or Pond	159.53	Sherburne	33.54	1.53	28.08	3.88	Higher
71001300	Orono	Lake or Pond	300.51	Sherburne	106.58	0.82	89.21	0.03	Impaired
86014800	Eagle	Lake or Pond	190.86	Wright	30.20	2.11	25.28	19.36	Highest
86006900	Long	Lake or Pond	96.04	Wright	22.00	1.75	18.42	2.33	High
71009600	Thompson	Lake or Pond	84.34	Sherburne	17.82	2.68	14.91	20.03	Highest
86007000	Bertram	Lake or Pond	110.69	Wright	31.88	1.57	26.68	1.66	High
86014600	Ida	Lake or Pond	225.53	Wright	13.63	3.97	11.40	26.41	Highest

Lake ID	Lake Name	Type	Acres	County Name	MEAN TP	MEAN SECCHi	TARGET TP	LPSS SCORE	LPSS CLASS
86006600	Birch	Lake or Pond	99.82	Wright	18.98	4.03	15.89	4.92	Higher
86016300	Limestone	Lake or Pond	233.86	Wright	23.75	3.04	19.88	5.84	Higher
86022900	Mink	Lake or Pond	279.75	Wright	125.92	1.05	105.40	0.12	Impaired
86013900	Little Mary	Lake or Pond	127.86	Wright	106.50	0.76	89.15	0.07	Impaired
71014100	Elk	Lake or Pond	356.89	Sherburne	163.25	0.58	136.65	0.01	Impaired
86015200	Millstone	Lake or Pond	199.63	Wright	357.00	1.65	298.83	0.00	Impaired
86017100	Ember	Lake or Pond	58.93	Wright	24.39	3.98	20.41	27.79	Highest
71012300	Camp	Lake or Pond	77.05	Sherburne	17.07	2.84	14.29	28.14	Highest
71014500	Julia	Lake or Pond	154.48	Sherburne	87.07	0.80	72.88	2.24	Impaired
86016800	Locke	Lake or Pond	139.98	Wright	58.34	1.04	48.84	0.43	Impaired
71014600	Briggs	Lake or Pond	404.36	Sherburne	99.51	1.08	83.30	0.83	Impaired
86022300	Indian	Lake or Pond	139.28	Wright	42.07	1.52	35.22	20.48	Impaired
71014700	Rush	Lake or Pond	160.91	Sherburne	117.67	0.69	98.50	0.24	Impaired
86014000	Silver	Lake or Pond	82.72	Wright	103.79	1.22	86.88	0.04	Impaired
86018300	Fish	Lake or Pond	97.35	Wright	49.24	1.29	41.22	3.06	Impaired
86024200	Wiegand	Lake or Pond	42.45	Wright	33.83	2.64	28.32	0.09	High
73000400	Long	Lake or Pond	68.57	Stearns	20.24	3.96	16.94	4.02	Higher
73000200	Feldges	Lake or Pond	24.35	Stearns	30.00	2.50	25.11	0.53	High
05000402	Donovan (main bay)	Lake or Pond	60.12	Benton	133.14	1.02	111.44	0.08	Impaired
73001100	Warner	Lake or Pond	37.43	Stearns	20.92	1.90	17.51	0.50	High
73000600	Crooked	Lake or Pond	77.08	Stearns	16.43	4.03	13.75	4.36	Higher
86025100	Pleasant	Lake or Pond	597.00	Wright	31.13	2.51	26.06	48.90	Highest
86023800	Nixon	Lake or Pond	59.57	Wright	18.82	3.35	15.75	5.61	Higher
86024300	Grass	Lake or Pond	71.47	Wright	22.44	2.68	18.79	0.44	High
05000700	Mayhew	Lake or Pond	127.98	Benton	154.44	1.84	129.28	0.01	Impaired
73000700	Quinn	Lake or Pond	22.45	Stearns	23.92	3.72	20.02	2.18	High
71015800	Pickerel	Lake or Pond	107.90	Sherburne	62.30	2.49	52.15	0.22	High
86023400	Bass	Lake or Pond	222.47	Wright	18.20	4.24	15.24	68.20	Highest
86023300	Sugar	Lake or Pond	1014.21	Wright	17.62	3.30	14.75	73.35	Highest

