Watershed assessment and trends update

# Mississippi River – Winona and La Crescent Watersheds Lower Mississippi River Basin



## Summary

The Minnesota Pollution Control Agency (MPCA) and partners have completed a study of the Mississippi River - Winona and La Crescent Watersheds. The Mississippi River - Winona Watershed covers 655 square miles in Wabasha, Winona, and Olmsted counties in southeast Minnesota. The Whitewater River falls within this watershed and is well known for its state park and trout fishing. The Mississippi River - La Crescent Watershed drains 95 square miles in Houston and southeast Winona counties, an area defined by wooded bluffs and spring-fed coldwater streams that flow directly to the Mississippi River.

Conditions remained relatively stable as significant change was not observed in biological condition between watershed monitoring periods. However, improvements were realized with several waterbodies being removed from the 2024 Impaired Waters List (IWL). Nitrate, bacteria, and excess sediment continue to be pollutants of concern.

Instead of relying on chemical testing of the water alone, scientists reached their conclusions through studying the variety of fish and bugs living in the waters. Doing so offers a more comprehensive understanding of the watershed's health over time. Volunteer water quality monitors contributed to the assessment, which is funded by Minnesota's Clean Water Land and Legacy Amendment. Details in this report will shape decisions on watershed management and pollution reduction measures for years to come. Figure 1: Minnesota's 80 major river drainages. Mississippi - Winona and La Crescent Watersheds highlighted.



## Watershed Study

The MPCA and partners initially monitored water quality conditions in 2010-2011 in the Mississippi - Winona and 2015-2016 in the Mississippi - La Crescent Watersheds. Both watersheds were monitored again in 2021-2022. Chemistry data collected by local partners between 2013 and 2022 were used for the recent assessment. Data used to assess the condition of Minnesota waterbodies focus on whether they are meeting water quality standards for aquatic life, recreation, and consumption. 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.

Water monitoring is essential to determining whether lakes and streams meet water quality standards designed to ensure that waters are fishable and swimmable. While local partners and state agencies monitor water quality on an ongoing basis, the MPCA and local partners conduct an intensive exam of major lakes and streams in each of the state's 80 watersheds every 10 years to detect any changes in water quality. This intensive monitoring looks at fish and macroinvertebrate (bug) communities as well as water chemistry to gauge water quality. The partners use these data to see which waters are healthy and need protection and which are impaired and need restoration. Waters are considered impaired if they fail to meet water quality standards.

## Changes in water quality

To detect any changes in water quality, this recurring exam looks at fish and macroinvertebrate communities as well as water chemistry. Scientists use a tool called the Index of Biological Integrity (IBI) to assess the health of biological communities in lakes, rivers, streams, and wetlands. High IBI scores indicate a healthy aquatic community, which can only be attained when water quality, habitat, and hydrology are minimally disturbed by human activities.

Over the past decade, scientists observed little change in water quality in the Mississippi - Winona and La Crescent Watersheds. While the biological condition in individual streams may have improved or declined between 2010 and 2022, the overall health of fish and macroinvertebrate communities across the watersheds did not change over this period. Continued problems include nitrate, elevated bacteria, and excess sediment in streams.

- Five stream segments are being removed from the 2024 Impaired Waters List for previous biological impairments (four fish and one macroinvertebrate).
- Across the watersheds, there is no significant change in stream biological condition between time periods for both fish and macroinvertebrates.



MPCA scientists monitored the fish and bugs, along with several water quality parameters, in the Mississippi - Winona and La Crescent Watersheds as part of the statewide effort to gauge the health of lakes, streams, and rivers.

- Within the Mississippi Winona Watershed only the North Fork Whitewater River (sediment, fish, macroinvertebrates) and Gorman Creek (fish) had new aquatic life use impairments identified.
- No new impairments were identified in the Mississippi La Crescent Watershed and Pine Creek is being delisted from the 2024 Impaired Waters List for fish as several sampling visits at multiple stations have demonstrated healthy coldwater fish communities.
- Stream clarity trends were detected at several individual stream stations within these watersheds seven have improving stream clarity and three have declining water clarity. Stream clarity is impacted by suspended sediment in the water column.
- Lake Winona current data was limited but in agreement with existing impairment status for aquatic recreation use based on excess nutrients. The lake will also have a new aquatic consumption use impairment due to excessive levels of mercury in fish tissue.



