Watershed assessment and trends update

Mississippi River- St. Cloud

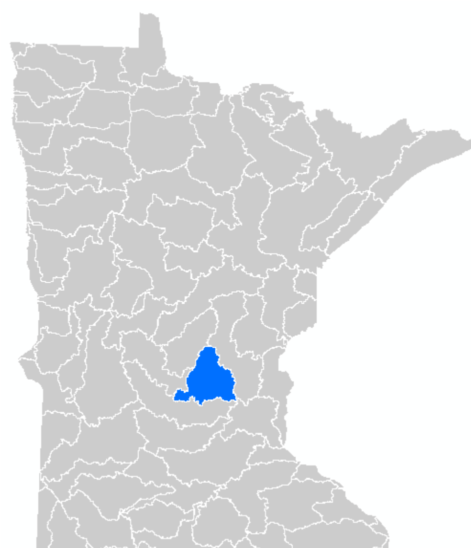
Upper Mississippi River Basin

Why is it important?

Water quality monitoring is essential in determining whether lakes and streams meet water quality standards designed for protecting beneficial uses like fishing and swimming. Regional and local water-stewardship groups, along with some state and federal agencies, continually monitor their respective watersheds on an ongoing basis. Once every 10 years, the Minnesota Pollution Control Agency (MPCA) joins local partners and the Minnesota Department of Natural Resources (MNDNR) in conducting intensive monitoring of the lakes and streams in each of the state's 80 major watersheds. For the Mississippi River-St. Cloud Watershed (MRSCW), this update summarizes the second round of intensive monitoring. The monitoring effort looks at fish and macroinvertebrate (aquatic insect) communities as a measure of aquatic life health, in addition to water chemistry, to evaluate water quality. Agency staff and local stakeholder partners collaborate to review and assess the monitoring data to identify healthy (or stressed) waters in need of protection, and impaired waters in need of restoration. Furthermore, there is an evaluation of how conditions have changed over the 10-year period. This continually increasing understanding of the watershed leads to refined restoration and protection strategies and better focus of resources toward beneficial on-the-ground efforts to improve water quality.

Is the water quality improving?

Over the past decade, scientists observed many positive improvements in water quality within the MRSCW. Between 2009 and 2019, the overall health of fish and macroinvertebrate communities in the watershed improved. Lake conditions told a similar story of improving quality with a number of restored waters earning approval to remove some nutrient impairments from the impaired waters list. These improvements are a testament to the efforts of local watershed managers and the partnerships they build. However, continued problems include loss of shoreline buffers and habitat due to development, excess nutrients, elevated levels of bacteria, and low dissolved oxygen levels.



- Across the watershed, there has been a statistically significant improvement in both fish and macroinvertebrate community condition over the last 10 years.
- Water clarity trends were improving on 17 different lakes and only slightly declining on three (Albion, Fish, and Crooked). Thirteen lakes showed no change.

- Average fish and macroinvertebrate community IBI scores in the watershed were statistically higher between 2009 and 2019. This watershed demonstrates some of the most dramatic positive changes over the 10-year time period compared to other Minnesota watersheds for which this analysis has been done.
- Since 2009, landowners have implemented hundreds of best management practices (BMPs) to improve water quality throughout the watershed. The headwaters of the Elk River, upper portion of the Clearwater River, and Mayhew Creek are a few areas where BMP implementation has flourished. In many areas, it takes time for these practices to show lasting results.
- Four streams and four lakes were removed from the impaired waters list (delisting). These delistings highlight the collaborative efforts by landowners and local partners to improve water quality through on-the-ground practices and outreach. Plum Creek highlights this effort with local partners leading the charge to identify and address the water quality issues and collect the data necessary to identify change.
- Clearwater River Watershed District (CRWD) demonstrated that the Kingston Wetland Restoration Project (WRP) and stream diversion efforts are creating positive results. The construction of channel meanders and a high-flow wetland diversion have already led to reduced sediment and total phosphorus loads that will benefit lakes downstream of the project. Within 10 miles, the river flows through a series of five nutrient impaired lakes, each of which comes close to, or are meeting Secchi transparency standards. Long-term nutrient reductions from the Kingston WRP will help move these lakes toward delistings.

- Beginning in 2009, a partnership between the city and residents of St. Cloud, Benton County SWCD, Short Elliot Hendrickson Inc. (SEH), MPCA, and Board of Soil and Water Resources (BWSR) assessed concerns of untreated stormwater runoff draining directly into the Mississippi River from 367 acres of residential and industrial northeast St. Cloud. By creating and implementing the Northeast Water Quality Improvement Plan, local enforcement, enhancing education, and five stormwater improvement projects, the goal of reducing total suspended solids (TSS) and total phosphorus (TP) concentrations was initiated. The five projects included underground treatment systems, parking lot bioretention, green spaces, and sump catch basins. In total, these projects are significantly reducing TSS and TP entering the Mississippi River by roughly 16.9 tons TSS and 48.6 pounds TP per year, respectively. For more information on this project, please see the NE St. Cloud Water Quality Improvements story board.

