Watershed assessment and trends update

Long Prairie River

Upper Mississippi River Basin

Summary

The Minnesota Pollution Control Agency (MPCA), Minnesota Department of Natural Resources (MNDNR), and partners have completed a study of the Long Prairie River Watershed in central Minnesota. This watershed includes the Long Prairie River itself, as well as numerous tributaries, and over 220 lakes. The Long Prairie Watershed contains a blend of land uses, from agricultural land to industrial and residential land, as well as a mix of natural landscapes, wetlands, forest, prairie scattered throughout. Since the last assessment ten years ago, two streams were delisted for aquatic life impairments, while two others had existing impairments corrected. A correction to the impaired waters list is warranted when a water body is placed on the list in error, or reassessment with new standards or assessment methods does not indicate impairment. In the most recent assessment, there were three new aquatic recreation impairments (*E. coli*) and one new fish impairment. One main area of concern is low dissolved oxygen (DO) throughout the Long Prairie River mainstem. A Total Maximum Daily Load (TMDL) has been developed for the DO impairment. Improvements to wastewater facilities are helping, but the DO levels in the Long Prairie mainstem are still low enough to warrant an impairment.

Instead of relying solely on chemical water testing, scientists assessed the watershed's health by studying fish and aquatic macroinvertebrates, which provide a more direct and comprehensive picture of long-term water quality and its effects of aquatic life. Volunteer water quality monitors contributed to the assessment, which is funded by Minnesota's Clean Water Land and Legacy Amendment. Findings from the full report will shape decisions on watershed management and pollution reduction measures for years to come.

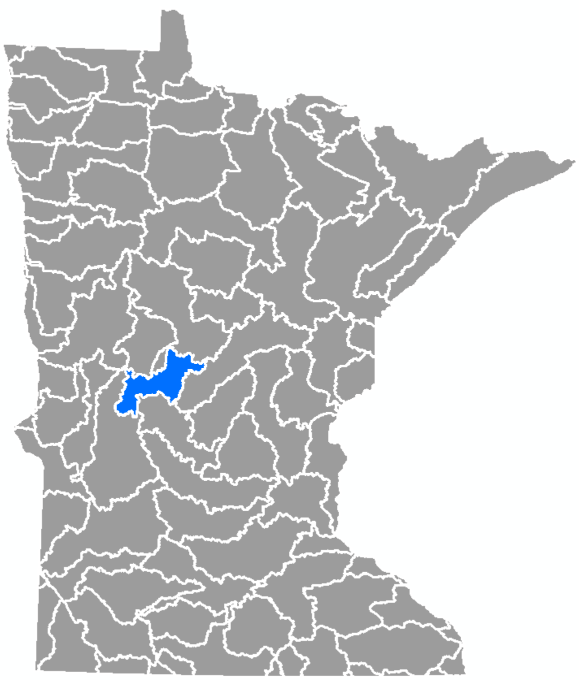
Watershed Study

Water monitoring is essential to determining whether waterbodies (lakes, streams, and ditches) meet water quality standards. While local partners and state agencies monitor water quality on an ongoing basis, the MPCA and local partners conduct an intensive survey of lakes and streams in each of the state's 80 watersheds every ten years to detect any changes in water quality. In the Long Prairie River Watershed, the MPCA and local partners conducted this intensive monitoring in 2011-2012. The second round of intensive monitoring took place in 2022-2023. Chemistry data collected by local partners between 2015 and 2024 were also used for assessment. The monitoring strategy focused on whether waterbodies met water quality standards that support aquatic life, recreation, and/or consumption use. Waters which fail to meet these use standards are considered impaired. The overall goal of these assessments is to determine which waters are healthy and may need protection or are polluted and require restoration. For more information on the MPCA's approach to water quality monitoring see the following links: [Watershed Approach to Water Quality](), [Minnesota's water quality Monitoring Strategy 2021 to 2031]()

Changes in water quality

To detect any changes in water quality, this recurring monitoring effort 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 often can only be attained when water quality, habitat, and hydrology are minimally disturbed by human activities.

Figure 1. Long Prairie River Watershed



Across the watershed, there is no significant change in stream biological condition over the last 10 years for fish, however macroinvertebrates showed a significant improvement in biological integrity. This may be in part to multiple small scale best management practices in the watershed aimed at reducing sediment and nutrient loads. Continued problems include low dissolved oxygen levels and elevated bacteria. Water monitoring is essential to determining whether lakes and streams meet water quality standards designed to ensure that waters are fishable and swimmable.

Landowners have installed hundreds of best management practices to improve water quality, but many more are needed. It takes time for these practices to show results.

- There was only one new fish community impairment for Unnamed Creek (County Ditch 11 to Lake Miltona) and no new Macroinvertebrate community impairments identified from this latest monitoring.

