Watershed

November 2024

Mississippi River – Lake Pepin Tributaries Watershed Restoration and Protection Strategy Report Update 2024

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

Authors

Kristen Dieterman

Contributors/acknowledgements

David DePaz, DNR

Beau Kennedy, Goodhue SWCD

Chad Hildebrand, Goodhue SWCD

Justin Watkins, MPCA

Joe Magee, MPCA

John Genet, MPCA

Editing and graphic design

Jinny Fricke (Final 11.6.24)

Cover photo credit: Kristen Dieterman

Document number: wq-ws4-101a

Contents

List of figures

List of tables

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.

Executive summary

The State of Minnesota has adopted a Watershed Approach for managing water quality for each of the 80 major watersheds in the state. Every 10 years intensive watershed monitoring (IWM) and assessment is conducted in each major watershed. Subsequent to monitoring and assessment, watershed restoration and protection strategies (WRAPS) are considered in support of local water planning. The first WRAPS IWM cycle in the Mississippi River - Lake Pepin Tributaries (MRLPT) Watershed began in 2008, and the *Mississippi River Lake Pepin Watershed Restoration and Protection Strategy Report* was approved in 2015.

The MRLPT WRAPS Report Update 2024 is an update of the 2015 MRLPT WRAPS Report. This WRAPS Report Update summarizes water quality findings from Cycle 2 IWM, stressor identification (SID), and water quality research projects and studies. Land use and water quality concerns within the watershed largely have not changed since the 2015 report, therefore restoration and protection strategies are unchanged. The goals of this updated WRAPS report are to:

1. Highlight differences in watershed conditions from Cycle 1 (2000 through 2009) to Cycle 2 (2010 through 2019).
2. Identify updated resources and tools for watershed stakeholders as they plan and implement best management practices (BMPs).
3. Identify pollutant sources.
4. Provide updated recommendations for prioritizing and targeting implementation throughout the watershed.

The MRLPT Watershed is a small watershed in Southeastern Minnesota. The MRLPT drains several coldwater streams in bedrock dominated bluff country. There are six main streams, of which five are designated trout streams. The MRLPT primarily consists of forests, and cultivated lands. This area is referred to as the blufflands due to the rolling hill landscape that is interspersed by many small streams that drop through steep forested valleys.

Cycle 2 watershed monitoring and assessment resulted in one new impairment and removal of two previous impairments. Overall, conditions in the MRLPT appear to be improving, with increases in trout populations and more diverse aquatic insect communities.

Excess sediment has long been an issue in many of the streams of the MRLPT Watershed. The conversion of many native prairies to row crop agriculture and modifications to its natural stream courses starting in the 1800s was a primary driver in sediment erosion to the streams. The MRLPT Watershed continues to experience high suspended sediment, especially after precipitation events, thus restoration and protection strategies are recommended.

Purpose	• Support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning
	• Summarize watershed approach work done to date including the following reports:
	  • *Mississippi River Lake Pepin Watershed Monitoring and Assessment*
	  • *Watershed Assessment and Trends update: Mississippi River - Lake Pepin Watershed*
	  • *Mississippi River - Lake Pepin Tributaries Biotic Stressor Identification*
	  • *Mississippi River - Lake Pepin Stressor Identification report (Cycle 2)*

Scope	• Impacts to aquatic recreation and impacts to aquatic life in streams

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.

Figure 1. Minnesota's watershed approach cycle.

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 permit requirements, as well as any restoration or protection actions. A 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 of 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.

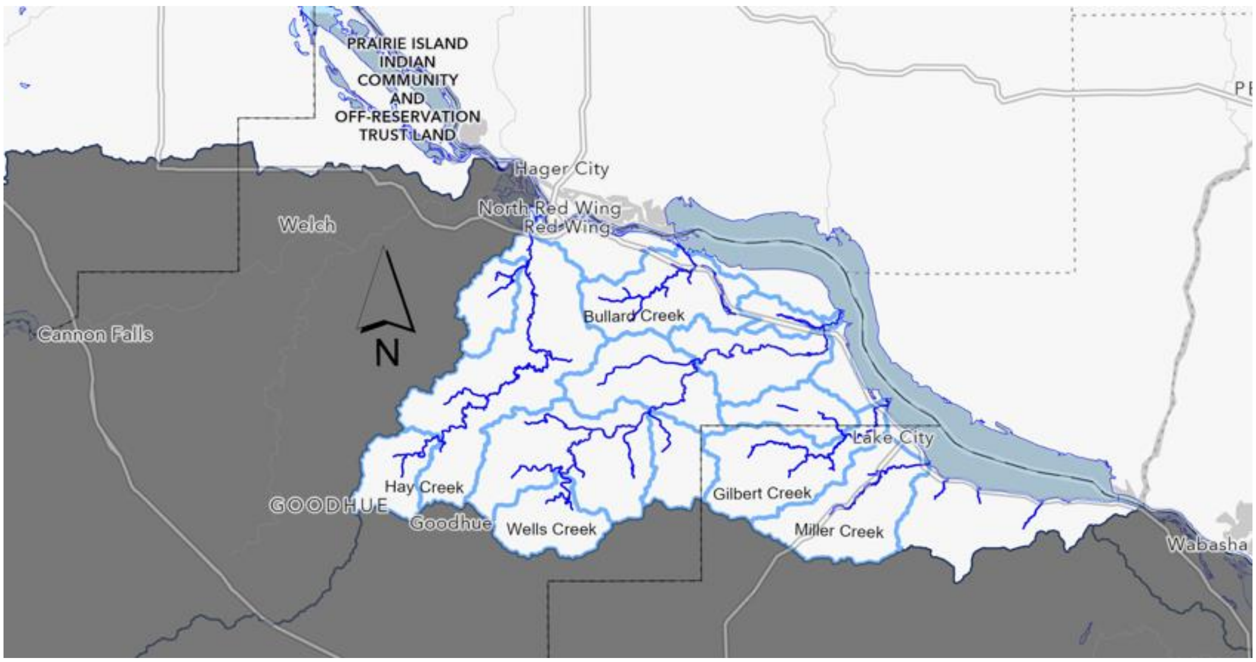
Key aspects of the MPCA's watershed work are to develop and utilize watershed-scale computer models, perform biological SID, conduct problem investigation monitoring, and use other tools to identify strategies for addressing point and nonpoint source pollution that will cumulatively achieve water quality targets. Point source pollution comes from sources such as wastewater treatment plants (WWTP) or industrial facilities; nonpoint source pollution is the result of runoff or contaminants 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 (CWLA), 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 CWLA 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.

1. Watershed background and description

Minnesota's MRLPT Watershed is a small watershed located in Southeastern Minnesota, covering approximately 322 square miles (205,747 acres). The MRLPT Watershed drains several coldwater streams in bedrock dominated bluff country. The largest of these streams is Wells Creek (45,954 acres), which winds through 18 miles of the blufflands and joins the Mississippi River near Old Frontenac, southeast of Red Wing, Minnesota. Hay Creek (30,405 acres) is a popular trout stream that flows from south to north, joining the Cannon River Bottoms at the Mississippi River at Red Wing, Minnesota. Four other named streams are in the MRLPT Watershed and are all designated trout streams that drain directly to the Mississippi River: Bullard Creek, Gilbert Creek, Miller Creek, and Second Creek. The MRLPT Watershed consists of forests, blufflands, and cultivated lands. The top of the MRLPT Watershed is rolling cropland interspersed by many small tributaries that drop steeply through forest valleys with scattered goat prairies atop cliffs.

Figure 2. Map of Mississippi River Lake Pepin Tributaries Watershed.



The MRLPT Watershed was largely unimpacted by the most recent glaciation that covered Minnesota and is dominated by karst (limestone) topography. The limestone rock, as it erodes, leads to underground streams, springs, sinkholes, and caves. This land has limited capacity to store water on the land surface and there is a substantial connection between surface and groundwater resources in this region.

Since European settlement in the 1800s, the tributaries in the MRLPT Watershed have been impacted by considerable land use modification, including the plowing of its native prairies, harvesting of its hardwood forests, and modifications to its natural stream courses (MPCA 2012). The hydrology of the MRLPT Watershed has been dramatically altered by land cover changes evident by an increase in high peak flows during rain events and lower water levels during low flow time periods (MPCA 2012).

Additional watershed background and characteristics can be found in the Cycle 1 reports available on the MPCA Watershed webpage.

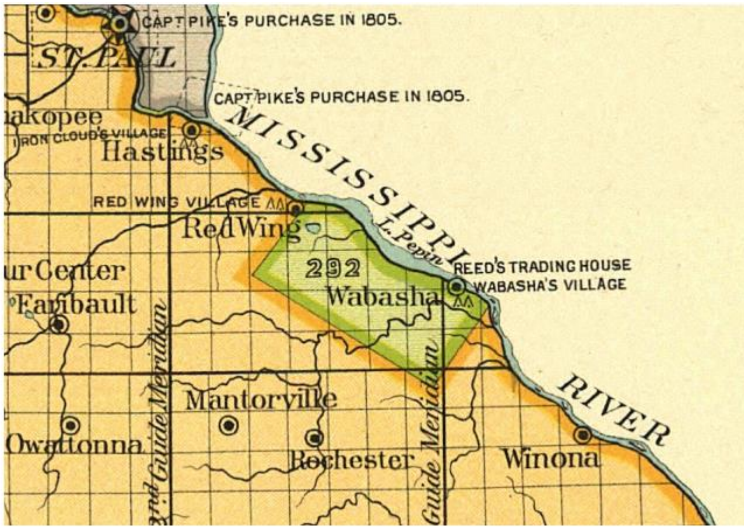
1.1 Cultural History

According to the information gathered for Minnesota's Why Treaties Matter project; land Cession Treaties in what is now Minnesota began with the 1805 treaty with the Sioux at "Pike Island". Significant expanses of land were ceded by Dakota and Ojibwe people to the U.S. through land cession treaties in a short, intense period of 30 years (1837 through 1867). These treaties are part of a larger picture that affected indigenous people and land in what is now Minnesota. The 1837 Land Cession Treaties with the Ojibwe and Dakota were the first major land cessions by Dakota and Ojibwe people in Minnesota. The 1851 Dakota Land Cession Treaties were transformative for the Dakota people as they sold most of their land, shown in red in Figure 3, to the U.S. in exchange for payment that was largely never received by the Dakota people. For more information on treaties, see Why Treaties Matter and U.S. Forest Service, Federal and Indian Lands and Land Cessions Viewer.

Figure 3. Map of land ceded to U.S. by 1851 Dakota Land Cession Treaties (treatiesmatter.org/treaties/land/1851-Dakota).