Highlights of monitoring

- During fish sampling, a total of 46 species were captured in 31 lakes. Eleven of these species are considered to be intolerant to anthropogenic stressors, while five species are considered to be tolerant to shoreline and watershed stressors. A total of 87 fish species and 303 macroinvertebrate taxa were captured in streams.

- Intense monitoring (2014-2019), state, local partners, and landowner partnerships, and strategic implementation of numerous best management practices have led to the removal of the bacteria impairment on Plum Creek.
- For the first time, fish-based indices of biological integrity (IBIs) were used to assess aquatic life in lakes.
- Several lakes in this watershed support fish Species of Greatest Conservation Need, including the least darter and pugnose shiner.
- Sugar Lake was noted to have an exceptional fish community.
- Augusta, Caroline, Clearwater, and Sugar Lake have cold water habitats and contain cisco (tullibee). This is noteworthy as this watershed is located along the southern range of this species.
- Many of the largely popular recreational lakes had improving clarity trends (Clearwater, Orono, Big, Mitchell, etc.).

Success story

The watershed has seen several successfully restored streams and lakes. One common theme that ties all these successes together is that through partnerships, planning and action, the state-supported approach to restoring and protecting water quality is working. This assessment cycle brought us three chemistry delistings with documented improvements in water quality.

The strategic benefits of promoting watershed engagement through partnerships between various governmental agencies beyond the two-year intensive watershed monitoring (IWM) process through watershed restoration and protection strategies (WRAPS) has led to successful civic engagement. That, in turn, has resulted in the successful implementation of several restoration projects. Some of the monitoring carried out in 2019-2020 was managed by the Sherburne County Soil and Water Conservation District (SWCD) through a Surface Water Assessment Grant. They worked with multiple local partners to carry out the intensive monitoring schedule. This data along with other data that had been collected over the 10-year assessment window led to the following success stories.

- **Plum Creek below Warner Lake:** This stretch of stream was originally listed for excessive bacteria in 2012. In the years that followed, a network of state/local partnerships including Stearns Soil and Water Conservation District (SWCD), private landowners, citizen volunteers, and the University of Minnesota (U of M) successfully completed a number of best management practices. Consequently, the average bacteria concentrations were low enough to delist bacteria in 2020. Efforts included a septic upgrade, culvert replacement/erosion control, buffer establishment, and a minor change to nearby agricultural practices. https://www.epa.gov/sites/default/files/2020-10/documents/mn_plum_creek_1923_508.pdf
- **Lake George nutrient delisting (St. Cloud):** The lake was listed for excessive nutrients in 2012, and by 2017 there was an approved action plan in place. Starting in 2018, the City of St. Cloud completed in-lake alum treatments, and an underground stormwater treatment upgrade is nearly completed. These efforts and residential raingardens have helped lower the seasonal concentrations of nutrients in the lake to the point of earning a delisting. More information is available on the Lake George Water Quality Improvement Project story board.

- **Union Lake and Lake Augusta nutrient delistings:** Both lakes near South Haven, Minnesota, show that restoration efforts have been successful, and standards are now being met. The Tri-County Conservation Project spearheaded significant collaborative efforts between Meeker, Stearns, and in 2020, the Minnesota Department of Natural Resources removed an old dam on Drywood Creek, a tributary to the Pomme de Terrre River.
- Birch Lake nutrient delisting**:** Birch Lake in Sherburne County has been restored and is now meeting standards. Public-private partnerships completed shoreline restoration projects, which reduced erosion and supported rooted plant growth. Installation of a stormwater filtration basin in partnership with Big Lake township has also helped reduce the amount of untreated runoff reaching the lake. Sherburne SWCD has documented the restoration efforts.

- **Unnamed Creek fish and macroinvertebrate delisting:** Restoration activity (culvert replacement) has led to the delisting of biological impairments (fish and macroinvertebrates) on a tributary to the Elk River at CR 65 near St. Cloud. The culvert replacement completed by Sherburne County Public Works restored perennial flow to the stream and reduced pooling and sediment build-up.

Watershed assessment results

The MPCA and partners monitored water chemistry in 2009-2010 and again in 2019-2020. The chemistry data collected between 2009 and 2019 were used to assess if the water quality standards for aquatic life, recreation, and consumption were being met. The overall goal of these assessments is to ultimately determine which waters are healthy and in need of protection, or are polluted and require restoration.

Streams and rivers

One way to assess the health of a stream or lake is to look at the organisms that live in it. These aquatic communities reflect the cumulative effects of natural and human-caused influences. Both the MNDNR and MPCA use the index of biological integrity (IBI) as a tool to assess these aquatic communities in lakes (MNDNR) and streams (MPCA). These indices are scaled 0-100; the higher the score, the better the condition of the aquatic community.

Between the first and second rounds of biological monitoring in this watershed, the MPCA adopted new rules to assess aquatic life in channelized streams and ditches. The new rules provide reasonable aquatic life protections for waterbodies that were legally altered prior to the advent of the Clean Water Act. As a consequence 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.

The MNDNR uses a similar IBI tool for assessing aquatic life in lakes, using fish communities. The FIBI is used to measure a lake's health and identify lakes that may be impacted by watershed disturbance, shoreline degradation, or other environmental stressors. FIBI data are used to help determine stressors affecting lakes and make recommendations for protection and restoration activities.