- Four stream reaches were taken off of the Impaired Waters List: Impairments of the fish and bug communities were removed from a section of the Long Prairie River from Eagle Creek to Turtle Creek and an unnamed creek that flows into Lake Miltona, respectively, the fish community impairment on Venewitz Creek from Charlotte Lake to the Long Prairie River was corrected due to effects of extended high water in 2012 resulting in impairment, as well as the benthic macroinvertebrate community impairment on Harris Creek between an Unnamed creek and Eagle Creek.
- Three new aquatic recreation use impairments were added to the impaired waters list in cycle two due to exceedances of the 1260 CFU/100ml E.coli standard. Impaired streams include: The Long Prairie River from Moran Creek to Fish Trap Creek, Fish Trap Creek, and Turtle Creek. The Long prairie River from Spruce Creek to Eagle Creek was also deemed vulnerable to future impairment with its proximity to exceeding the standard for E. Coli.

Highlights of monitoring

- Over 15,000 fish from 46 species were collected in streams during cycle two monitoring. The most commonly sampled species include: Common shiner (3,869 individuals), Black Bullhead (1,389 individuals), Western Blacknose Dace (1,308 individuals), and Hornyhead Chub (1,098 individuals). Notable sensitive species included: Greater Redhorse, Least Darter, Mottled Sculpin, and Burbot.
- Primary tributaries to the Long Prairie River (Spruce Creek, Eagle Creek, Turtle Creek, and Moran Creek) all support healthy biotic communities.
- A total of 48 fish species were collected in lakes during fish IBI sampling. Of these, 15 are considered intolerant species—susceptible to pollution, shoreline habitat disturbance, and watershed disturbance. Notable species included Burbot and Cisco (Tullibee) which are considered coldwater species, requiring cold, oxygenated water to survive. Least Darter (State Species of Concern) and the Pugnose Shiner (State Threatened Species) were also collected.
- Due to interest from area sportsmen groups, the MNDNR is now managing Spruce Creek near Miltona, as a trout stream. Although primarily put and take for rainbow trout due to thermal stress, there is evidence of over summering brown trout. The trout fishery in Spruce Creek is a uncommon resource for this part of the state.

Success story

The city of Long Prairie faces unique wastewater management challenges as a small town with significant industrial presence. In 2014, several large industrial facilities were required to send their wastewater to the Long Prairie Wastewater Treatment Facility, increasing the plant's treatment demands. To accommodate this, the city upgraded and expanded its wastewater treatment facility in 2020 at a cost of 13-14 million dollars. The project involved converting existing aeration basins into anoxic basins while adding three new, improved aeration basins. This expansion increased the facility's holding capacity, enhanced its ability to recycle water through the anoxic basins on demand, and reduced the need for chemical treatments. These upgrades significantly improved water quality in the Long Prairie River by dramatically reducing Total Phosphorus and Ammonia levels discharged into the waterway. www.pca.state.mn.us/featured/going-natural-water-quality.

Watershed assessment results

Streams and rivers

Assessable data was collected at 40 biological monitoring stations across 21 WID (waterbody identifier) where at least one assemblage (fish or macroinvertebrates) was collected. In general, fish and macroinvertebrate communities in the Long Prairie River Watershed are supporting aquatic life standards. Of the 21 WIDS assessed using fish IBI tools, only three failed to meet standards. Two of these WIDs: Long Prairie River from Spruce Creek to Eagle Creek (-505) and an unnamed creak which is the headwaters to lake Miltona (-599) were already impaired for aquatic life use based on fish samples collected in 2011-2012. An unnamed tributary to lake Miltona (-522) received a new fish impairment during this assessment cycle.