Most of the MRLPT Watershed is located within the boundaries of the 1830 Indian Reservation at Lake Pepin, at the time known as the 'Half-Breed Tract', highlighted in green in Figure 4. Dakota people, pressed by the U.S. Government to cede land they held in Wisconsin, signed a treaty in 1830 that included a provision creating an Indian Reservation at Lake Pepin (Lake City Historical Society 2023). It was intended to be the home, into perpetuity, of the mixed heritage descendants of traders and their Dakota wives. The reservation extended downriver from present-day Red Wing to Kellogg, and inland 15 miles from the shore of Lake Pepin.

Figure 4. Detail from Minnesota Map No. 33 in Indian Land Cessions in the United States 1845-1893, Charles C. Royce, comp. (Washington, D.C.: US Government Printing Office 1899).



According to research done by Frederick Johnson of the Goodhue County Historical Society, the treaty and reservation designation did not stop settlers and land speculators from claiming ownership of reservation land. To resolve the matter, a plan was made to identify all eligible Dakota persons and give them scrip, coupons granting each bearer rights to 480 acres within the tract, or anywhere else in the Public Domain. General Shields, appointed by the U.S. Government to carry the scrip documents from Washington D.C., arrived in Wabasha, Minnesota on March 23, 1857. The next day he began distributing scrip to 638 eligible persons, or to their husband or father if they were a married woman or under the age of 21. Streams, towns, and other locations within the region, and beyond, were named after many of these 'mixed' families. Although the scrip was supposedly nontransferable, settlers and land speculators found the reservation/tract to be a mere complication in eventually acquiring most of the reserved land. Some paid off or intimidated the men who were related to the Dakota persons who were eligible for scrip (Johnson 2022).

Locations of land claimed under the Reservation at Lake Pepin scrip are available through the U.S. Bureau of Land Management (BLM) and are being compiled through a partnership between the MPCA, Minnesota Historical Society, and Winona County Historical Society. Winona County Historical Society also hopes to connect with tribal nations to determine the best use of this data and stories. The data can be found online at [Search - BLM GLO Records].

1.2 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. This means that all people – regardless of their race, color, or 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.

The MPCA considers tribal areas and census tracts with higher concentrations of low-income residents, people of color, or limited English language proficiency as areas of increased concern for environmental justice. The four criteria that could make a census tract an area of increased concern for environmental justice are:

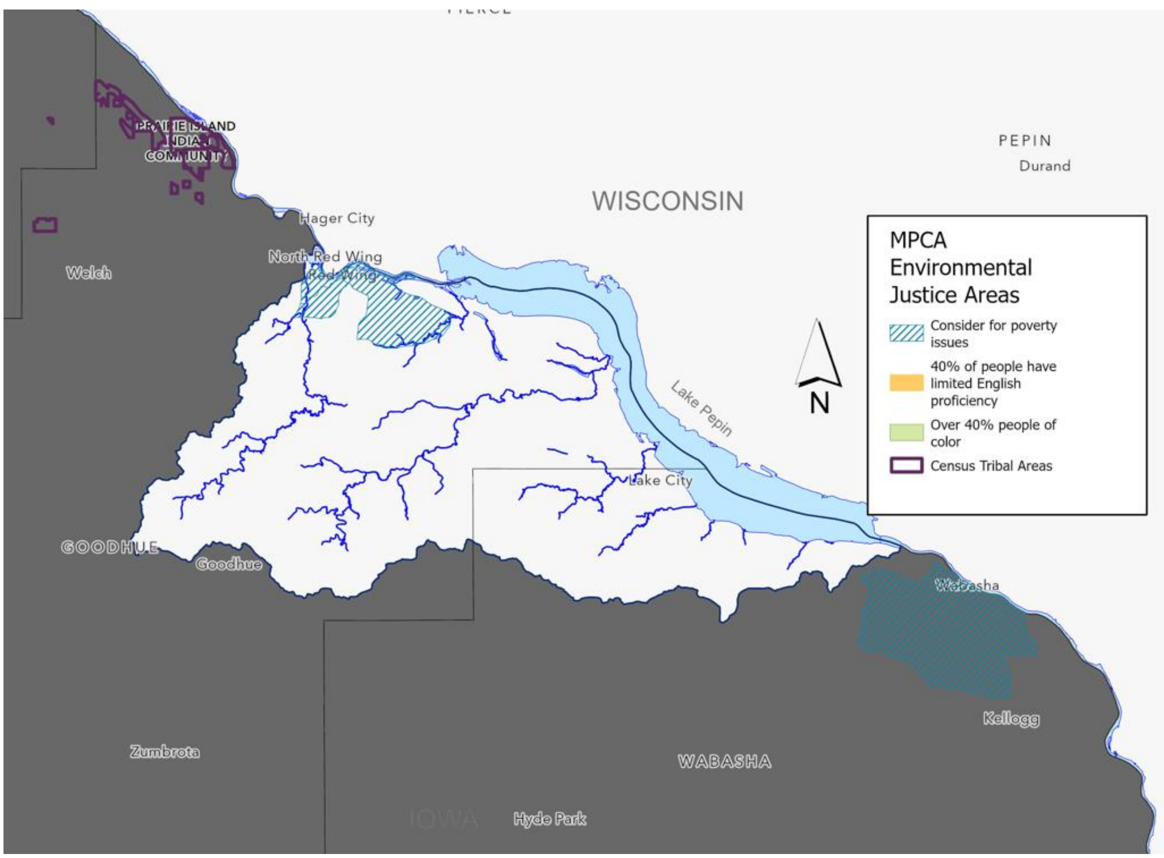
- At least 35% of people reported income less than 200% of the federal poverty level
- 40% or more people of color
- Federally recognized Indian Tribes
- At least 40% or people have limited English proficiency

Interactive maps and more information on MPCA's environmental justice efforts are available at https://www.pca.state.mn.us/about-mpca/environmental-justice. The areas of increased concern for environmental justice in the MRLPT Watershed are shown in Figure 5.

According to the Prairie Island Indian Community, descendants of the Mdewakanton Band of Eastern Dakota, also known as the Mississippi or Minnesota Sioux, returned to the MRLP area and bought back small parcels of their ancestral home. In 1936, the federal government officially recognized the Prairie Island Indian Community as a reservation, awarding them 534 acres. The community now has only approximately 300 livable acres due to the construction of Lock and Dam Number 3, which flooded Community land including burial mounds. The Prairie Island Indian Community is located roughly five miles north of the MRLPT Watershed. For more information on the Prairie Island Indian Community please visit https://prairieisland.org/.

Within the MRLP Watershed are census tract 27049080201 and 27157490100. These census tracts are around the city of Red Wing and are considered areas of concern, since 35% or more people reporting income less than 200% of the federal poverty level (Figure 5).

Figure 5. Map of Environmental Justice Areas of Concern in and around the MRLPT Watershed.



2. Watershed conditions

The MPCA's initial examination of the MRLPT Watershed began in 2011. The first 10-year cycle of the watershed approach included monitoring, biological SID, and TMDL and WRAPS reports. Watershed reports from this effort can be accessed on the MPCA webpage.

The second 10-year cycle of the watershed approach began in 2018 with IWM. The water chemistry and aquatic life data allowed MPCA to evaluate recent data and review Cycle 1 data and decisions. The water quality monitoring and aquatic life data collected from 2010 to 2019 were assessed against water quality standards. See the MRLP Watershed Assessment and Trends Update Report covering these findings.

2.1 Impairments

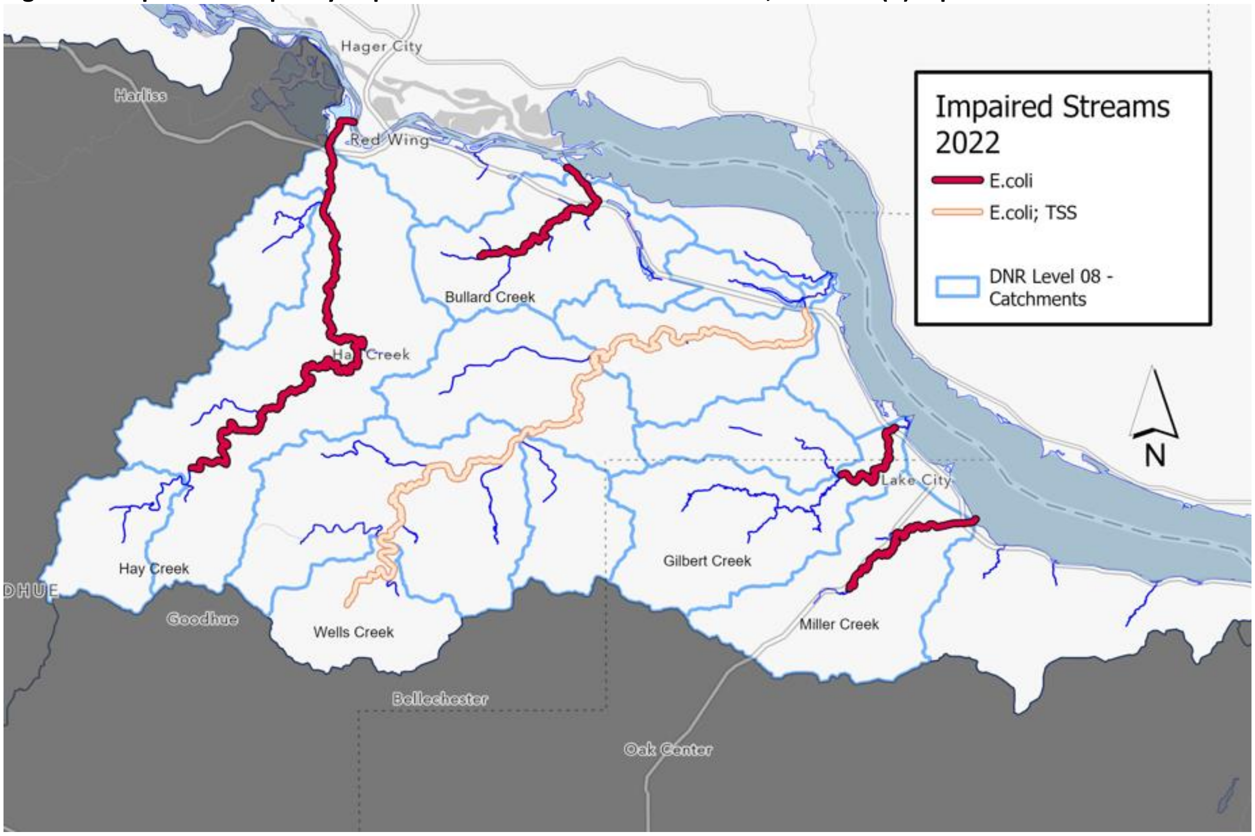
Only one new impairment was added in Cycle 2, a total suspended sediment impairment in Wells Creek (Figure 5). All previously determined *Escherichia coli (E. coli)* bacteria impairments were found to persist in this cycle. There are several downstream impairments that the MRLPT Watershed contributes to, including Lake Pepin and the Mississippi River (Table 2). Although there are no biological impairments in the watershed, the Mississippi River – Lake Pepin Stressor Identification Report (Cycle 2) noted, overall, the biggest threats to fish and aquatic macroinvertebrates in the watershed are excess sediment, increased stream flows, and habitat degradation (MPCA 2020).