Overall, 40% of the assessed stream reaches in the MRSCW support aquatic life use (Figure 1). The lower reaches of the Elk and St. Francis Rivers have fish and macroinvertebrate communities that are in good condition, but many streams, particularly in the lower two-thirds of the watershed, have biological communities that are severely degraded (Figure 2). Although some dramatic improvements have occurred, most fish and macroinvertebrate communities in the watershed exhibit signs of degradation characterized by a dominance of pollution-tolerant species.

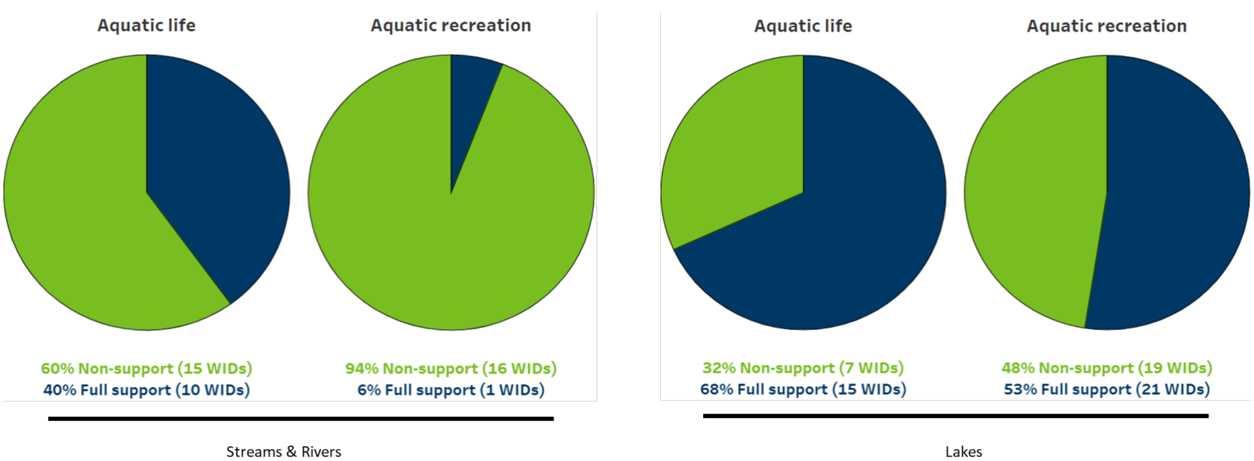
There were four new biological listings added to the 2022 Impaired Waters List. All of the new listings were on coldwater tributaries to the Elk (Snake River) and Clearwater Rivers (Threemile Creek). Cold water temperatures and numerous coldwater benthic macroinvertebrates suggest that these streams could support coldwater fish species (e.g., brook and brown trout), but poor habitat appears to be a limiting factor. With improved habitat and given the proximity of these streams to large metropolitan areas, they could provide coldwater angling opportunities to local anglers.

For the most part, general stream chemistry assessments met, or were close to, meeting water quality standards. Continued high bacteria concentrations throughout the watershed are still impacting stream recreational uses, with one shining exception: the Plum Creek bacteria impairment between Warner Lake and the Mississippi River is being delisted.

Water chemistry parameters generally stayed the same or improved slightly between the two assessment periods. Only two new chemistry impairments were identified during this cycle: excessive bacteria in Johnson (Meyer) Creek, and excessive total suspended solids (TSS) in the Clearwater River (focus is upstream of the Kingston Wetland complex).

Elevated nutrients (such as total phosphorus) were noted on several stream sections in the headwaters area of the Clearwater River. However, thanks in part to the Kingston Wetland project, river nutrients and sediments entering Lake Betty are now lower than they used to be. Low dissolved oxygen remains a potential problem in Rice and Mayhew Creeks, the St. Francis River and the Clearwater River below Clearwater Lake.

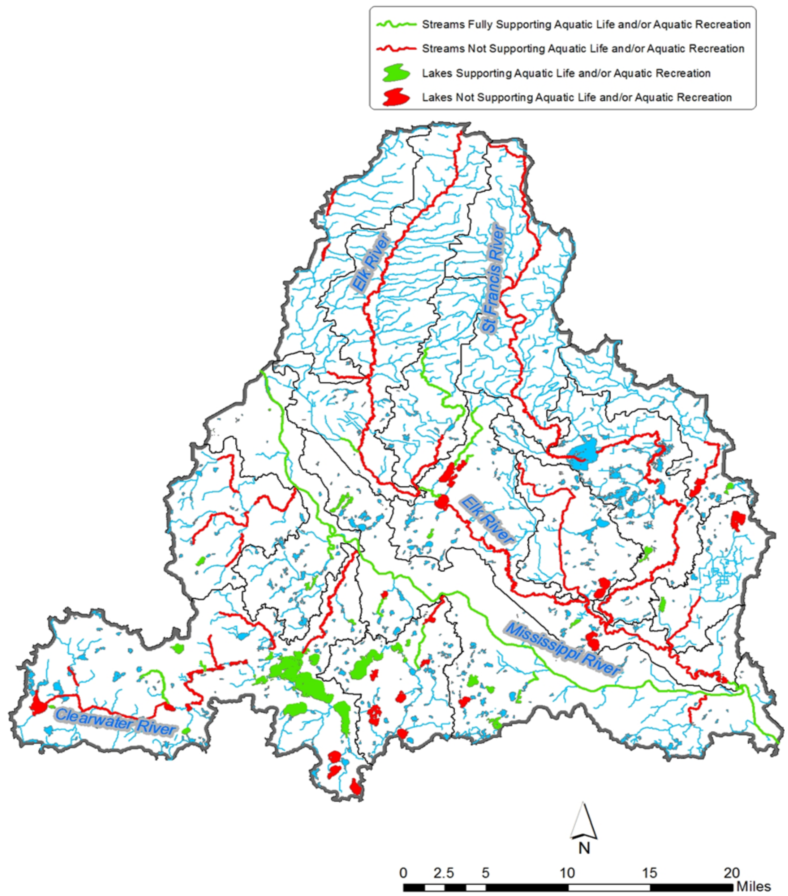
Figure 1. Watershed assessment results for aquatic life and aquatic recreation in streams and lakes.