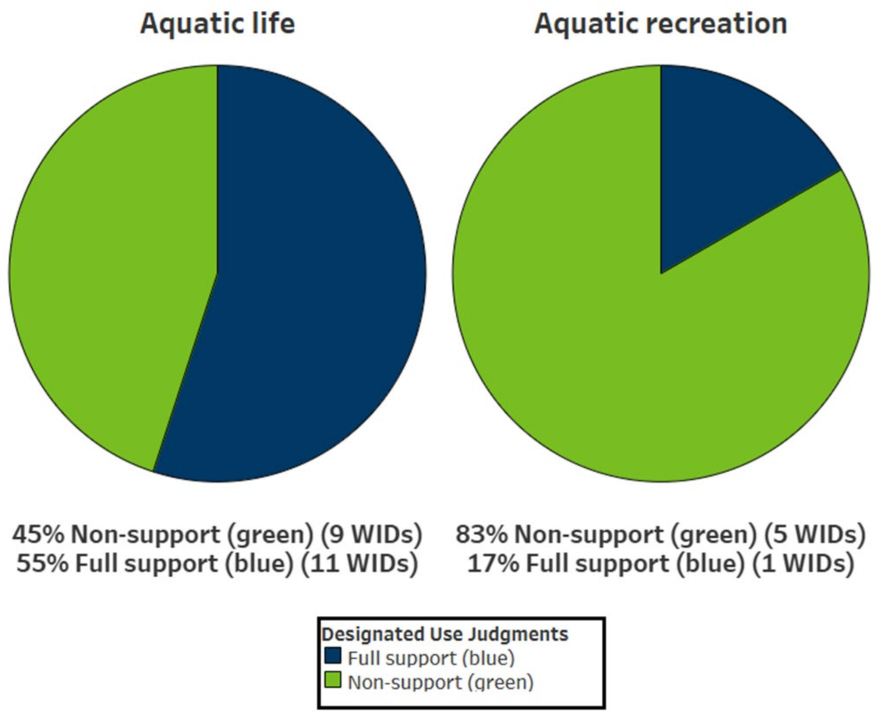
Of the 20 WIDS assessed using macroinvertebrate/bug IBI tools, there were no WIDs that failed to meet standards… The only existing macroinvertebrate impairment is an unnamed creek (-600).

Approximately fifty-five percent of assessed stream reaches support aquatic life use in the Long Prairie River Watershed (Figure 2). These include major tributaries to the Long Prairie River such as: Eagle Creek, Moran Creek, Turtle Creek, Spruce Creek, Dismal Creek, Venewitz Creek, Harris Creek, Fish Trap Creek, and a few other unnamed Creeks. Two unnamed creeks (-552 and -599) are not supporting aquatic life use due to low scoring fish communities.

The primary chemical impairments in the Long Prairie River Watershed were dissolved oxygen and E.coli. 6 of 7 WIDs of the Long Prairie River mainstem, are not supporting aquatic life uses primarily due to low dissolved oxygen. Land use in the headwaters consists of a combination of mixed forest, wetlands, row crop, and pastures. Moving downstream, it transitions to primarily row crop, wetlands, and a few stretches of urban/industrial which may be driving some of the dissolved oxygen issues seen in the downstream reaches of the Long Prairie River.

A mixture of urban, industrial, and agricultural landscapes all likely play a part in the E.coli impairments.

Figure 2. Watershed assessment results for aquatic life in streams and aquatic recreation in streams and lakes.