Table 1. List of impaired waters in the MRLPT Watershed.

Water body Name	Assessment Unit Identification (AUID)	Affected designated use	Pollutant or stressor	Year added to List
Wells Creek	07040001-708	Aquatic Life	Total suspended solids (TSS)	2022
Hay Creek	07040001-518	Aquatic Recreation	*E. coli*	2012
Bullard Creek	07040001-526	Aquatic Recreation	*E. coli*	2012
Gilbert Creek	07040001-530	Aquatic Recreation	*E. coli*	2012
Miller Creek	07040001-534	Aquatic Recreation	*E. coli*	2012
Wells Creek	0704001-708	Aquatic Recreation	*E. coli*	2012
Lake Pepin	25-0001-00	Aquatic Recreation	Nutrients	2002
Mississippi River	07040001-531	Aquatic Life	Aluminum	2020
		Aquatic Life	Total suspended solids (TSS)	2014
		Aquatic Consumption	Mercury in water column	2004

Water body Name	Assessment Unit Identification (AUID)	Affected designated use	Pollutant or stressor	Year added to List
		Aquatic Consumption	Mercury in fish tissue	1998
		Aquatic Consumption	PCBs in fish tissue	1998
Mississippi River	07040003-627	Aquatic Life	Aluminum	2020
		Wild Rice Production	Sulfate	2020
		Aquatic Consumption	PCBs in fish tissue	1998
		Aquatic Consumption	Mercury in fish tissue	1998
Mississippi River	07040006-515	Aquatic Consumption	Mercury in fish tissue	1998
		Aquatic Consumption	PCBs in fish tissue	1998
Mississippi River	07060001-509	Wild Rice Production	Sulfate	2020
		Aquatic Consumption	Mercury in fish tissue	1998
		Aquatic Consumption	PCBs in fish tissue	1998

Figure 6. Map of water quality impairments in the MRLPT Watershed, 2022 303(d)Impaired Waters List.



2.1.1 Sediment

The MRLPT Watershed supports healthy fish and aquatic macroinvertebrate populations. However, the streams are also impacted by high sediment loads, especially after precipitation events. Water quality data indicate that total suspended solid (TSS) concentrations are often above the 10 mg/L standard (MPCA 2020). Continuous turbidity data confirm that low water clarity occurs mainly in pulses following spring snow melt and precipitation events throughout the year (MPCA 2020). Assessments of aquatic life use support consider both biological and water chemistry data as important lines of evidence. These data, in summary, indicate aquatic life use support (good fish and bugs) for nearly all of the streams in the MRLPT Watershed (MPCA 2021).

The most recent assessments yielded only one new aquatic life impairment, a TSS impairment on Wells Creek. According to the 2021 Monitoring and Assessment Report, this determination was based on a robust data set with >95% of samples over the last decade exceeding the cold water TSS standard of 10 mg/L. These monitoring results corroborated DNR's recent geomorphic surveys of the stream, which showed excessive streambank erosion and sedimentation. While currently still attaining aquatic life expectations, the macroinvertebrate community condition appears to be declining in Wells Creek relative to 2008 and earlier 2004 results. The fish community of Wells Creek also attains cold water aquatic life expectations (MPCA 2021).

Sediment degrades the quality of water for drinking, wildlife and the land surrounding streams in the following ways (Kjelland M., et al. 2015):

- Water polluted with sediment becomes cloudy, preventing animals from seeing their food (Figure 7).
- Murky water prevents natural vegetation from growing in water by reducing the amount of light penetrating the water, depriving plants of light needed for photosynthesis.
- Sediment in stream beds disrupts the natural food chain by destroying the habitat where the smallest stream organisms live and causing declines in fish populations.
- Sediment can clog or damage fish gills, reducing resistance to disease, lowering growth rates, and affecting fish egg and larvae development.
- Sediment particles absorb warmth from the sun and increase water temperature, this can stress some species of fish like trout.
- Settling sediment can bury and suffocate fish eggs and bury the gravel nests they rest in.
- Sediment deposits in rivers can alter the flow of water and reduce water depth, making recreational use more difficult and increasing the potential for flooding.
- Excess sediment from eroding soils contains organic matter that contributes to oxygen depletion in the water as it is decomposed.
- Eroding soils also contribute nutrients like nitrogen and phosphorus and possibly toxic compounds such as heavy metals and pesticides.

Figure 7. Brown trout in Trout Run Creek.

The following images provide a visual for specific TSS concentrations in Hay Creek, showing a range of conditions. Figure 8 is an image from June 2019, when the TSS concentration in Hay Creek was 5.2 mg/L. This is an acceptable concentration. Figure 9 shows Hay Creek in August 2019, with TSS concentration of 19 mg/L, slightly above the standard for the protection of aquatic life. Figure 10 was taken in July 2019, when TSS concentrations were 460 mg/L, far exceeding the water quality standard of 10 mg/L.

Figure 8. Hay Creek (S004-004) 06/25/2019 5.2 mg/L TSS.

Figure 9. Hay Creek (S015-283) 08/01/2019 19 mg/L TSS.

Figure 10. Hay Creek (S000-430) 07/16/2019 460 mg/L TSS.

2.1.2 *E. coli* bacteria

The presence of fecal pathogens in surface water is a regional issue in southeast Minnesota (MPCA 2006). Minnesota's 2022 303(d) list of impaired waters includes 169 stream reaches impaired by fecal pathogens in the Cedar River and Lower Mississippi River Basins of Minnesota. Water quality monitoring over several decades has shown widespread exceedances of state and federal water quality standards for fecal coliform bacteria throughout the basin (MPCA 2006).

All streams in the MRLPT Watershed with sufficient data available for assessment did not meet aquatic recreation standards due to regular exceedances of the *E. coli* water quality standard (Bullard, Gilbert, Hay, Miller, and Wells Creeks). Higher levels of *E. coli* in water may or may not be accompanied by higher levels of pathogens and an increased risk to human health; varying survival rates of bacteria make it impossible to definitively state when pathogens are present (MPCA 2006). See the Minnesota Department of Health Waterborne Illness webpage for more information on how to reduce your risk for waterborne illnesses when swimming, boating, or wading. The MPCA also has developed answers to the most frequently asked questions about bacteria in Minnesota waters.

2.2 Improvements

Since the first cycle of the watershed approach, two streams in the MRLPT Watershed have been removed from the 303(d) list of impaired waters (Figure 10, Table 2). In 2014, Hay Creek's turbidity impairment was removed and in 2022, Gilbert Creek's fish community impairment was removed.

Figure 11. Map of streams in the MRLPT Watershed removed from 303(d)Impaired Waters List.

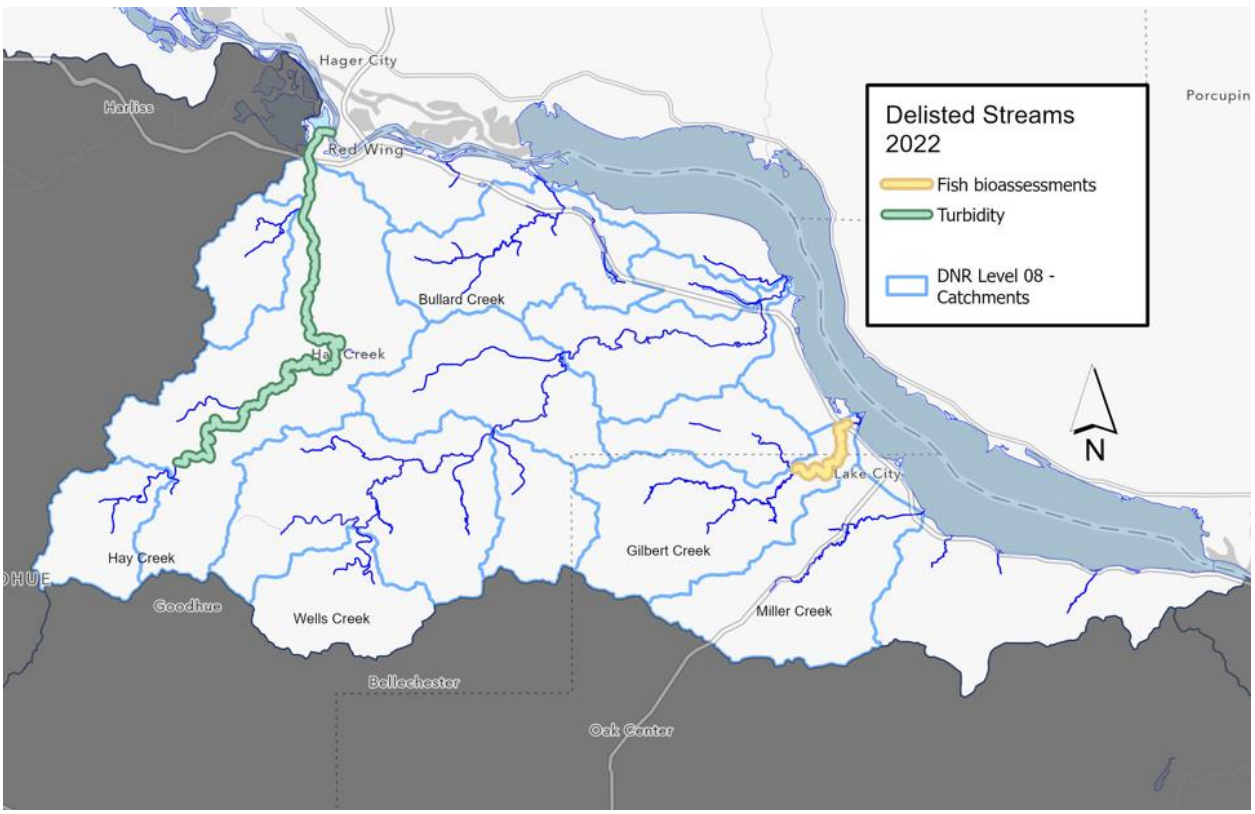


Table 2. Waters removed from the 303(d) Impaired Waters List, 2022.