Lake ID	Lake Name	Type	Acres	County Name	MEAN TP	MEAN SECCHi	TARGET TP	LPSS SCORE	LPSS CLASS
86025200	Clearwater	Lake or Pond	3186.89	Wright	44.10	2.24	36.91	3.63	Higher
73000300	Maria	Lake or Pond	78.90	Stearns	32.42	2.25	27.13	0.95	High
73001000	Bunt	Lake or Pond	114.53	Stearns	51.83	1.23	43.39	5.98	Higher
86022400	Sandy	Lake or Pond	69.19	Wright	19.50	0.99	16.32	9.18	Higher
71016700	Round	Lake or Pond	35.78	Sherburne	69.76	3.45	58.40	0.04	High
73000100	Dallas	Lake or Pond	25.14	Stearns	25.00	3.27	20.93	0.36	High
73001500	Otter	Lake or Pond	91.75	Stearns	21.88	2.80	18.31	1.51	High
71015900	Long	Lake or Pond	174.01	Sherburne	75.54	2.35	63.23	0.11	High
86028400	Augusta	Lake or Pond	187.12	Wright	44.44	1.85	37.20	0.36	High
47004200	Betty	Lake or Pond	153.66	Meeker	169.41	1.35	141.81	0.00	Impaired
73001400	Marie	Lake or Pond	145.82	Stearns	137.46	1.11	115.07	0.01	Impaired
86029700	Scott	Lake or Pond	82.70	Wright	151.76	1.09	127.03	0.00	Impaired
73002000	Laura	Lake or Pond	140.42	Stearns	20.17	1.50	16.88	20.74	Highest
73002300	Beaver	Lake or Pond	111.91	Stearns	17.33	3.63	14.51	31.18	Highest
73003500	School Section	Lake or Pond	210.54	Stearns	24.19	2.49	20.24	29.29	Highest
86028100	Caroline	Lake or Pond	137.15	Wright	66.53	1.36	55.69	0.09	Impaired
86028200	Louisa	Lake or Pond	192.70	Wright	108.05	1.26	90.44	0.02	Impaired
47009600	Little Mud	Lake or Pond	37.37	Meeker	50.66	2.49	42.40	7.23	Higher
47009500	Clear	Lake or Pond	529.07	Meeker	152.48	0.88	127.63	0.04	Impaired

High	17
Higher	13
Highest	16
Impaired	28



Appendix I - MRSCW – Priority Streams, based on water quality assessment results

Watershed – HUC-8 7010203 Mississippi River - St. Cloud	WID	VULN.	Use class	Stream name	TALU	Priority Rank	Proposed Use Class	VULN.	Priority Ranking
	07010203-507		2B	Elk River	General	12			B (Medium priority)
	07010203-512	AQL	2B	Rice Creek	General	9		AQL	A (High priority)
	07010203-538		2A	Briggs Creek	General	12			B (Medium priority)
	07010203-546		2B	Stony Brook	General	6			A (High priority)
	07010203-548	AQL; AQR	2B	Elk River	General	9		AQL; AQR	A (High priority)
	07010203-555		2B	Silver Creek	General	7			A (High priority)
	07010203-561	AQL	2A	Unnamed creek (Luxemburg Creek)	General	7		AQL	A (High priority)
	07010203-566		2A	Unnamed creek (Thiel Creek)	General	12			B (Medium priority)
	07010203-572		2B	Plum Creek	General	12			B (Medium priority)
	07010203-579	AQL	2B	Elk River	General	9		AQL	A (High priority)
	07010203-633	AQR	2A	Johnson Creek (Meyer Creek)	General	9		AQR	A (High priority)
	07010203-639	AQL	2B	Johnson Creek (Meyer Creek)	General	10.5		AQL	A (High priority)
	07010203-684		2B	Unnamed creek	General	6			A (High priority)
	07010203-690		2B	Otter Creek	General	9			A (High priority)
	07010203-694		2B	County Ditch 13	Modified	7	2Bm, 3C		A (High priority)
	07010203-697		2B	County Ditch 5	General	6			A (High priority)
	07010203-735		2B	Tibbets Brook	Modified	13.5	2Bm, 3C		B (Medium priority)
	07010203-736	AQL	2B	Tibbets Brook	General	9		AQL	A (High priority)