Lakes

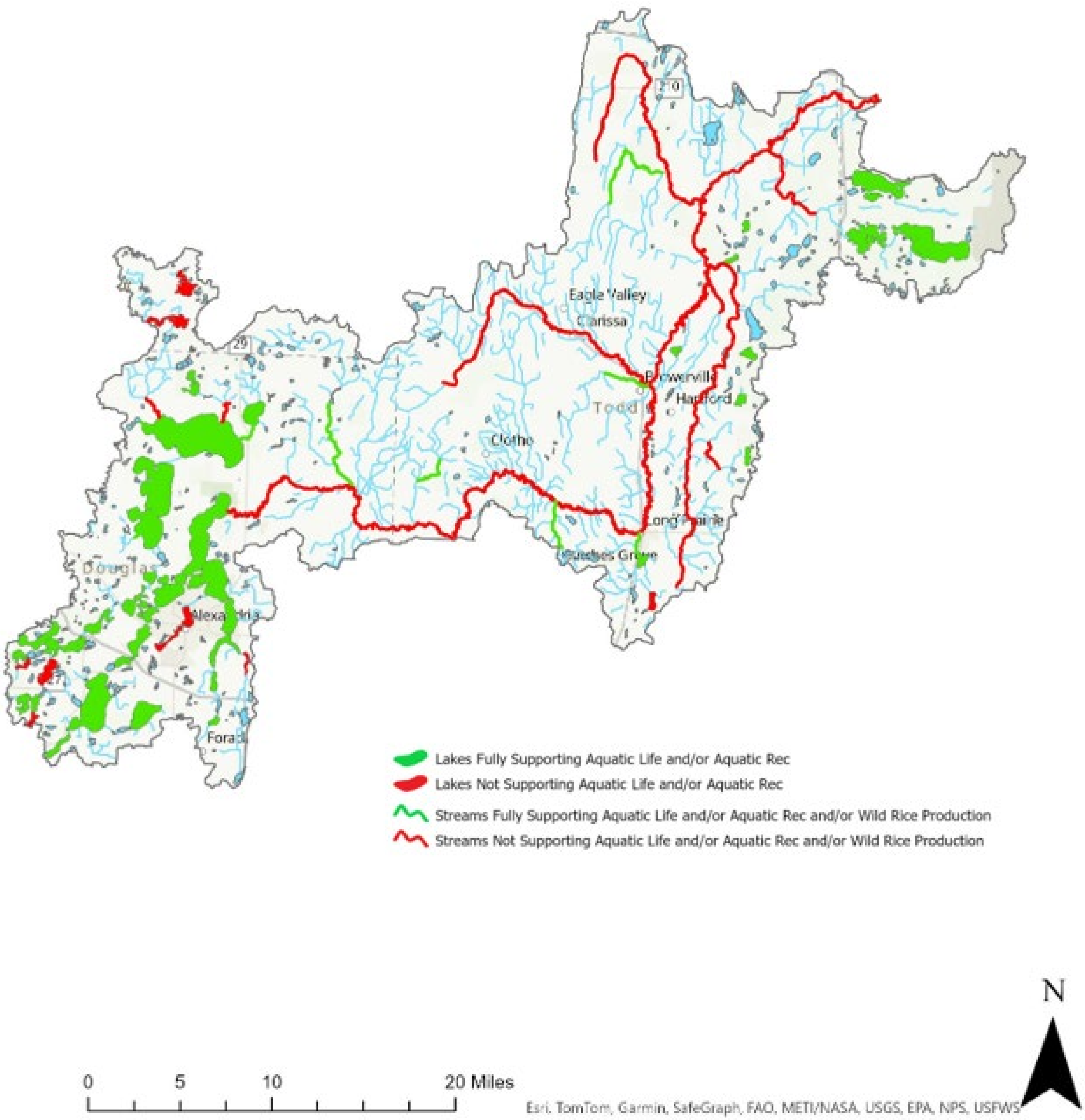
Forty-Two lakes within the Long Prairie Watershed were assessed for aquatic life for the first time using a FIBI developed for Minnesota lakes. The vast majority (74%) of lakes were found to fully support aquatic life use, and a large percentage of those (28%) contained exceptional fish communities, including Miltona, Mina, Ida, Alexander, Shamineau, Charlotte, and Crookneck. The watersheds associated with these lakes that fully supported aquatic life were generally forested and the shorelines were generally less developed than lakes statewide, although development pressure is occurring within the watershed. Efforts to protect the forested lands and undeveloped, natural shorelines associated with these lakes should continue to ensure the water quality and habitat remains intact to support the diverse fish communities.

Only a small percentage (24%) of the lakes were determined to be impaired (Henry, Agnes, Winona, Mill, and Latimer lakes) or vulnerable to impairment (i.e., Geneva, Victoria, Mary, Brophy, and Round) based on FIBI scores. Stressors that are likely influencing these fish communities include excess nutrient inputs from agricultural and urban land uses and degraded and/or developed shorelines.

> In general, most large lakes like Miltona, Carlos, and Alexander all met current use standards and are classified as deep warmwater systems (more than 15 ft). In the first round of monitoring, ten lakes were found to have impairments for nutrients and three lakes (Henry, Agnes and Winona) had chloride impairments. These three lakes are in downtown Alexandria. All impairments identified in the first round of monitoring were confirmed in again in this round.

There is one Sentinel Lake in this watershed. Lake Carlos is a large and very deep lake located just outside Alexandria, within a chain of lakes that form the headwaters of the Long Prairie River. Carlos is a very popular recreational lake due to its good water quality, nearby State Park and proximity to Alexandria. The lake includes both cold water fish (cisco), and cool / warm water species such as walleye, largemouth bass and northern pike. More information about the numerous data sets collected here can be found at: [Monitoring Minnesota's changing lakes | Minnesota DNR.]()

Figure 3. Assessment Results for aquatic life and aquatic recreation on rivers, streams, and lakes



Trends

A key objective of the 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 four different aspects of water quality were analyzed to provide as robust a picture as possible of what is happening in the Long Prairie River Watershed:

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

Figure 4. Average TP flow weighted mean concentration (FWMC) by major watershed.