Water body Name	Assessment Unit Identification (AUID)	Affected designated use	Pollutant or stressor	Year removed from List
Hay Creek	07040001-518	Aquatic Life	Turbidity	2014
Gilbert Creek	07040001-530	Aquatic Life	Fish bioassessments	2022

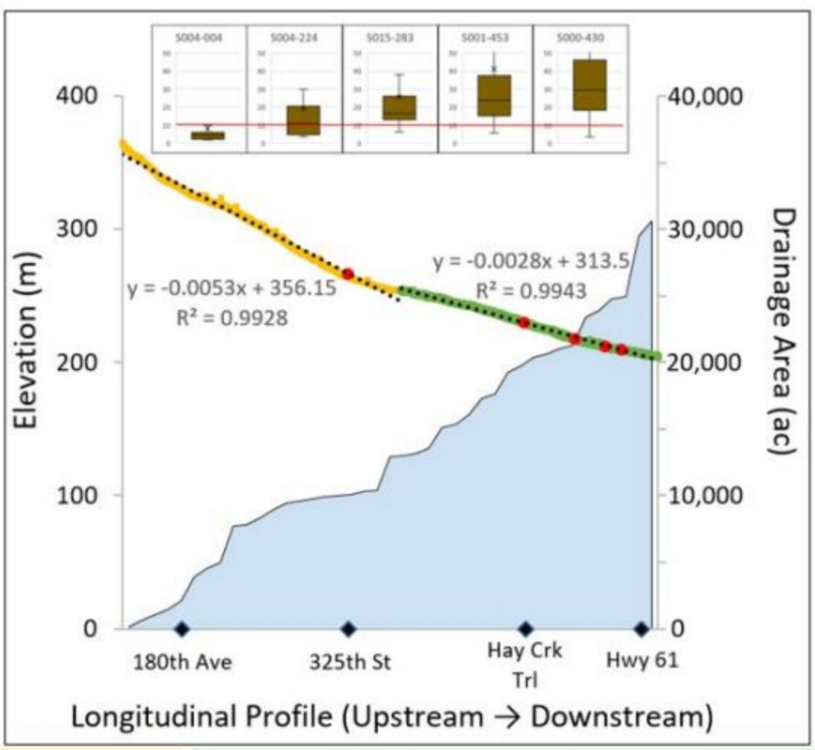
Throughout the MRLPT Watershed, private landowners, local government units, and state agencies have worked together to implement a substantial number of BMPs. According to [MPCA's Healthier watersheds](): Tracking the actions taken webpage, within the Goodhue County portion of the MRLPT Watershed, $12.97 million has been dedicated to conservation work from 2004 through 2022. Ninety-eight percent of this funding has been used to address nonpoint source pollution, and 2% to address point sources. A little more than one third of this funding has come from the Federal Conservation Reserve Program (CRP). Another 36% has been contributed by landowners within the MRLPT Watershed. This is likely a low estimate, as some landowners choose to implement conservation practices on their own, without government assistance. This investment has undoubtedly contributed to improvements on the land and in the water.

BMPs implemented include grassed waterways, water and sediment control basins, terraces, grade stabilization structures, streambank protection and habitat improvement, cover crops, reduced and no till practices, critical area plants, and many more. These are BMPs that were recommended in the 2015 WRAPS report.

2.2.1 Hay Creek

In 2008, Hay Creek was added to the impaired waters list due to data indicating frequent instances of high turbidity in the stream. Subsequent data (2004 through 2010) provided for a more recent and comprehensive assessment, indicating that Hay Creek is meeting water quality standards and exhibiting good fish and bug communities (MPCA 2020, 2021). This data provided a better understanding of sediment and turbidity dynamics and resulted in Hay Creek being removed from the Impaired Waters List in 2014.

Figure 12. Hay Creek longitudinal profile and stream gradient upstream to downstream with TSS concentrations shown (MPCA 2019).



The most recent assessment period, utilizing data from 2010 through 2019, shows a pattern of good water quality upstream, but higher suspended sediment in the lower portion. The lower portion of Hay Creek often exceeds the total suspended sediment standard of 10 mg/L (MPCA 2020, 2021).

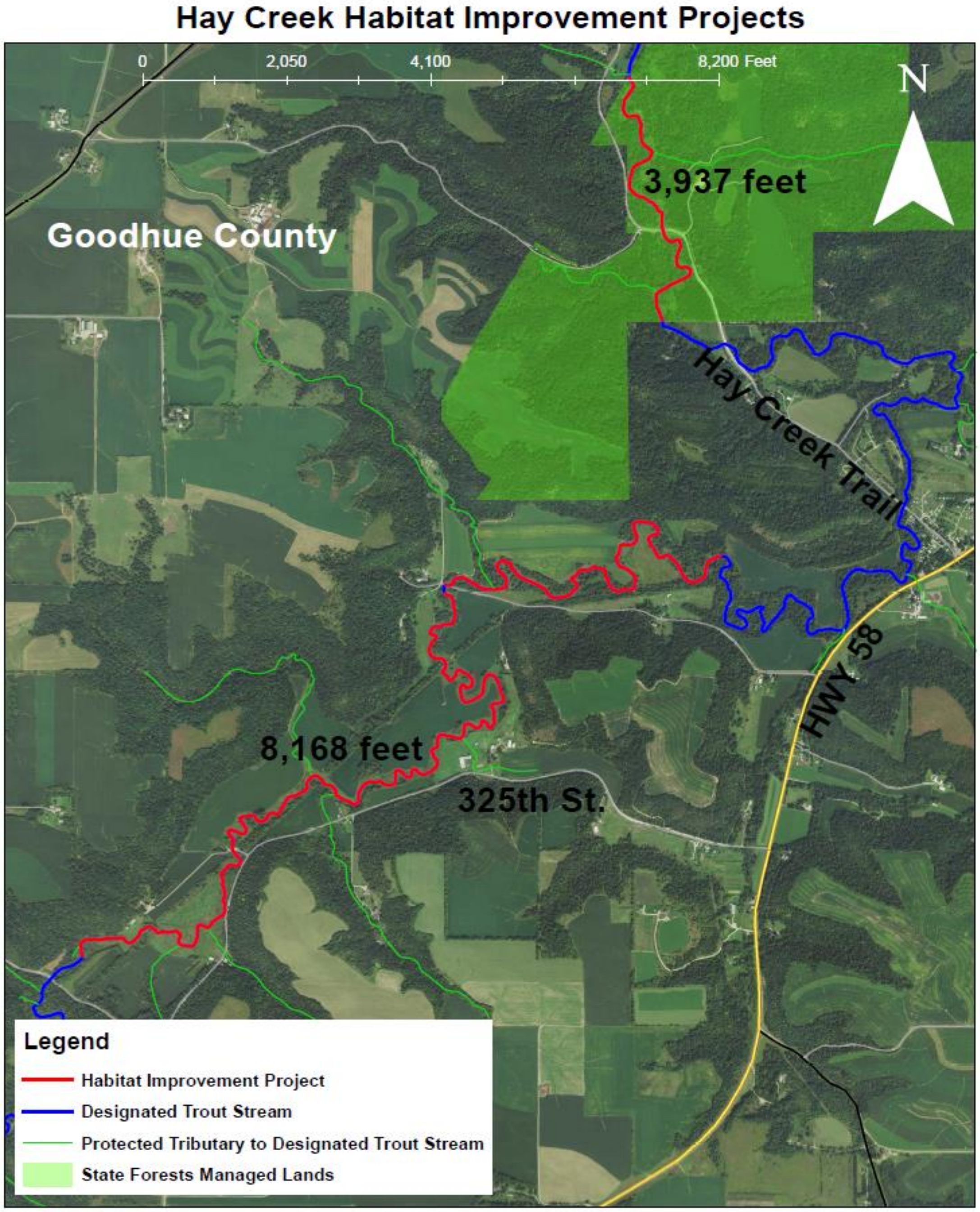
Longitudinal sampling was conducted in Hay Creek by the MPCA SID staff in 2019 to further characterize sediment dynamics and identify areas that may be contributing a disproportionate amount of sediment to the stream (MPCA 2020). This sampling confirmed previous observations during both IWM and SID efforts, TSS concentrations were below the standard in the upper part of the MRLPT Watershed, but frequently exceeded the standard in the lower part of the MRLPT Watershed. Concentrations increased moving downstream (Figure 12), with changes in drainage area and stream gradient likely having significant influence. Stream walks in 2019 identified large raw banks, Figure 12, and a sand dominated stream bed in the lower end of Hay Creek. Additional information is available in the Mississippi River – Lake Pepin Stressor Identification Report (Cycle 2).

The most recent monitoring in Hay Creek showed improving fish communities in the upper portion and one monitoring station on Hay Creek produced over 400 brown trout that were captured, measured, and released (MPCA 2021).

Figure 13. Hay Creek high eroding stream banks and sand dominated stream bed, 2019.

Minnesota Trout Unlimited, in partnership with local government units and state agencies, completed habitat improvement projects on Hay Creek in 2013 and 2023. These projects included more than 18,000 feet of stream stabilization, habitat restoration, including grading high stream banks, reconnecting the stream to the floodplain, and habitat improvements for trout and nongame species (Hoffman 2023). The map in Figure 14 shows these projects are located around the middle or change point referenced in Figure 12, near 325th Street.

Figure 14. Map of Hay Creek habitat improvement projects completed in partnership by Trout Unlimited and DNR in 2023.



2.2.2 Gilbert Creek

Gilbert Creek's fish community indicated impairment in the 2011 assessment, due to a moderately low fish Index of Biotic Integrity (IBI) (MPCA 2012). More data at multiple sites on Gilbert Creek confirm that the fish community has improved, and the 2022 assessment indicated aquatic life use was supported and thus Gilbert Creek was removed from the impaired waters lists (MPCA 2021). Both fish and aquatic insect community scores have improved since 2010, and brook trout (Figure 15) densities have increased indicating improvements in water quality and/or habitat conditions (MPCA 2021).

Figure 15. Brook trout captured, measured, and released in Gilbert Creek.

Additionally, in 2022, an exceptional aquatic life use designation was proposed by MPCA biological monitoring staff for the upstream section of Gilbert Creek (MPCA 2021). This designation holds the water body to a higher standard and helps to protect the fish and aquatic insect communities in the future. Several lines of evidence are considered to determine aquatic life uses in Minnesota streams and rivers, including biological condition, habitat limitation, the nature of any habitat alterations, and the restorability of the habitat. The review of biological condition covers both fish and macroinvertebrate communities, both communities must meet the criteria for Exceptional Use.

2.3 Pollutant sources

The MRLPT Watershed is a rural landscape and contains few permitted or point sources of pollutants (Figure 16). Pollutants primarily enter surface and groundwaters of the watershed via nonpoint pathways. Land use in the MRLPT Watershed has not changed significantly since the original WRAPS report (MPCA 2015a) was published (Table 3 and Figure 16), thus the general pollutant sources and pathways likely have not changed significantly.

Urban stormwater accounts for very little of the MRLPT Watershed and the urban areas are located generally at the “bottom” of the watershed- near the mouths of the streams as they empty to Lake Pepin. Similarly, municipal and industrial discharges are located at the bottom of the watershed and are not considered significant sources of pollutants throughout the watershed. Feedlots are the primary permitted entity within the watershed and cropland and pasture are the primary land uses.