• The Watershed Pollutant Load Monitoring Network (WPLMN) station on the Whitewater River demonstrates an increasing trend in nitrate concentrations within the Mississippi - Winona Watershed.

## Highlights of monitoring

- Two streams, Miller Valley and Little Trout creeks, were recently designated "exceptional use" coldwater streams for their high-quality fish and bug communities.
- Four segments on three streams (North Fork Whitewater River, Logan Branch, and Pine Creek) previously considered warmwater use were recently re-designated as a coldwater use class.
- Several streams (Logan Branch, Pleasant Valley, East Indian, and Dakota Creeks) were identified as vulnerable to impairment and in need of protection.
- Dakota Creek in the Mississippi La Crescent Watershed is a naturally reproducing brook trout stream with severe bank erosion and channel instability evident within the sampling reach.
- During monitoring efforts in the summer of 2021, when most parts of Minnesota were experiencing severe drought conditions, the Mississippi Winona Watershed had near normal precipitation while the La Crescent had an above normal amount of rain.
- Macroinvertebrate monitoring crews observed extremely high densities of the western humpless caddisfly (*Brachycentrus occidentalis*) in 2021, a sensitive coldwater species, completely covering rocky substrates and even some sandy areas of the stream bottom at several monitoring stations in the watershed.
- Three long-term biological monitoring stations are located within the Mississippi River -Winona watershed, providing an in-depth evaluation of aquatic communities and their habitat within Beaver Creek as well as the North and Middle Forks of the Whitewater River.
- Stream reaches with sufficient nitrate data for drinking water assessment resulted in agreement with one existing impairment (Middle Fork Whitewater River) and three others where criteria was supporting of the drinking water use (Pine Creek, North Fork Whitewater River, and Whitewater River).



Native brook trout and the case-making caddisfly Brachycentrus are important components of coldwater streams in SE Minnesota.

## Success story

Beaver Creek has a history of erosion and sedimentation issues. Notorious for the frequent flooding and partial burying of Beaver, MN in the 1920s and 30s—ultimately leading to the town's abandonment—Beaver Creek is now showing signs that its sedimentation issues have improved substantially. In 2012, MPCA Biologists determined that Beaver Creek was impaired for aquatic life based on an assessment of its macroinvertebrate community. Stressor identification found poor habitat due to excess sedimentation as the primary cause of impairment and the subsequent Watershed Restoration and Protection Strategies (WRAPS) report recommended that addressing sedimentation issues would restore the stream's macroinvertebrate community.

While conservation has been historically noted in this area since the 1930's, in more recent years there have been a multitude of best management practices (BMPs) installed within Beaver Creek's watershed to reduce erosion and sediment deposition, including grade stabilization structures, planting perennial vegetation or cover crops, no-till farming, and strip-cropping. According to the BMP tool on the <u>MPCA's Healthier</u>



Widespread BMP implementation within the watershed of Beaver Creek has improved the habitat and water quality for fish and bug populations.

Watershed page, there are a total of 71 BMPs that have been installed in the Beaver Creek watershed since 2004. In 2023 the evidence was overwhelming, the macroinvertebrate community consistently met expectations for a coldwater stream. Beaver Creek has a long-term biological monitoring station that has been visited six times since the impairment determination with results indicating a healthy macroinvertebrate community at five of those visits, including the last three. The improvement in the macroinvertebrate community has resulted in the proposal to US EPA for its impairment to be removed from the Impaired Waters List, citing restoration activities as the reason!