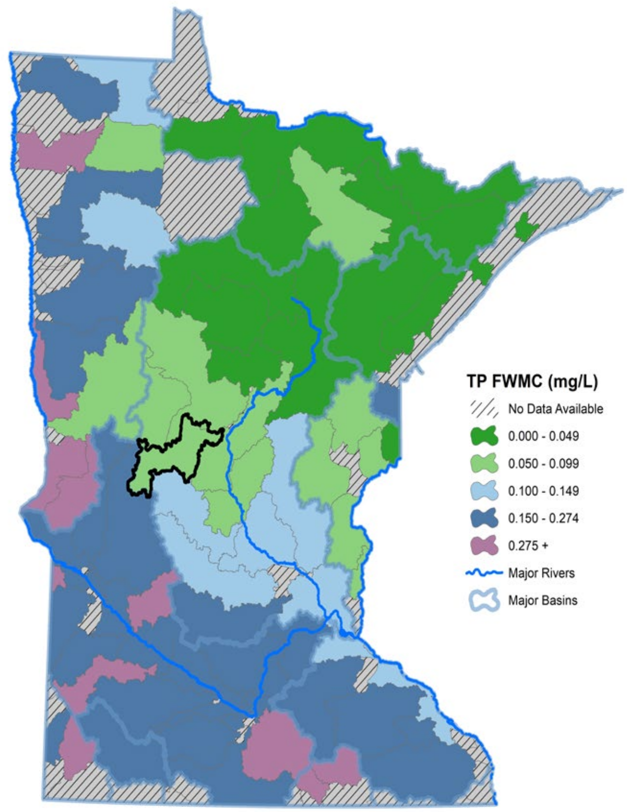
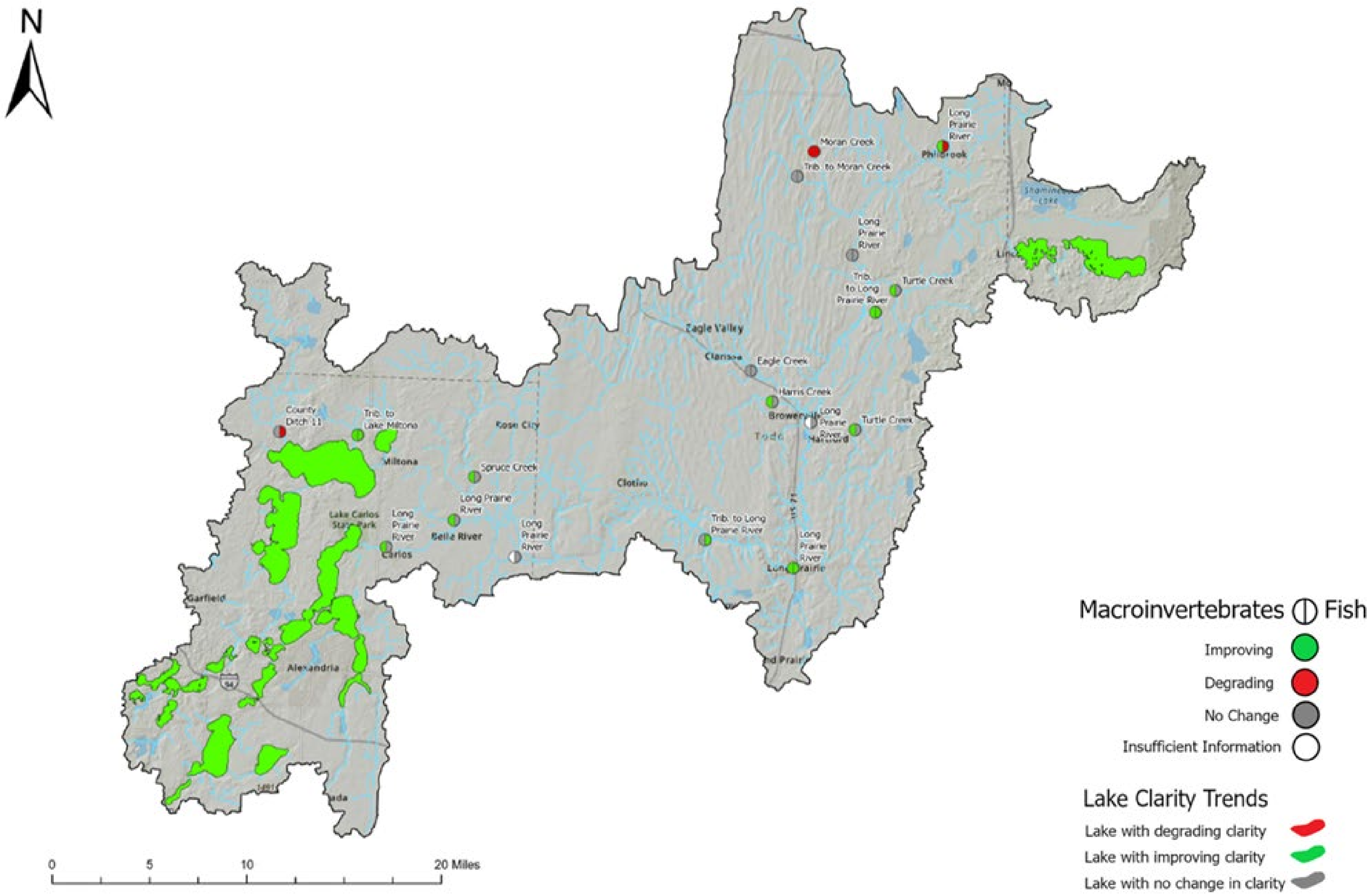


Figure 5. Change in water quality in the Long Prairie River Watershed.