Additional discussion of pollutant sources can be found in the 2015 Mississippi River Lake Pepin WRAPS Report and the 2015 Mississippi River – Lake Pepin Tributaries TMDL Report.

Table 3. Land use percentages for the MRLPT Watershed.

Land use category	Percentage of watershed (approximate)
Developed	7.2%
Cultivated & Pasture/Hay	63%
Forest & Shrub	28.2%
Wetland & Water	1.6%

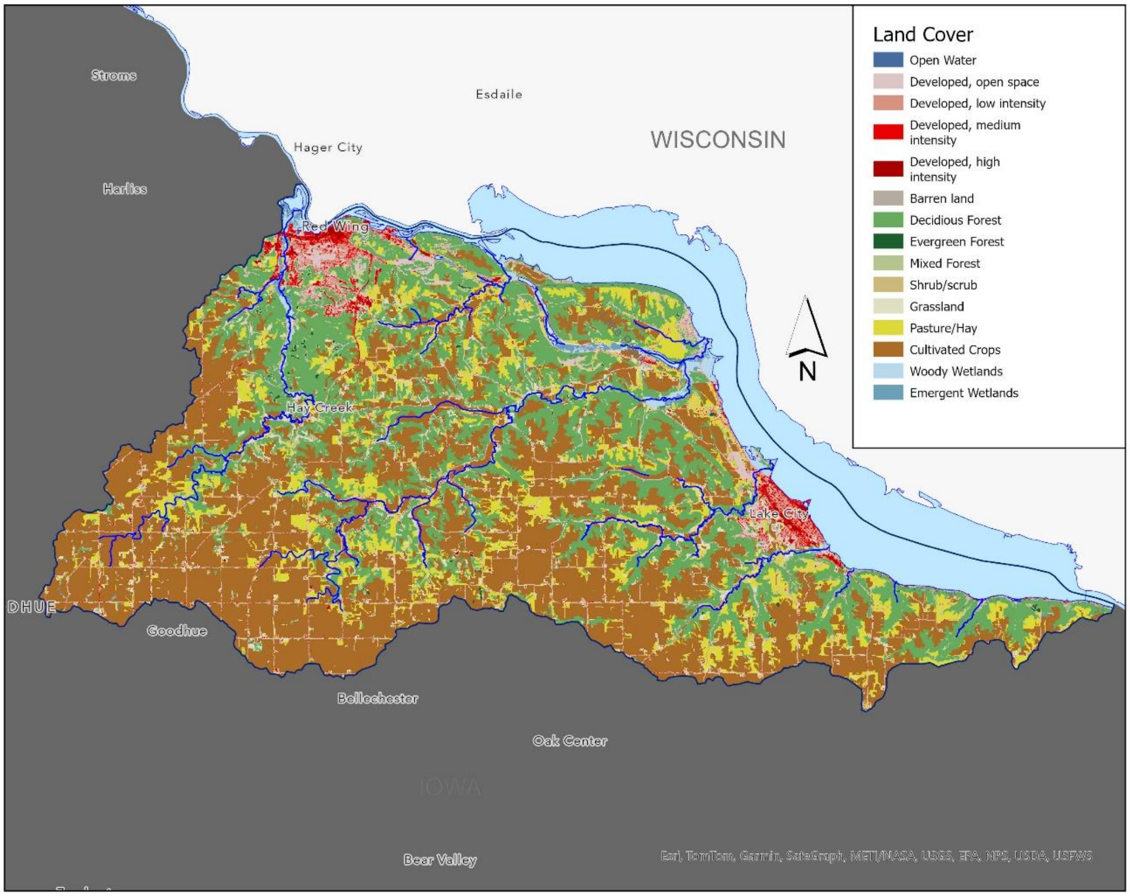
A summary of nonpoint sources and their relative magnitudes was developed for the 2015 MRLPT WRAPS Report and is shown below (Table 4; MPCA 2015a). This table lists the five main streams in the watershed and ranks various sources of pollution as high, moderate, or low. The highest-ranking sources across the MRLPT Watershed are poor riparian vegetation cover, upland soil erosion, and fertilizer and manure leaching loss.

Table 4. Nonpoint sources and their relative magnitude in the MRLPT Watershed.

HUC-10 Subwatershed	Stream/Reach (AUID) or Lake (ID)	Pollutant	Pollutant Sources							
			Fertilizer & manure run-off	Fertilizer & manure leaching loss	Livestock overgrazing in riparian	Failing septic systems	Wildlife	Poor riparian vegetation cover	Upland soil erosion	Urban Runoff
Hay Creek – Mississippi River 0704000104	Hay Creek 070400010401	Bacteria	●		O	○	○			○
		TSS			○			O	●	○
		TP			○			O	O	○
		N	○	●	○	○	○			
	Bullard Creek 070400010402	Bacteria	O		○	○	○			○
		TSS			○			O	○	○
		TP			○			O	○	○
		N	○	●	○	○	○			
Wells Creek 0704000106	Upper Wells Creek 070400010601	Bacteria	●		O	○	○			
		TSS			O			O	●	
		TP			O			O	●	
		N	○	●	○	○	○			
	Lower Wells Creek 070400010602	Bacteria	O		○	○	○			
		TSS			○			O	O	
		TP			○			O	O	
		N	○	●	○	○	○			
Lake Pepin 0704000107	Gilbert Creek 070400010703	Bacteria	O		○	O	○			○
		TSS			○			O	●	○
		TP			○			O	●	○
		N	○	●	○		○			
	Miller Creek 070400010704	Bacteria	●		●	O	○			○
		TSS			O			O	O	○
		TP			O			O	O	○
		N	○	●	○	○	○			

Key: ● = High O = Moderate ○ = Low

Figure 16. MRLPT Watershed land cover dataset, USGS NLCD 2019.



2.3.2 Sediment sources

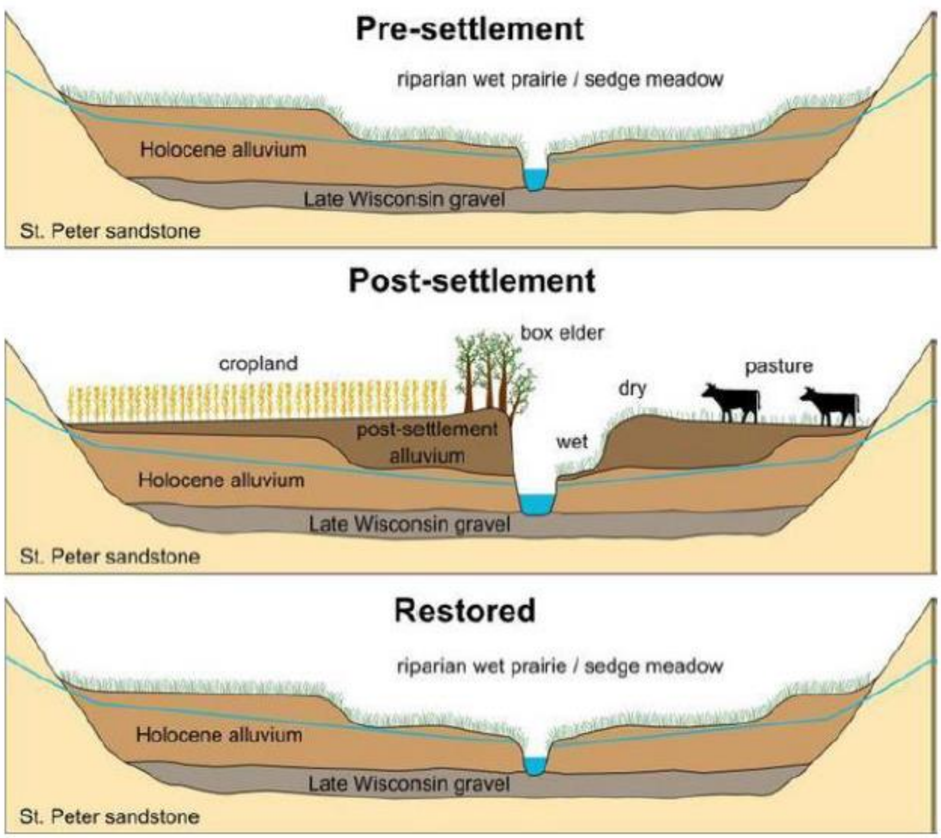
Between 2020 and 2022, the DNR conducted an extensive study of sediment dynamics in Wells Creek, the results of this study were published in the Wells Creek Watershed Assessment of River Stability and Sediment Supply (DNR 2021) and the Wells Creek Watershed Sediment Reduction Strategies (DNR 2022). This study concluded that in Wells Creek, streambank erosion accounts for 89% of the total sediment supply (Table 5). The remaining 11% of the total sediment supply was attributed to overland sources (Table 5).

Table 5. Sediment sources and amounts identified in Wells Creek (DNR 2022).

Sediment Supply Process	Total Annual sediment (tons/yr)	Percent of Total Sediment Supply
Roads	13	0%
Streambanks	9,404	89%
Surface Erosion (HSPF)	1,187	11%
Total Sediment	**10,604**	**100%**

The DNR study found that the upper and middle sections of Wells Creek, areas with steeper slopes, generate the majority of excess sediment from streambank erosion. The lower half of the watershed is then affected by aggradation or filling in, driven by settling of current and past sediment generated upstream. These findings are similar to those observed in Hay Creek. This creates over-wide, shallow channels prone to mass wasting or bank slumping. These results can be extended to the other streams in the MRLPT Watershed given their similarities in land use, topography, and soils (DNR 2022). Figure 17 shows a generalized cross-sectional progression of erosion and aggradation in these streams from pre-settlement to post-settlement and what a restored channel could look like. The pre-settlement view shows a narrow and deep channel with established, native riparian vegetation and a connected floodplain. The post-settlement view shows a wider channel with sediment deposited in the floodplain and steep, actively eroding streambanks. The restored view is an example of one restoration option, which looks very similar to the pre-settlement view.

Figure 17. Diagram of floodplain change in the Driftless Area and one of many restoration options (Booth and Loheide 2010).



A 2013 HSPF modeling study of sediment sources and dynamics for the neighboring Zumbro River Watershed concluded that the relative contributions of "nonfield" sources of sediment to the overall watershed sediment yield appears to be increasing over time, with a likely link to the "flashier" hydrology (i.e., rapidly increasing and decreasing flow volumes) resulting from agricultural land use and associated drainage and urban development (LimnoTech 2013).