## Watershed assessment results

### Streams and rivers

Fish and macroinvertebrate communities are a direct measure of aquatic life in rivers and streams. Between the 2010 and 2021 cycles of biological monitoring in the Mississippi - Winona and La Crescent Watersheds, the MPCA adopted new rules to assess aquatic life in channelized streams and ditches. This new framework, Tiered Aquatic Life Use (TALU), allowed channelized streams in the watershed to be assessed against reasonable aquatic life goals if they were legally altered prior to the advent of the Clean Water Act and currently demonstrate habitat-limiting conditions for fish or macroinvertebrate communities. Streams with these characteristics are classified as modified aquatic life, which have lower biological condition expectations than general aquatic life use streams. This framework also allows the designation of streams that exhibit exceptional aquatic communities or a much higher quality than would be expected for supporting general aquatic life use goals. Two streams, Little Trout Creek within the Mississippi - Winona and Miller Valley Creek within the Mississippi - La Crescent, were designated as exceptional use. Only one stream reach, Dry Run Creek in the Mississippi - Winona Watershed, meet the criteria to be designated as a modified use.

Biological communities in streams as a whole have either improved slightly or remained similar over the last 10 years. Overall, about one-third (36%) of the stream reaches assessed in the Mississippi - Winona and La Crescent Watersheds are fully supporting of aquatic life use (Figure 2). Aquatic life was determined to be fully supporting on 12 river and stream segments in 2021, increasing the total for the two watersheds to 20 (16 in Winona, four in La Crescent) overall. Nearly all non-supporting stream reaches were identified in previous assessments as only Figure 2. Current assessment results for aquatic life and aquatic recreation in streams of the Mississippi – Winona and La Crescent Watersheds.



three reaches of the North Fork Whitewater River (sediment, fish, macroinvertebrates) and one on Gorman Creek (fish) had new aquatic life impairments identified this cycle. Overall, there was a net decrease in impaired reaches as five were removed from the 2024 Impaired Waters List compared to four that were added. Aquatic macroinvertebrate communities appear to be fairing worse than fish as there are now a total of 13 bug impairments compared to just five for fish within the two watersheds (i.e., new + existing impairments). See Figure 3 for spatial illustration of supporting and non-supporting waters within the Mississippi - Winona and La Crescent Watersheds for this assessment cycle.

Excess bacteria, sediment, and nitrate continue to be evident from the latest monitoring and assessment work in certain parts of these watersheds. All 11 stream reaches with more recent bacteria data indicate poor aquatic recreation use conditions remain from previous assessment years. Suspended sediment data available from the recent monitoring efforts confirm poor water quality conditions persist and do not support healthy aquatic life on certain stream reaches within these watersheds. While assessment results based on monitoring data and water quality standards do not warrant delisting of sediment impairments, its noteworthy that improving water clarity trends were detected on several stream reaches, which can be taken as an indicator of improvement over time.

There are many streams within the Mississippi - Winona and La Crescent watersheds that are considered coldwater, which by default are protected for drinking water use even though they are not serving as a drinking water source. Therefore, where sufficient nitrate data is available these streams must be assessed against the statewide drinking water standard. Recent nitrate data on three stream reaches indicated support of the drinking water use (Pine Creek, Whitewater and North Fork Whitewater rivers). Past assessment efforts have identified two stream reaches within the Mississippi - Winona Watershed as not meeting state standards for drinking water use, these are isolated reaches of the South Fork and Middle Fork Whitewater rivers, and recent nitrate data from these reaches substantiate past results.

For more specific assessment data, go to the Tableau workbook: <u>https://public.tableau.com/app/profile/mpca.data.services/viz/WaterQualityAssessmentResultsDa</u> taViewer/HomePage.

### Lakes

Excessive nutrient loads, in particular total phosphorus (TP), lead to increased algae blooms and reduced transparency – both of which may significantly impair or prohibit the use of lakes for aquatic recreation (e.g. swimming). The ecoregion-based eutrophication standards are the primary basis for aquatic recreational use assessments in lakes and require data for phosphorus, chlorophyll-a (algae), and Secchi (water clarity) collected from June to September over two years.