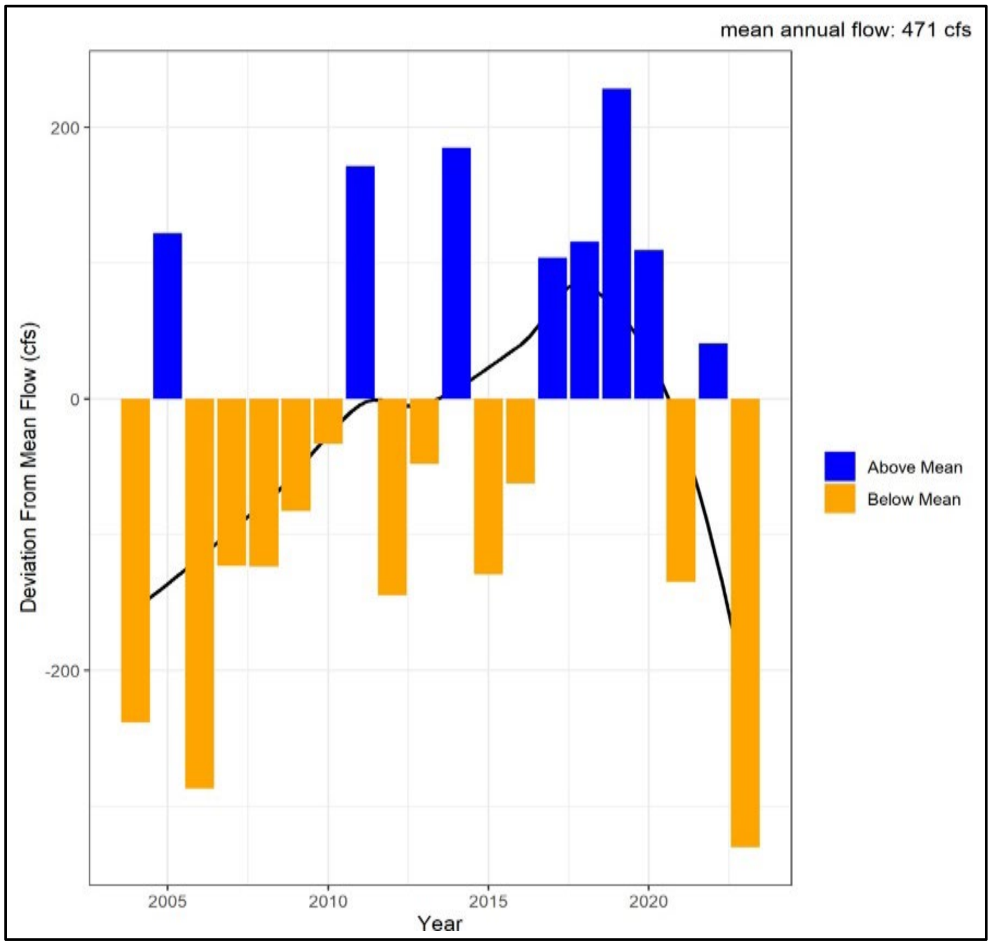


Streamflow and pollutant concentrations

Long-term water quality and stream flow monitoring occurs annually throughout Minnesota, with intensive sampling across a range of flow conditions. For more information about this sampling, please visit: https://www.pca.state.mn.us/wplmn

Annual streamflow (discharge) data for the Long Prairie River Watershed is available since 2004 and water chemistry data is available since 2008. Both stream flow and chemistry are measured at the watershed outlet on the Long Prairie River near Philbrook at 313th Avenue, approximately ten miles upstream of the confluence with the Crow Wing River.

Figure 6. Long Prairie River Watershed percent deviation from normal flow over time (CFS).



Seasonal Kendall trend tests for suspended sediment (TSS), phosphorus (TP), and nitrate-nitrogen concentrations were used to determine if changes over time were statistically significant. Trends were analyzed using data from 2008-2022, with all three parameters showing differing results. Nitrate-nitrogen showed a statistically significant change, increasing roughly 3.7% each year, or about 0.017mg/L per year. TP concentrations decreased significantly with a 2.1% drop in concentrations, or about 0.012mg/L per year. TSS showed no significant change during this timeframe. Although the increasing change in nitrate-nitrogen and decrease in TP are significant, from a watershed and statewide perspective, these concentrations are relatively low when compared to other parts of the state.