2.3.3 Nitrogen sources

Nitrogen, like phosphorus, is a nutrient that pollutes in-state waters, and concentrations in many rivers have been increasing from historic natural levels over time due to human influences. Cropland sources account for an estimated 89% to 95% of the nitrate load in the Minnesota, Missouri, Cedar, and Lower Mississippi River basins (MPCA 2013b). In tiled cropland, most of the rainwater that ends up in surface water flows through tile drainage. This water is typically high in nitrate. In cropland without tile drainage, most nitrate is delivered to surface waters via a groundwater pathway. The MRLPT Watershed and other regions of southeast Minnesota are vulnerable to nitrate losses because of shallow bedrock, sinkholes, and underground caves, which lead to exchanges between surface and ground water resources.

For more information on nitrogen sources, see *Mississippi River Lake Pepin Watershed Restoration and Protection Strategy Report* and visit MPCA's webpage. For information on addressing nitrate in southeastern Minnesota visit the MPCA's website dedicated to addressing nitrate in southeastern Minnesota.

2.4 Climate

Climate data collected by DNR indicates that the MRLPT Watershed is experiencing higher precipitation and air temperature, but also more heavy rain events. According to the last published report about climate in this watershed, average annual air temperatures in the watershed over the period of record (1895 through 2018) have increased 1.6 degrees Fahrenheit and average winter temperatures have increased 3.0 degrees (Figure 18) (DNR 2019). Additionally, the DNR reports the watershed is receiving 3.2 more inches of precipitation, on average, annually when compared to the entire climate record dating back to 1895 (Figure 19).

Figure 18. Annual average air temperature in degrees Fahrenheit 1895-2018, DNR 2019.

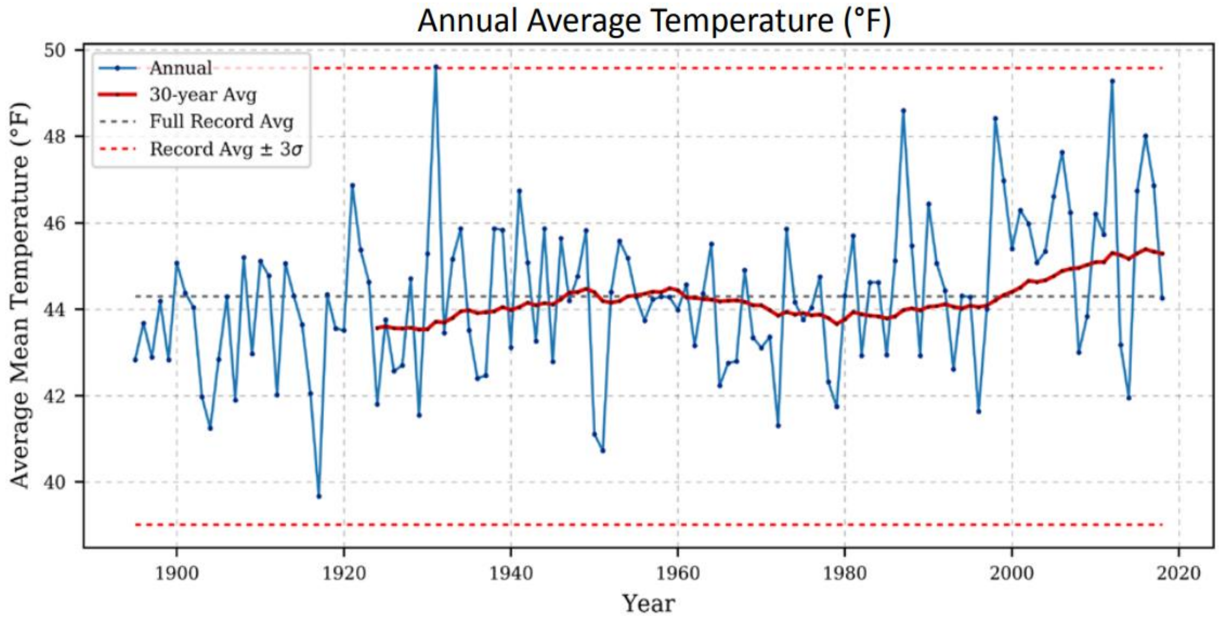
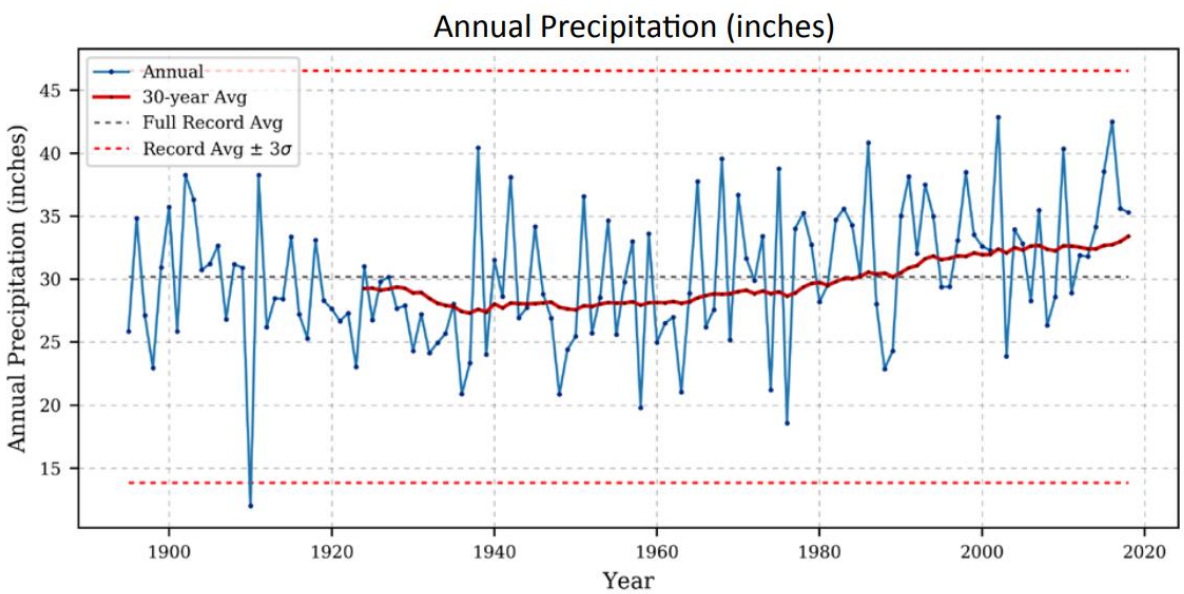


Figure 19. Annual precipitation in inches 1895-2018, DNR 2019.



Large rain events were assessed by the DNR using available daily precipitation data from a nearby long-term monitoring station in Red Wing, Minnesota. These data show the occurrence of 24-hour storm events of one inch and greater, over 30-year time periods, going back to the beginning of the 20th century (Table 5). The largest shift appears to be in the period of 1960 through 1990, where large increases in the 1-to-2 inch and 2-to-3-inch events occurred. The following period, from 1990 through 2020 had the most occurrences of events above 3 inches of all the periods. Both storm intensity and total annual precipitation volumes have been increasing in the watershed (DNR 2021).

Table 5. MRLPT Watershed average annual and seasonal temperatures, DNR 2021.

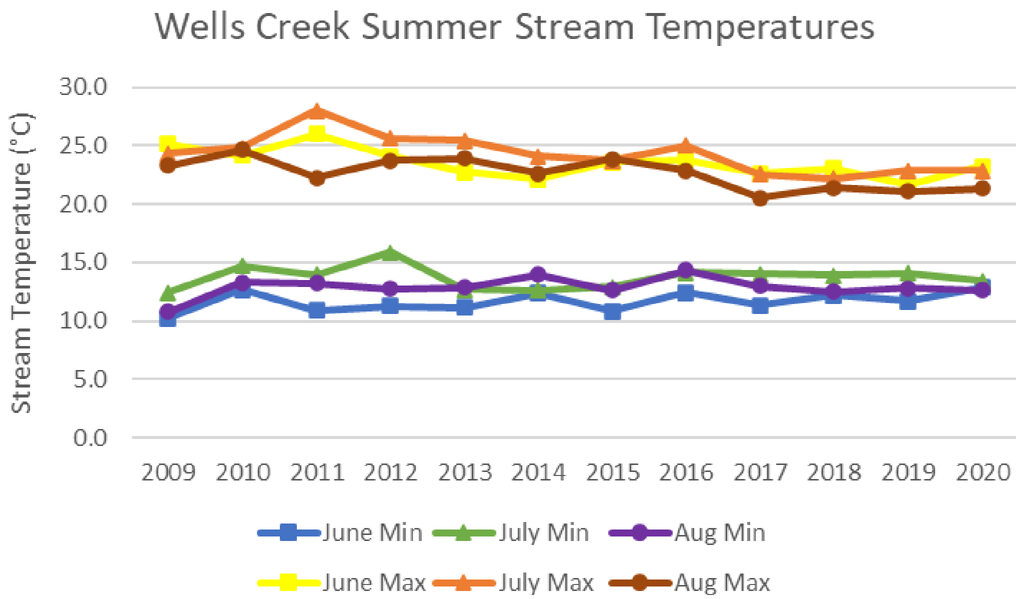
Time period	Average Temperature (degrees Fahrenheit)
Annual	45.3°
Winter (December – February)	18.2°
Spring (March – May)	45.1°
Summer (June – August)	69.7°
Fall (September – November)	48.1°

Table 6. MRLPT Watershed 24-hour rain event intensity totals over 30-year time periods, DNR 2021.

Time Period	1-2”	2-3”	3-4”	>4”
1900-1930	135	18	2	1
1930-1960	122	18	5	3
1960-1990	153	30	4	2
1990-2020	177	34	6	6

Stream temperature summer minimum and maximum values from continuous monitoring in Wells Creek appear to show no significant trend over the last decade (Figure 20). A recent study by Hoxmeier and Dieterman (2019) discusses the increased air temperatures, decreased water temperatures, and impact to fish populations in a neighboring watershed. The study concluded; “Water temperature decreased within our study area despite an overall increase in air temperature in the region. Riparian cover and land use was similar throughout the study period and likely did not contribute to the observed decreased temperature change. Instead, increased base flow within the station was the most likely explanation for the decreasing water temperature, given the increase of cold groundwater inputs. Limited data on discharge in our study site was overcome by other studies that showed base flows have increased in Driftless Area streams as a result of implementing conservation land use practices and increased precipitation.” (Hoxmeier and Dieterman 2019, Gebert & Krug 1996, Juckem et al. 2008, Lenhart et al. 2011). It will be important to continue monitoring these trends over time to ensure the protection of these coldwater resources.

Figure 20. Minimum and maximum summer stream temperatures in Wells Creek 2009-2020.