Lake Winona is the only lake within the watersheds that was monitored (2021) as part of this study and consists of two bays (Southeast and Northwest). The single year of data was insufficient to determine use support by itself but does indicate water quality conditions for swimming are still poor during the summer months on both portions of the lake, therefore, the existing recreational use impairments will remain. However, some improvement was observed in the recent data for all recreational use condition indicators. Continued monitoring of Lake Winona is necessary to understand if conditions continue to improve over time as local efforts are implemented to restore water quality.

Fish tissue data was also available for assessment during this monitoring effort and indicates impairment of the fish consumption use for both lake basins due to excessive levels of mercury in fish tissue. This impairment will be addressed as part of the <u>statewide plan</u> for mercury reduction.

## Figure 3. Aquatic life and recreation use support for streams and lakes in the Mississippi - Winona and La Crescent Watersheds in the current assessment cycle.





## Trends

A key objective of the 2021/2022 monitoring effort was to evaluate if and how water quality has changed since the initial monitoring. If water quality has improved, it is important to understand to what extant human actions may be responsible for the change. 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 three different aspects of water quality were analyzed to provide as robust a picture as possible of what is happening in the Mississippi - Winona and La Crescent Watersheds:

- 1) Streamflow, sediment (total suspended solids/TSS), phosphorus, and nitrogen (nitrate)
- 2) Biological communities
- 3) Climate

### Streamflow and pollutant concentrations

Annual streamflow (discharge) data is available since 2009 for the Whitewater River within the Mississippi - Winona Watershed. There is an increasing trend in flow on the Whitewater River (Figure 4), which has implications for stream channel conditions and pollutant loading. This could mean more channel erosion and possibly more pollutant loading, even if pollutant concentrations are stable. Since loads represent the total amount of a pollutant moving through a system, this way of measuring water quality is important for downstream resources such as the Mississippi River, where these pollutants may accumulate.



#### Figure 4. Whitewater River at Beaver average annual flow.

Seasonal Kendall trend tests on suspended sediment, phosphorus, and nitrate concentrations at the Whitewater at Beaver site were used to determine if changes over time were statistically significant. Trends in pollutants were identified with and without flow correction. Flow-corrected trend results are considered the definitive analytical result and can be interpreted as changes that

would occur if flow had been the same year after year. Both phosphorus and suspended sediment showed a statistically significant decrease from 2008-2020 after flow correction. With no flow correction, suspended sediment shows an increasing trend. This suggests that while suspended sediment concentrations are lower at any given flow, the high flow volume during 2016-2019 pushed concentrations up, resulting in an increasing trend. In addition to the mainstem site near Beaver (that has been operating every year since 2007) there is a sub-watershed-scale site upstream on the North Fork Whitewater River that has been operating since 2013. Results suggest that phosphorus, suspended sediment, and nitrate concentrations increase moving downstream from the upper watershed to the lower watershed.

Nitrate concentrations were increasing for both corrected and non-corrected flow. Southeast MN geology and land use practices are the likely cause of the increasing nitrate trends. Most of the nitrate that leaves the Whitewater system takes a groundwater path from the land surface to the coldwater streams in the watershed. Nitrate leaching loss to groundwater can vary significantly across the watershed depending on land use practices. An increasing trend for the Whitewater River at the Beaver monitoring site does not mean that nitrate leaching loss is increasing everywhere in the watershed; some areas will have higher nitrate contributions than others.

When compared with watersheds throughout the state, Figure 5 shows average annual suspended sediment flow weighted mean concentration to be several times higher in southeastern watersheds than those of north central and northeast Minnesota but in line with the agriculturally rich watersheds found in the northwest and southern regions of the state. As a general rule, elevated levels of suspended sediment are regarded as a "non-point" source pollutant originating from many small diffuse sources such as agricultural or urban runoff. It should be noted that phosphorous and nitrate concentrations are also elevated when compared statewide. While these concentrations are a concern, the magnitude is not as severe as suspended sediment.