Lakes

Lake water quality overall has improved since 2009. A handful of lakes that were previously listed for excessive nutrients have successfully been removed from the Impaired Waters List (Augusta, Union, George, and Birch). The City of St. Cloud, Sherburne & Stearns SWCD, and Clearwater River Watershed District have each worked to successfully restore water quality in these lakes. All groups have plans of continued diligence as long-term protection efforts begin.

Figure 2. Assessment results for aquatic life and aquatic recreation on rivers, streams, and lakes.



There are now 21 lakes that support recreational uses, and 19 that are impaired (Fremont, Julia, and Indian Lakes are all close to meeting standards). Flow through type "riverine" lakes are often more likely to be nutrient impaired (like the chain of Betty-Scott-Louisa-Marie-Caroline-Augusta), but efforts by the Clearwater River Watershed District (CRWD) to reduce suspended solids and river nutrients had a hand in the Lake Augusta nutrient delisting. Hopefully, we will continue to see improvements in lake water quality in the future because of the great work our partners are doing on both sides of the Mississippi River.

Twenty-nine lakes within this watershed were assessed for aquatic life for the first time using a fish-based IBI developed for Minnesota lakes. Two lakes (Mayhew and Long) were not assessable due to size or frequent winterkill events. A total of 15 lakes (Bass, Beaver, Birch, Caroline, Cedar, Clearwater, Eagle (71-0067-00), Elk, Julia, Limestone, Marie, Mink, Rush, School Section, and Sugar) fully supported aquatic life. Bass and Cedar Lakes were considered vulnerable with fish IBI scores very near the impairment threshold. Sugar Lake was noted as containing an exceptional fish community.

Assessment results for seven lakes (Ann, Augusta, Elk, Indian, Louisa, Pleasant, and Somers) were inconclusive, with four of those lakes (Augusta, Elk, Louisa, and Pleasant) considered vulnerable. Ida and Long lakes did not have enough data to make a formal assessment. The final seven lakes (Betty, Big, Briggs, Eagle, Locke, Mary, and Mitchell) did not support aquatic life use.

Overall fish diversity was similar to other Minnesota watersheds in central Minnesota. Across the MRSCW, 46 total fish species were captured in 31 lakes during FIBI sampling. Eleven of these species are considered to be intolerant to anthropogenic shoreline and watershed stressors within the watershed (e.g., banded killifish, blackchin shiner, blacknose shiner, cisco, Iowa darter, least darter, logperch, mimic shiner, pugnose shiner, rock bass, and smallmouth bass), while five species were considered to be tolerant to these stressors (e.g., bigmouth buffalo, black bullhead, common carp, fathead minnow, and green sunfish). Four lakes (Augusta, Caroline, Clearwater, and Sugar) have coldwater habitats and contain cisco (tulibee). This is noteworthy as this watershed is located along the southern range for this species.

Stressors that are likely influencing these communities include excess nutrient inputs from agricultural and urban land uses. Most of the assessed lakes (21) are in basins with greater than

50% disturbed land use, and all the impaired and vulnerable lakes are in highly disturbed basins. Degraded and/or developed shorelines are another likely stressor. Most of the unimpaired lakes had shoreline habitat scores that are considered moderate or high, and all impaired lakes had shoreline habitat scores of very low, or low.

Protection efforts would be particularly beneficial in lakes that are sensitive to an increase in phosphorus (e.g., Thompson, Bass, Sandy, Ann, Ida, and Laura), with a documented decline in water quality as measured by Secchi transparency (e.g., Sugar and Nixon Lakes), a comparatively high percentage of developed land use in the area (e.g., Beaver, Big, Mitchell, School Section, Ember, Camp, and Pleasant Lakes), or monitored phosphorus concentrations close to the water quality standard (Figure 5).

Load monitoring results

The MRSCW is in a transitional zone in Minnesota, where the wooded northern portions of the state begin to meet the agricultural and more urbanized areas of the south. Concentrations of total phosphorous (TP), nitrogen, and total suspended solids (TSS) reflect the transitional nature of this watershed, with concentrations generally beginning to increase in this region from north to south.