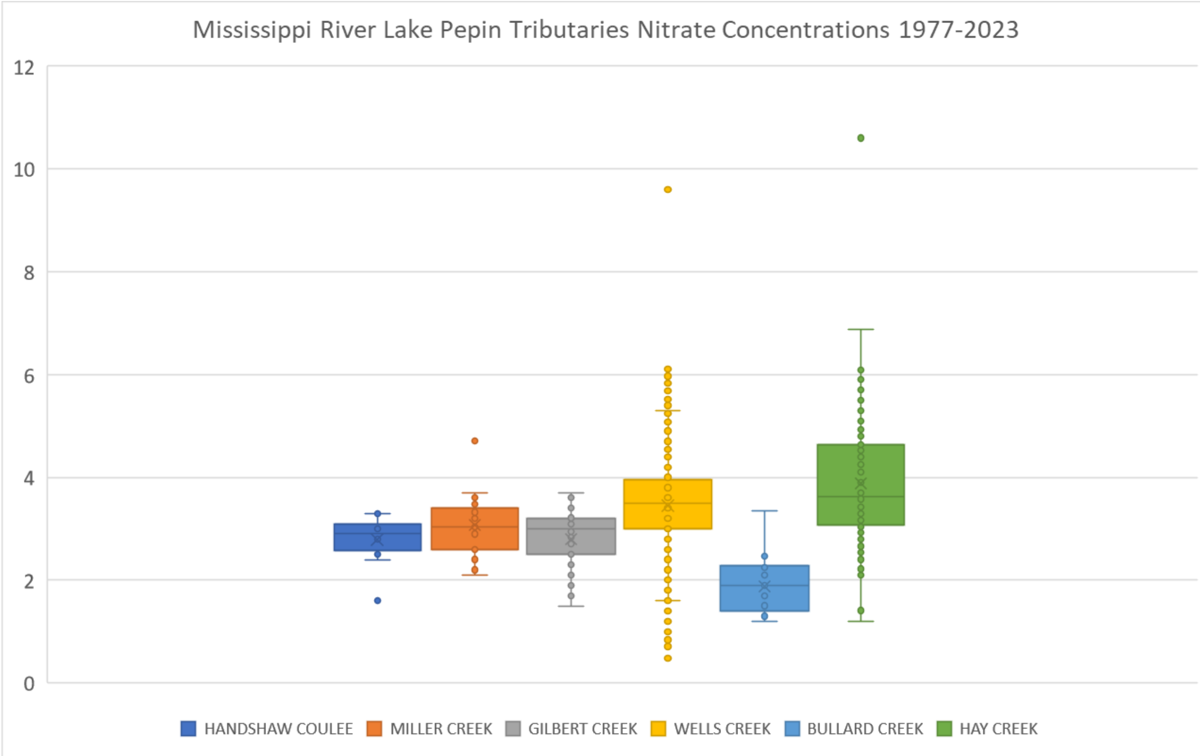
2.5 Protection considerations

All the assessed streams in the watershed demonstrated aquatic life use support yet are impacted by high sediment loads These waters should be protected from degradation that can occur via increased pollutant loading, flow alterations and habitat impacts. Efforts to reduce pollutant loads in pursuit of downstream water quality goals (i.e. Lake Pepin and Mississippi River, Gulf of Mexico) will serve to benefit and further protect aquatic life in the watershed.

2.5.1 Nitrate

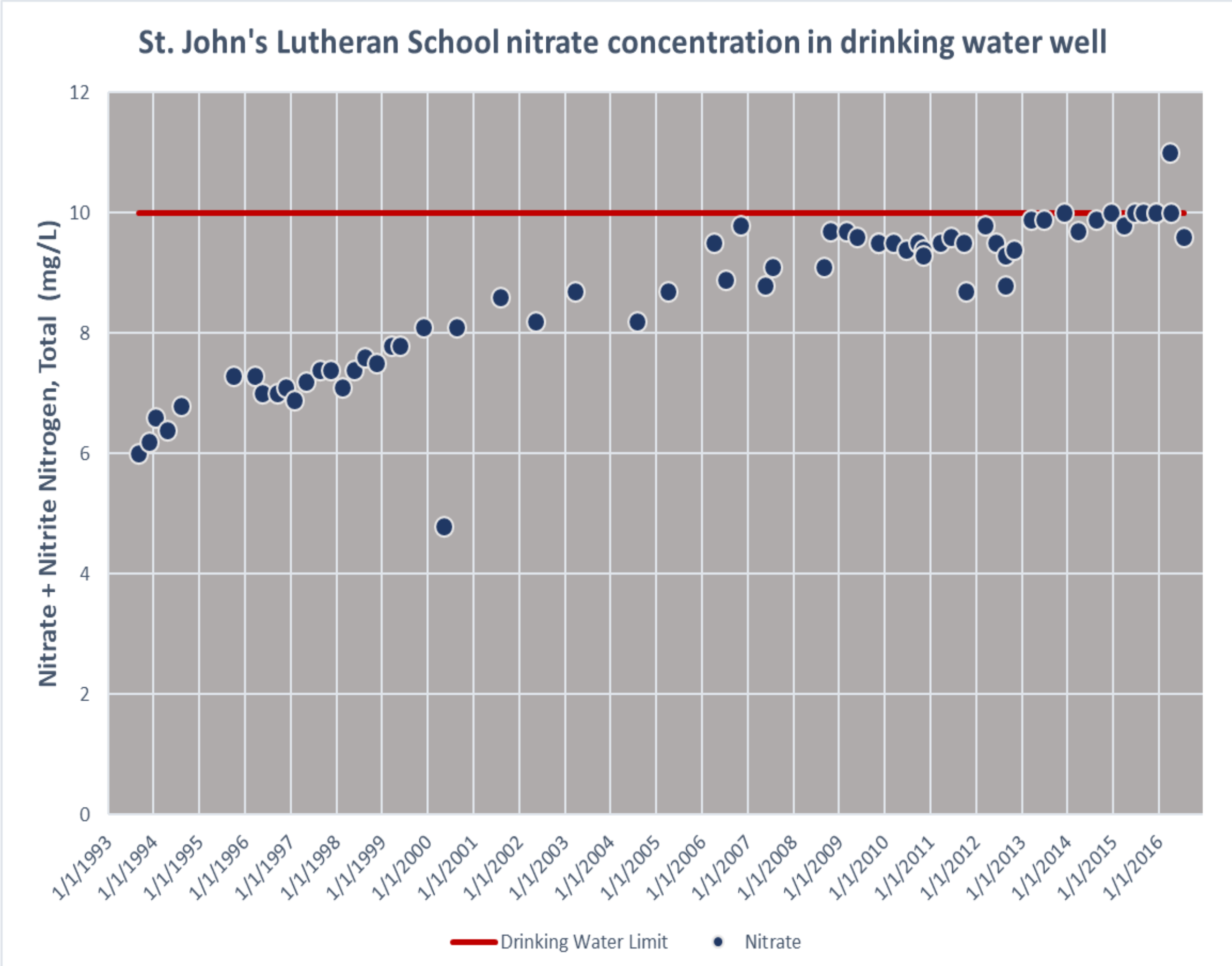
Nitrate in groundwater has been a foremost water quality issue in southeastern Minnesota for several decades. The widespread cultivated acres combined with the underlying geology of the region, results in high concentrations of nitrate in groundwater. Nitrate is a particular concern for those who get their drinking water from private wells in eight counties in southeast Minnesota: Olmsted, Goodhue, Dodge, Wabasha, Fillmore, Mower, Winona, and Houston. Many streams in southeast Minnesota are fed by groundwater springs, thus areas with elevated nitrate in groundwater can also have higher nitrate in streams which can cause stress to aquatic biological communities.

Figure 21. Nitrate concentrations in MRLPT streams 1977-2023.



Nitrate concentrations in the Watershed's streams are generally below 5 mg/L, less than one half of the state standard for cold water streams (10 mg/L) (Figure 21). However, the 2015 Mississippi River Lake Pepin Tributaries WRAPS document discusses the need for nitrate reductions in St. John's Lutheran Church and School Drinking Water Supply Management Area (DWSMA) at the headwaters of Wells Creek (MPCA 2015). Since the 2015 report was published, nitrate concentrations in the St. John's well water continued to rise (Figure 21) and a new well was drilled in 2016 (St. John's Lutheran Church 2023). The city of Goodhue has also experienced increasing concentrations of nitrate in their municipal well supply over the past few decades (Goodhue SWCD 2023). Currently, the city of Goodhue's municipal well supply nitrate concentration is 7 mg/L and the quarterly samples collected by city staff have shown a trend that is rising at a rate that warrants a proactive approach to prevent exceeding the health limit of 10 mg/L (Goodhue SWCD 2023).

Figure 22. Nitrate concentration of St. John's Lutheran School well 1993-2016 (St. John's Lutheran Church 2023).



2.3.1 *E. coli* bacteria sources

In the MRLPT Watershed, the most significant sources of bacteria are livestock manure (feedlots and land applied manure) and septic systems, although these do not demonstrate good correlations between their presence and the corresponding downstream *E. coli* concentrations (MPCA 2015).

E. coli is proposed to have two primary habitats, the first being the intestinal tracts of mammals and birds, and the second being the nonhost environment (water/sediment) (Zhi, S et.al. 2016). *E. coli* and other fecal indicator bacteria (FIB) were thought to survive poorly in the nonhost environment. Because of this, elevated levels of FIB in surface waters are often blamed on run off from feedlots and manure amended agricultural land, septic system leakage, untreated sewage from sewer overflows, human recreation, wildlife, and urban runoff (Chandrasekaran, et al. 2003, Chalmers et al. 1997, Cox et al. 2005, Coye and Goldoft 1989, Dufor 1984a, Haile et al. 1999, Novotny et al. 1985, Wells et al. 1991). In recent years though, more and more studies have reported the growth and persistence of *E. coli* in various natural environments (Byappanahalli et al. 2003, Carrillo et al. 1985, Whitman and Nevers 2003). Byappanahalli et al. reported the persistence and growth *of E. coli* in soils and riparian sediments of Indiana and also in coastal forest soils from the Great Lakes Watershed (Byappanahalli et al. 2003, Byappanahalli et al. 2006). Similarly, Ishii and coworkers provided evidence supporting the long-term survival and growth of *E. coli* in Lake Superior watersheds of Minnesota (Ishii et al. 2006a, Ishii et al.

2007). Additionally, hydrogeologic features in southeast Minnesota have the potential to favor the survival of fecal coliform bacteria. Cold water, shaded streams, and sinkholes may protect fecal coliform from light, heat, drying, and predation (MPCA 1999).

A microbial source tracking study was conducted in 2013 within the MRLPT Watershed. Samples were collected July through September in Miller Creek and a tributary to Wells Creek and analyzed for the presence of human, cow, or ruminant bacteria. Human and ruminant bacteria were present only in some of the samples collected in September (MPCA 2015b).