Similar maps for other pollutants and supporting data can be found at: <u>https://www.pca.state.mn.us/air-water-</u> <u>land-climate/watershed-pollutant-load-</u> <u>monitoring</u>

## Figure 5. Average suspended sediment flow weighted mean concentration by major watershed (Whitewater River at Beaver Watershed outlined).



### **Biological communities**

Paired t-tests of fish and macroinvertebrate IBI scores were used to evaluate if biological

condition of the watershed's rivers and streams has changed between 2010 and 2021 in the Mississippi - Winona Watershed and 2015 and 2021 in the Mississippi - La Crescent Watershed.



Independent tests were performed on each community with 18 sites evaluated for macroinvertebrates and fish (i.e., sites that were sampled in both time periods).

Data from both watersheds were combined for the change analysis as only 1 paired site existed in the Mississippi - La Crescent Watershed. The average macroinvertebrate IBI score for the watersheds increased by 2.1 points between time periods, this however does not represent a statistically significant change. Similarly, fish IBI scores across watersheds increased by 5.2 points, which was also not statistically significant. While the overall health of fish and macroinvertebrate communities across the watersheds did not change between time periods, biological condition at individual stream sites may have improved or degraded (± 10 IBI points)(Figure 6).





In 2010, the Mississippi River - Winona Watershed experienced significantly above normal precipitation (+11.7 in) and was abnormally hot (+1.2 °f) during the May to September time period (Figure 7). However, it should be noted that a large contribution to the 2010 precipitation total occurred after biological monitoring had finished for the season during an extreme flood event that impacted a large swath of southern Minnesota in late September. This event pushed the already above normal precipitation total for the summer of 2010 into the extreme category but did not impact the biological monitoring results obtained that year. In comparison, this watershed had near normal rainfall (+1.1 in) and was abnormally hot (+1.8 °F) in 2021 over the May to September time period. Overall, given the wetter than normal conditions affecting the watershed in 2010, while 2021 had near normal rainfall, there is a high likelihood that any observed changes in biological condition at either the watershed or individual site scale are at least partially due to differences in climatic conditions between the two years.



For the Mississippi River - La Crescent Watershed, there was near normal rainfall (-0.22 in) and abnormally hot temperatures (+2.1 °F) present during the summer of 2015. In 2021 this watershed experienced above normal rainfall (+5.1 in) and was abnormally hot (+1.8 °F) over the May to September time period. A relatively large precipitation event in early August contributed to the above normal rainfall in 2021 and potentially impacted any biological monitoring data collected on or after August 6<sup>th</sup> of that year. Given the sizeable difference in precipitation between 2015 and 2021 there is a moderate chance that any observed changes in biological condition at either the watershed or individual site scale are at least partially due to differences in climatic conditions between the two years.

Figure 7. Characterization of air temperature and rainfall conditions for May-September period across historical record for the Mississippi - Winona Watershed. Biological monitoring years for the watershed highlighted in red.



### Climate

The Mississippi - Winona and La Crescent Watersheds now receive on average 3.5 to 3.6 additional inches of rain from the historical average (1895-2018). Furthermore, climate scientists suggest that precipitation events are becoming more intense. In addition, average air annual temperatures in the watersheds have increased by about 1.1 °F over this time period. Increased rainfall and temperature can worsen existing water quality problems. More precipitation and reduced snow cover can increase soil erosion, pollutant runoff, and streamflow. Increased streamflow in turn can lead to stream channel erosion and degraded habitat for aquatic life. Longer growing seasons with higher temperatures can lead to more algal blooms. These changes will complicate efforts to protect and restore the watershed. For more details see DNR's climate summary reports for the Mississippi - Winona and Mississippi - La Crescent Watersheds.



# For more information

This study of the Mississippi - Winona and La Crescent Watersheds 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. Stressor identification for new impairments and updates to the Watershed Restoration and Protection Strategy Report follow the completion of monitoring and assessment. 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 Mississippi - Winona and La Crescent Watersheds, 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 -Winona or La Crescent webpage, or search for the watershed of interest on the MPCA website.

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