The Watershed Pollutant Load Monitoring Network (WPLMN) has three monitoring stations within the MRSCW. The Clearwater and Elk Rivers discharge directly into Mississippi River, while the St. Francis River discharges into the Elk River shortly before its confluence with the Mississippi River. All three subwatershed stations are sampled from snow melt through October 31 annually. The MRSCW is unique in the fact that unlike other watersheds along the Mississippi River, this watershed does not have a major/basin station that is monitored year-round. The flow volume and pollutant loads from the three stations were not only analyzed individually, but cumulative results from the three subwatershed stations were compared to the Mississippi River site at Anoka, which is the closest downstream monitoring station on the Mississippi River. This analysis makes it possible to estimate what contribution the MRSCW has to the Mississippi River.

The three subwatershed stations have good water quality across all three parameters analyzed: TP, nitrogen, and TSS. All concentrations are expressed as the average flow-weighted mean concentrations (FWMC), which is the average concentration of a pollutant for all water that passed a monitoring station over the course of the monitoring period 2015-2019 (Table 1). Each of the three stations has TSS and nitrogen concentrations in the low range for the regions, all being well below their respective standards of 30 mg/L (TSS) and 10 mg/L (NO_2+NO_3). Total phosphorus levels are low for the Clearwater River and moderate for the Elk and St. Francis, both of which do have TP concentrations that approach and/or slightly exceed the state standard (0.10 mg/L) As noted previously, however, there are localized TSS and nutrient concerns in the headwaters of the Clearwater River; and the total phosphorus levels in the Elk and St. Francis Rivers are high enough to warrant keeping an eye on. (Figure 3).

Table 1. Comparison of average total flow-weighted mean concentrations (FWMC) for the Clearwater, Elk, and St. Francis Rivers (2015-2019).

Station	Station ID	TSS (mg/L)	NO2+NO3 (mg/L)	TP (mg/L)
Clearwater	S004-508	5.36	0.14	0.028
Elk	S000-278	7.00	0.53	0.085
St. Francis	S002-952	5.14	0.12	0.078

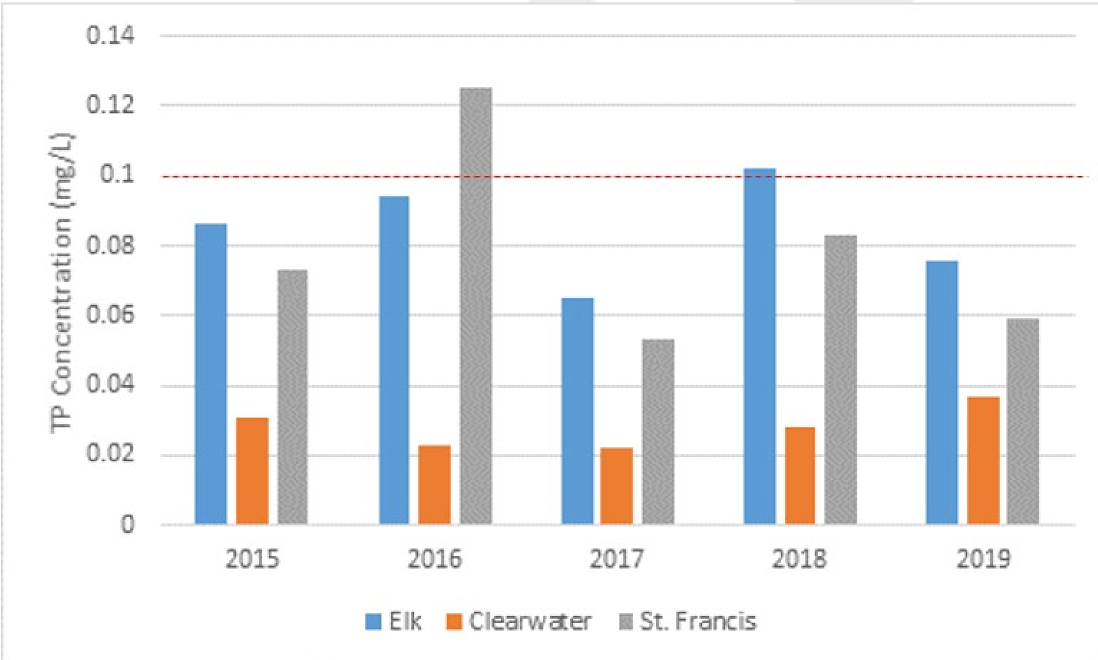
Nitrate concentrations at the three stations are roughly equal to or slightly higher than the watersheds to the north but lower than those to the south. Furthermore, the nitrate concentrations within these systems vary depending on time of year, with concentrations being higher during spring (specifically during snowmelt runoff) and late fall and lower during the early summer to early fall time period. Agriculture is more common in this watershed than those to the north, specifically along the Elk and St. Francis Rivers. It is plausible that nitrates from fertilizers, manure applications, and decomposition of soils and organic matter are infiltrating the soil and groundwater below. The groundwater (and nitrates) then enter these rivers during a time when flows are low and there is less water to dilute the nitrates. Other possible sources of nitrates could include, but are not limited to, overland flow, municipal and industrial wastewater, as well as other point and non-point sources.