Streamflow and water chemistry data is also available at an additional site on the Long Prairie River, located in the town of Long Prairie, roughly 40 river miles upstream of the Philbrook station. The station has been operational since 2015 so there is not enough data yet for statistical trend analysis but results so far suggest that results are similar to the Philbrook station. In general, it appears nitrate-nitrogen is increasing, TP is decreasing and TSS is roughly the same or slightly decreasing at the Long Prairie location. When the two locations (Long Prairie and Philbrook) are compared, annual average concentrations (2015-2021) of nitrate-nitrogen more than double from Long Prairie to Philbrook (0.17mg/L to .44mg/L, respectively) while TP stays roughly the same and TSS increases roughly 3mg/L from Long Prairie to Philbrook. Per year (2015-2021) the average flow at the Philbrook station is 114,855cfs higher than the Long Prairie station, which amounts to approximately 315cfs per day.

The Long Prairie River Watershed is located within a transitional area of the state where the concentrations of these parameters are nearly the same or lower in watersheds to the east and northeast but higher in watersheds to the west and southwest (Figure 7). Nitrate-nitrogen is the largest pollutant concern within this watershed based on increasing overall trends and the increase in concentrations from upstream to downstream. Identification of the potential sources of nitrate-nitrogen would be beneficial with a goal of reducing inputs and hopefully slowing or negating the positive trend and/or increase. Likewise, identifying potential beneficial land use practices are reducing TP inputs could allow for further protection of these practices or implementation of addition beneficial practices.

Figure 6 shows the percent deviation from normal flow over time at the Long Prairie River outlet station. The changing yearly average flow (black line) is calculated using LOESS (locally estimated scatterplot smoothing) with the yellow and blue bars showing each years' deviation as above or below the average (471cfs). Significant increases in flow have negative 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. Pollutant loads provide important information for downstream resources such as the Crow Wing and Mississippi Rivers, where these pollutants may accumulate.

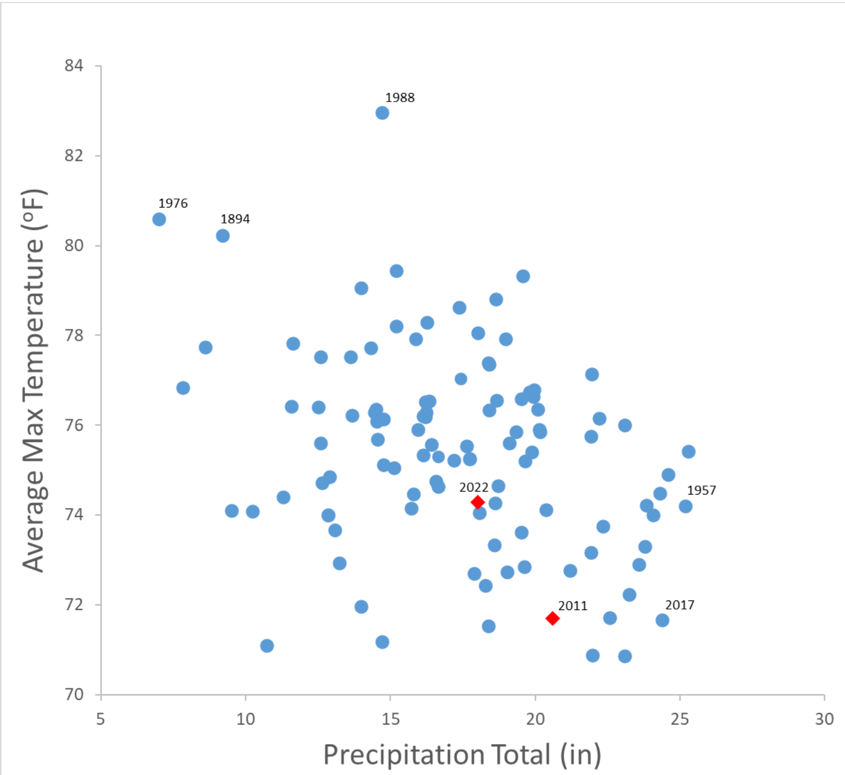
Biological communities

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 time periods. Independent tests were performed on each community with 16 sites evaluated for macroinvertebrates and 18 sites evaluated for fish (i.e., sites that were sampled in both time periods).