TP and TSS concentrations are higher than other watersheds further to the north and lower than concentrations in watersheds in southern Minnesota. Generally, TSS concentrations are associated with TP concentrations; when one parameter rises so does the other. The increases are commonly associated with rising flows that occur immediately following heavy rain events. The association suggests that phosphorus is bound within the sediment particles and when rain events erode the topsoil and/or river banks surrounding these rivers, the sediment that is washed into the river from overland flow carries phosphorus along with it.

It should be noted that although agricultural lands are prevalent within the MRSCW, vast areas of natural landscapes do exist as well, with the most prevalent being the Sherburne National Wildlife Refuge (NWR) (30,700 acres) and the Sand Dunes State Forest (11,040 acres). Both areas are located within the St. Francis River Subwatershed with the St. Francis River flowing directly through the vast network of wetlands within the Sherburne NWR. These wetlands have a strong influence on the water quality of the St. Francis River and subsequently all downstream waters. Wetlands provide a multitude of positive benefits, including flood control, sediment trapping, and nutrient (NO_2+NO_3 and TP) intake. On balance however, wetlands sometimes have “negative” impacts on water quality, including exporting some of their stored nutrients and producing water that is low in dissolved oxygen.

At a local scale, water quality impacts from the three subwatershed sites on the central portion of the Mississippi River in Minnesota is fairly low for all three parameters when compared to the average loads measured in the Mississippi River at Anoka. In total, the MRSCW contributes 6% of the total drainage area and 4.5% of the total flow volume to the Anoka station. Phosphorus is the largest contributing pollutant at 3.5% of the annual load at Anoka while nitrates and TSS inputs have a lesser impact, contributing 1.4 and 1.9% percent of the average loads, respectively. Additional maps and supporting data can be found at https://www.pca.state.mn.us/water/watershed-pollutant-load-monitoring.

Figure 3. Mississippi River-St. Cloud Subwatershed stations Total phosphorous (TP) flow-weighted mean concentration (FWMC), 2015-2019. State TP standard is 0.1 mg/L (dashed red line).



Trends

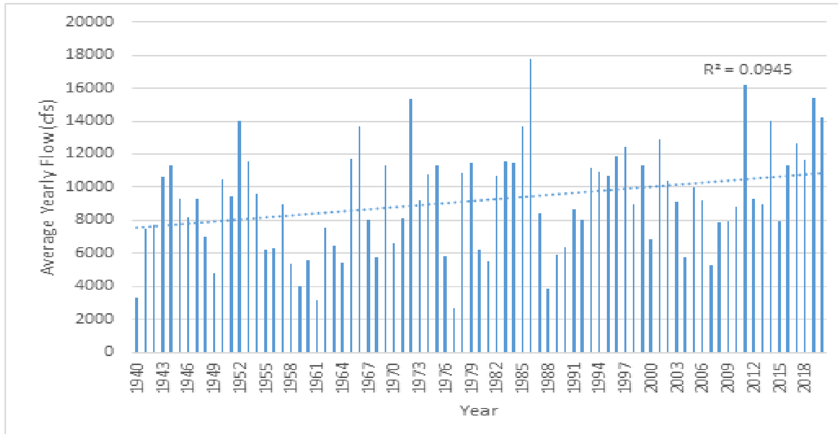
A key objective of the 2017 monitoring effort was to evaluate if and how water quality has changed since 2007 (Figure 4-next page). If water quality has improved, it is important to understand to what extent strategy development, planning, and implementation, based on the initial work and combined with actions that were already underway, may be responsible. It is equally important to understand if water quality does not appear to be changing, or is declining. Either way, the knowledge will help inform future activities.

Trends in four different aspects of water quality were analyzed to provide as robust a picture as possible of what is happening in the MRSCW:

1. Streamflow, sediment (total suspended solids), TP, and nitrogen (nitrate)
2. Biological communities
3. Clarity of lakes
4. Climate

Streamflow and pollutant concentrations

Figure 4. Average yearly flow (cfs) at Mississippi River near Anoka, 1940-2020.

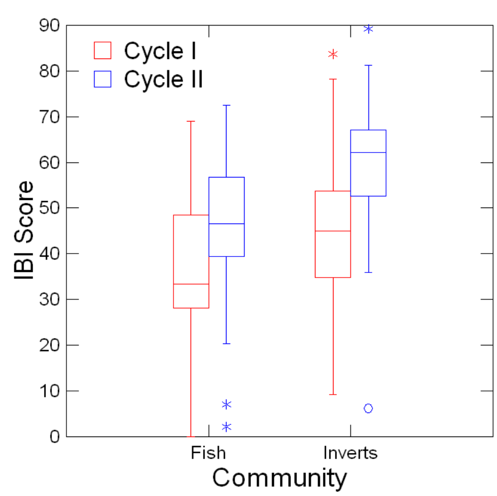


Without a major/basin station, a direct measure of flow volume and pollutant loads within the MRSCW was not possible. An analysis of flow volume and pollutant loads at the Mississippi River at Sartell and Anoka, which bracket this watershed, provide a useful substitute for the purpose of determining trends with the caveat that the Crow River and Sauk River Watersheds also contribute water between these two stations. Short- (10 year) and long- (40 year) term trend results were mixed between parameters. TP concentrations declined over the short- and long-term at both stations, while TSS concentrations showed similar declines except for the short-term (10 year) analysis at Anoka, which showed a slight increase. Nitrate trend results showed significant increases in concentrations at both stations over the short- and long-term time periods. Figure 4 displays the long-term yearly average flow data at Mississippi River near Anoka. Flows at the Anoka station have increased by roughly 3,000 cfs or 25% during the 80-year period of record shown in Figure 4. Flows in the Minnesota River, by contrast, have shown an increase of nearly 300% over the same period. This suggests a higher level of landscape resiliency to precipitation increases in the Upper Mississippi Basin, including in the Mississippi River-St. Cloud Watershed.

Biological communities

Paired t-tests of fish and macroinvertebrate IBI scores were used to evaluate if the biological condition of the watershed's rivers and streams has changed between time periods. Independent tests were performed on each community with 22 sites evaluated for macroinvertebrates and fish (i.e., sites that were sampled in both time periods). The average macroinvertebrate IBI score for the watershed increased by 12.0 points between 2009 and 2019, which represents a statistically significant increase. Similarly, FIBI scores across the MRSCW increased by 8.2 points, which was also a statistically significant increase (Figure 5). Large changes in IBI score occurred in some streams, namely portions of the Elk, St. Francis, Clearwater Rivers, and a few smaller streams. MIBI scores in the Elk River increased by 30 points in the upper reach (-508) and nearly 50 points in the lower reach (-579). While the lower reach is still listed as impaired for fish and macroinvertebrates, a TMDL for the biological stressors on this reach will not be required. The reach has been classified as vulnerable to provide added protection from future degradation. MIBI scores on the St. Francis River also increased, resulting in the delisting of the upper reach for macroinvertebrates. While this delisting was not directly attributed to a specific watershed improvement activity, cattle were excluded from the stream in the upper portions of the segment where they previously had access.

Figure 5. Index of Biological Integrity Scores between intensive watershed monitoring efforts; note IBI score does not correspond to assessment thresholds.



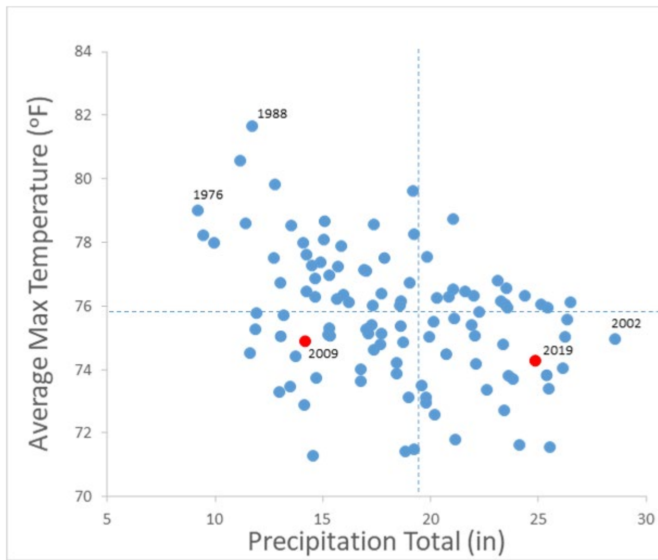
For fish, the upper and middle portions of the St. Francis River saw a range of improvements (9-26.5 points) in FIBI score; however, numerous dams within the Sherburne National Wildlife Refuge continue to restrict the movement of large migratory fish species (e.g., shorthead and silver redhorse).

A similar change analysis was not completed for lakes because comparable fish community data had not been collected during the first time.

Climatic conditions can affect aquatic communities in a variety of ways by altering flow volumes, increasing water temperatures, decreasing dissolved oxygen concentrations, degrading habitat, and decreasing connectivity. The impact of climatic conditions/weather events on stream aquatic life are dependent on the timing, magnitude, frequency, and duration of events as well as the type of stream or biological community.

Overall, given the dry conditions affecting the watershed in 2009 and the wet conditions present in 2019, some of the observed changes in biological condition at either the watershed or individual site scale may (in part) be due to differences in climatic conditions between the two years. In 2009, the MRSCW experienced a moderate rainfall deficit (-4.8 inches) and near normal temperatures (-0.6 °F) during the period that biological stream monitoring was conducted by the MPCA (May-September). In contrast, the watershed had above normal precipitation (+5.9 inches) and was somewhat cooler (-1.2 °F) in 2019 between May and September (Figure 6). The calendar year of 2019 is just shy of the estimated wettest on record for the watershed with a total of ~40 inches of rain.