The average macroinvertebrate IBI score for the watershed increased by 12.9 points between 2012 and 2023, which represents a statistically significant change. Overall health for macroinvertebrate communities showed a much larger margin of positive change between time periods where some stream sites showed increases of over 25 points. Statistically significant change in macroinvertebrate IBI performance across the watershed can be explained by a number of factors. A number of feedlot storage improvements, septic improvements, and cover crop implementation are scattered throughout the watershed which may have improved conditions for macroinvertebrate communities. It is also possible that changes to macroinvertebrate sampling procedures/training may play a role. Fish IBI scores across the Long Prairie River Watershed increased by 2.3 points, which was not statistically significant. While the overall health of fish communities across the watershed showed little change between time periods, biological condition at individual stream sites may have improved or degraded (± 10 IBI points). (Figure 5)

Context for the change analysis results is provided by a characterization of the conditions under which biological monitoring occurred in each time period. In 2011, the Long Prairie River Watershed experienced above normal rainfall (+3.1 in) and was abnormally cold (-3.8 ^{o}F) during the May to September time period (Figure 6). In comparison, the watershed had near normal precipitation (+0.5 in) and was cooler than normal (-1.2 ^{o}F) in 2022 over the May to September time period. Overall, given the relatively wetter/cooler conditions observed in 2011 compared to 2022, there is a moderate 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 periods.

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



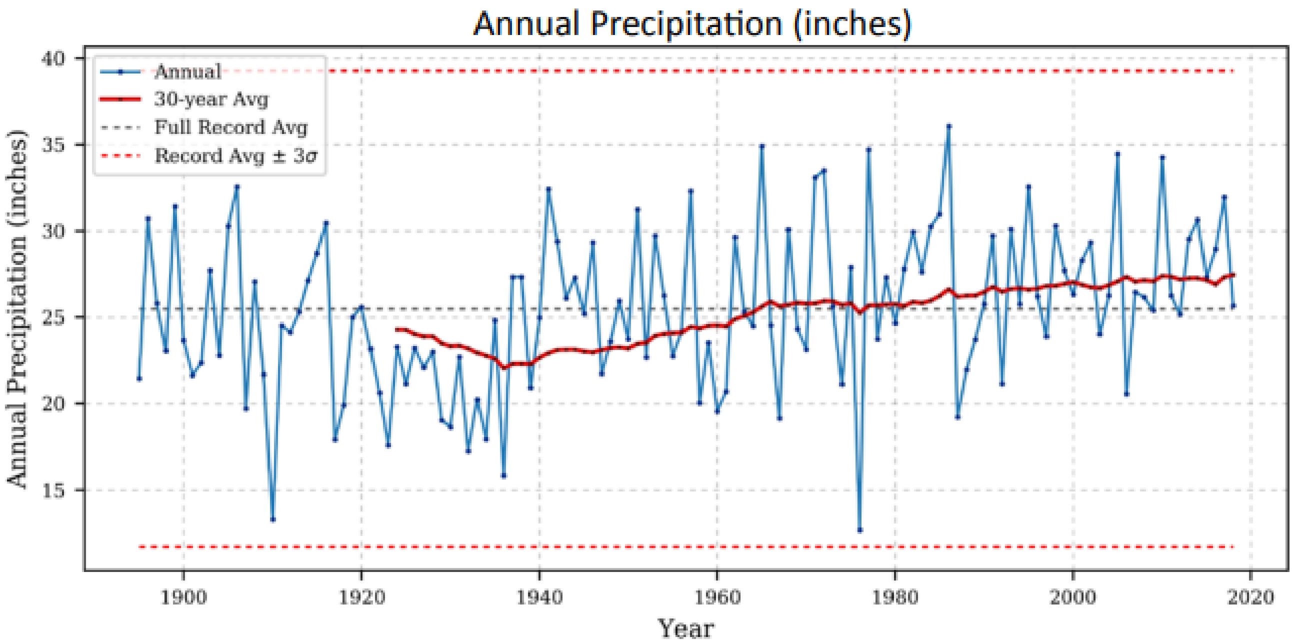
Clarity of lakes

The Long Prairie River Watershed has 68 lakes with some level of transparency data. Trend analysis was conducted on 25 lakes that met data requirements (50 Secchi measurements, eight years of data). Like most lakes across the state, lakes in the Long Prairie River Watershed do not exhibit a significant trend. Of the 25 lakes that met the criteria for clarity trend, 17 have shown increasing water clarity. There are no lakes in this watershed that have decreasing Secchi measurements currently, the ones that are not improving are showing no trends.

Climate

The Long Prairie River Watershed now receives on average two additional inches of rain from the historical average (1895-2018). Furthermore, climate scientists suggest that precipitation events are becoming more intense. In addition, temperatures in the watershed have increased by about one degree in spring and fall 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's. Increased streamflow's can lead to stream channel erosion and degraded habitat for fish and other 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. Climate Summary for Watersheds, Long Prairie River.

Figure 8: Average annual precipitation for the Long Prairie River Watershed (1989-2018).



For more information

This study of the Long Prairie River Watershed 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 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 Long Prairie River Watershed, 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 Long Prairie River webpage, or search for "Long Prairie River" on the MPCA website.

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