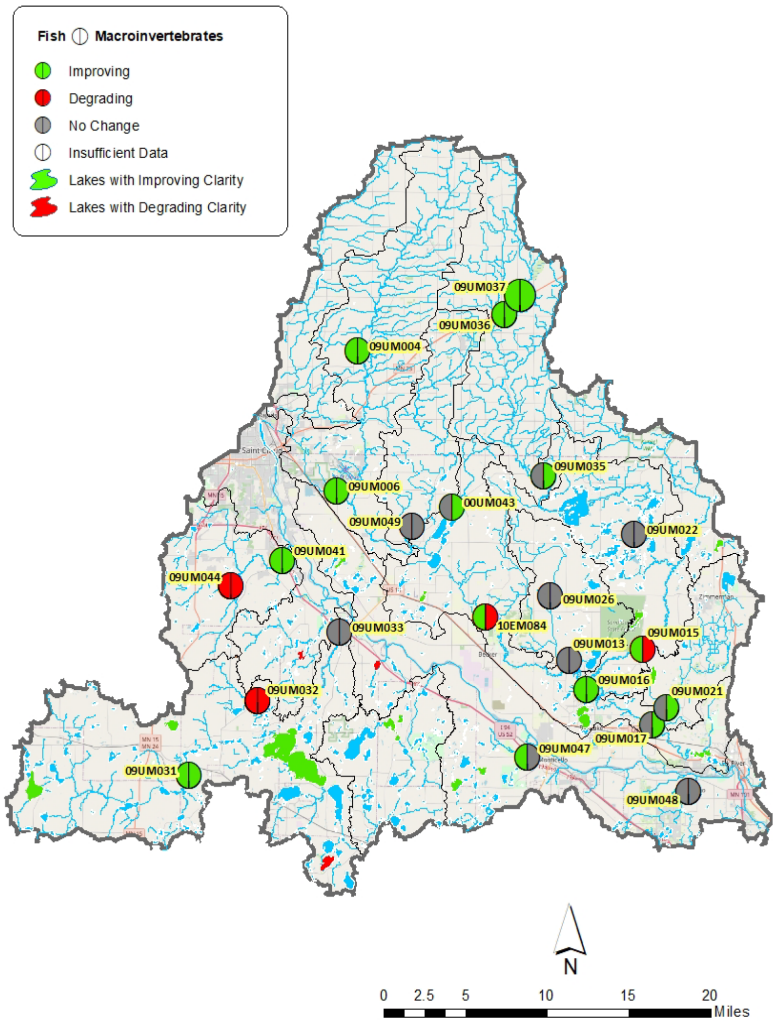
Figure 6. Characterization of air temperature and rainfall conditions for May-September period across the historical record of climate data for the Mississippi River-St Cloud Watershed. Dashed lines represent normal (1991-2020) maximum temperature and total precipitation values for the watershed. IWM years highlighted in red.



Clarity of lakes

Water transparency is typically a good indicator of overall lake water quality. As water clarity increases, there is a greater likelihood that water quality standards are being met. There are 64 lakes with some level of transparency data in this watershed, thanks in large part to volunteer monitoring. Of those 64 lakes, 58 have enough data to estimate a long-term change in clarity if it were present (i.e., at least 50 Secchi measurements over eight years). An improving trend was noted in 16 lakes, including some of the most heavily used recreational lakes (Clearwater, Orono, Big, Mitchell, etc.) while only three showed a decline (Albion, Fish, and Crooked) (Figure 7). For more details of a particular waterbody, please visit the [Water Quality Assessment Results Data Viewer | Tableau Public].

Figure 7. Change in water quality in the Mississippi River-St. Cloud Watershed over the last 10 years. Blue lakes indicate either no change or they were not sampled as part of this effort.



Climate

The MNDNR Climate Summary for Watersheds summarizes regional climate data (available from 1895 through 2018) and provides a comparison of the most recent 30-year average against the entire data record. Compared with the historical average (1895-2018), the MRSCW currently receives on average an additional 2.3 inches of rain. Most of this increase occurs in the spring (March-May; 1.0”) and summer months (June-August; 0.8”). Meanwhile, the average annual temperature across the watershed has increased by 1.4° F, with a more pronounced increase (+2.8° F) observed during the winter (December-February).

More precipitation and reduced snow cover can increase soil erosion, pollutant runoff, and stream flow. Increased stream flow in turn can lead to in-stream channel erosion and degraded habitat for aquatic life. Longer growing seasons with higher temperatures can lead to more algal blooms, especially in lakes. These changes will complicate efforts to protect and restore the aquatic resources in the watershed. For a more comprehensive analysis of climate trends for the MRSCW. See: DNR climate summary for the Mississippi River-St. Cloud Watershed.

For more information

This study of MRSCW was conducted as part of Minnesota's Watershed Approach to restoring and protecting water quality. Efforts to monitor, assess, study, and restore impaired waters, and to protect healthy waters are funded by Minnesota's Clean Water, Land, and Legacy Amendment. This approach allows for efficient and effective use of public resources in addressing water quality challenges across the state. The data and assessments produced by this study can inform local efforts to restore and protect waters in the MRSCW, such as the One Watershed One Plan document, a comprehensive watershed management plan that targets projects to protect and restore the watershed's most valuable resources. For more information, go to the MPCA Mississippi River-St. Cloud webpage, or search for "St. Cloud" on the MPCA website.

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