Intensive sampling at numerous sites in southeastern Minnesota shows strong positive correlation between stream flow, precipitation, and fecal coliform bacteria concentrations (MPCA 2006). Besides precipitation and flow, factors such as temperature, livestock management practices, wildlife activity, fecal deposit age, and channel and bank storage also affect bacterial concentrations in runoff (Baxter-Potter and Gilliland 1988).

2.5.2. Preventing fish kills

While hundreds of fish kills occur in Minnesota every year, mostly in lakes and ponds, fish kills in trout streams in southeast Minnesota are much less common. The causes of most lake and pond fish kills are disease and low oxygen levels. Low oxygen levels in lakes and ponds are often driven by chronic environmental conditions such as excess nutrients.

In trout streams, fish kills are usually related to the discharge or runoff of pollutants from the landscape through incidents like toxic spills, runoff of manure, pesticides, fertilizers, and high temperature wastewater or stormwater discharges. In recent years, major fish kills near Lewiston, Minnesota have been reported. Several commonalities exist across these events, including:

- The streams were all in low flow condition just prior to the fish kill.
- A strong rainstorm occurred in each contributing area, with enough intensity to mobilize pollutants from the watershed but without enough volume to dilute the pollutant concentration in the trout streams.
- Investigations of all four cases determined that polluted runoff from the upstream drainages caused the fish kills.

These commonalities can be useful to resource managers in describing high risk conditions and locations for fish kills. More information including tips for farms and homes, as well as a communication toolkit are available on MPCA’s Minimizing Fish Kills webpage.

3. Strategies for restoration and protection

The CWLA requires that WRAPS include strategies that are capable of cumulatively achieving needed pollution load reductions for point and nonpoint sources, including water quality goals, strategies, and targets by parameter of concern, and an example of the scales and timeline of adoption to meet water quality protection and restoration goals. This section of the WRAPS Update report provides the results of such strategy development. Because many of the nonpoint source strategies outlined in this section rely on voluntary implementation by landowners, land users, and residents of the watershed, it is imperative to create social capital (trust, networks, and positive relationships) with those who will be needed to voluntarily implement BMPs. Thus, effective ongoing public participation is fully a part of the overall plan for moving forward.

The implementation strategies, including associated scales of adoption and timelines, provided in this section are the result of watershed modeling efforts and professional judgment of agency and local government staff, based on what is known at this time and, thus, should be considered approximate. Furthermore, many strategies are predicated on needed funding being secured. As such, the proposed actions outlined are subject to adaptive management—an iterative approach of implementation, evaluation, and course correction.

Although this watershed has few impairments on the Federal 303(d) List of Impaired Waters, there are issues concerning erosion, sediment, aquatic habitat, and bacteria. Additionally, there are downstream impairments and goals for Lake Pepin, the Mississippi River, and the Gulf of Mexico that are impacted by this watershed. Sediment and nutrients from the watershed impact these downstream waters, thus strategies for sediment and nutrient reduction, drawn from studies and plans of greater scale, are included here.

3.1 Sediment

Sediment is the primary pollutant causing impairment in this watershed. Strategies to address sediment sources are outlined in the 2015 WRAPS report as well as the Greater Zumbro 1W1P and include:

- Installation of upland BMPs,
- Maintaining/rehabilitation of existing BMP structures,
- Increased use of reduced and conservation tillage, especially on steep slopes; focus on reduced tillage following soybeans,
- Stream restoration and channel work in watersheds that have been sufficiently treated in the uplands to address legacy sediment issues, channel incision and habitat deficiencies.

These strategies continue to be the most effective for addressing excess sediment and flow in the MRLPT Watershed. The 2022 Wells Creek Watershed Sediment Reduction Strategies Report by the DNR provides catchment and stream reach level recommendations for addressing streambank erosion. These recommendations were focused on addressing stream channel instability, restoration of natural stream processes, and improved ecological function. Addressing streambank erosion is more involved and often requires more funds than overland and upland treatments. Streambank erosion is the primary source of sediment in the MRLPT Watershed and should be a focus for BMP implementation, funding and support for practices addressing streambank erosion is needed in the MRLPT Watershed.

Another important strategy to protect and restore the streams in this watershed is to implement BMPs that ‘slow the flow’ or hold water on the land and reduce peak flows during and after precipitation events. These were highlighted and modeled in the 2015 WRAPS report and briefly listed below. These practices will help reduce both overland and streambank sediment sources as well as help reduce nutrient loss from the watershed, to work toward the state’s Nutrient Reduction Strategy goals and Lake Pepin TMDL goals.

- Structural impoundment BMPs in subwatersheds with lower upland treatment and higher percentage of land in row crop agriculture.

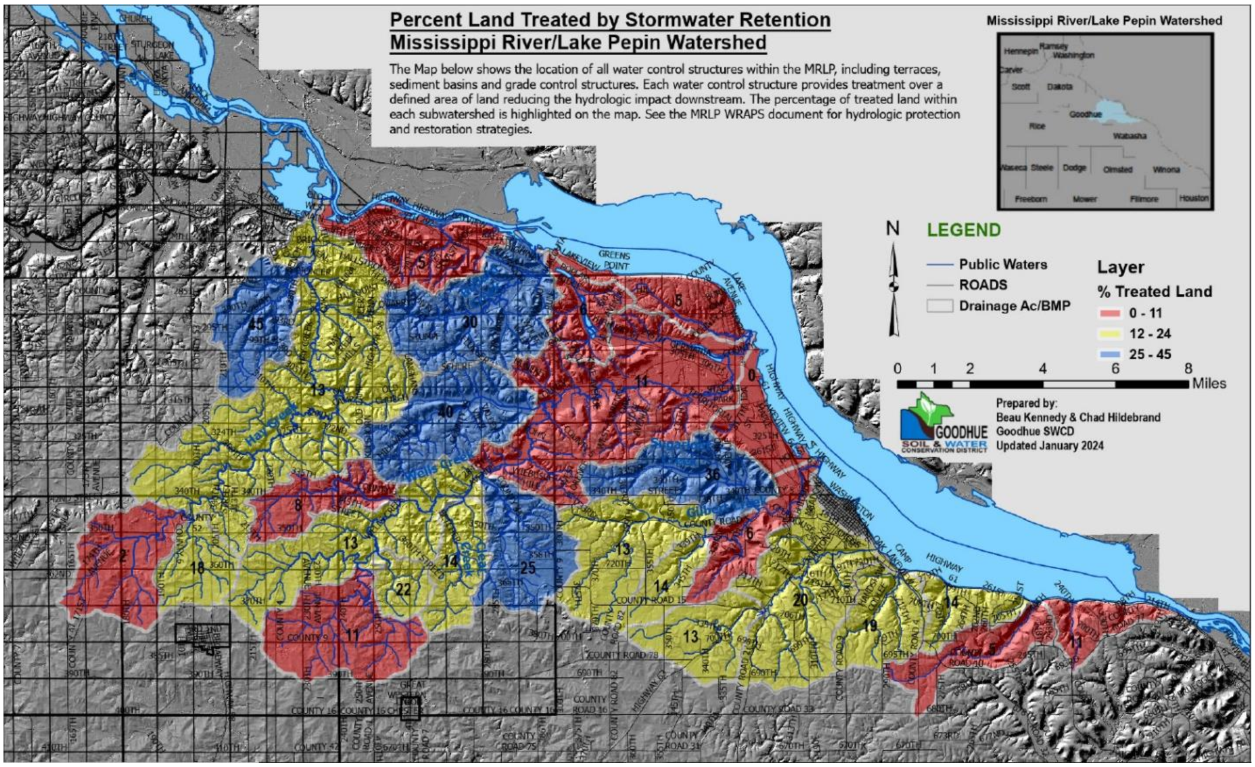
- Land retirement/acquisition in priority subwatersheds.
- Stream and streambank restoration and stream habitat improvement in subwatersheds with sufficient upland treatment.

Structural BMPs have been targeted in this watershed for many years. With grant funding through the MPCA, BWSR, and others, Goodhue SWCD assisted in the installation of 144 erosion and sediment reducing BMPs in the watershed between 2004 and 2023 (MPCA Healthier Watersheds), making significant progress on water quality goals. BMP data and more are available on MPCA's Healthier Watersheds webpage. These BMPs include watershed and sediment control basins, grade stabilization practices, streambank protection and restoration, and grassed waterways. Factsheets detailing the BMPs and associated benefits in each of the Watershed's catchments can be found in the Appendix.

Goodhue Soil and Water Conservation District maintains an inventory of structural BMPs installed in the watershed. This helps target future work in areas with less treatment (Figure 22). Areas shaded red are high priority for future structural practices which currently have only 0% to 11% treatment. Areas shaded yellow have 12% to 24% treatment and are medium priority for future implementation.

Goodhue SWCD has also been selected to participate in Minnesota's 319 Small Watershed Focus grant program, Group D (the fourth and final group) to protect and restore the Wells Creek portion of the Watershed. A Nine Key Element Plan is currently being developed and includes numerous structural practices including water and sediment control basins, grade stabilization structures, terraces, and grassed waterways. Other BMPs in the plan are reduced tillage, conservation crop rotation, cover crops, streambank restorations, buffer/filter strips, and many others to address the sediment impairment. This grant program is administered by the MPCA and has the potential to provide up to 16 years of dedicated funding for BMPs, outreach, and monitoring in Wells Creek. Funding could total over one million dollars of federal funds, with an additional 40% local match requirement.

Figure 23. Percent land treated by structural BMPs in MRLPT Watershed, Goodhue SWCD 2024.



3.2 *E. coli* bacteria

The 2006 *Revised Regional Total Maximum Daily Load Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota* and the 2007 *Lower Mississippi River Basin Fecal Coliform Implementation Plan* provide approaches for reducing pathogen loading to surface waters. Some recommendations from the plan include:

- Reduction of runoff from smaller, open lot livestock feedlots through increased technical, educational, and financial support.
- Assistance to beef and dairy producers to accelerate the use of rotational grazing.
- A doubling in the rate at which inadequate septic systems and small unsewered communities are being upgraded.

Many strategies and corresponding BMPs designed to address phosphorus and sediment loading will also reduce loading of fecal pathogens to surface waters. Since the initial WRAPS report, MPCA administered several grants in response to the 2006 regional fecal coliform TMDL. This included a 319-grant titled “Reducing Bacteria from SEMN Feedlots”. This grant began in July 2019, and ended in August 2022. Over the three-year grant period, $899,498.81 was spent in 10 counties across the southeast region to reduce runoff and fecal bacteria loading from feedlots. To achieve water quality standards, the Regional TMDL Implementation Plan calls for reducing bacteria impairments from all major sources by an average of 65%. Building local capacity for accelerating producer compliance with state feedlot rules has been a successful strategy. Employing this strategy in six previous regional feedlot projects, 2,295 livestock producers in the region signed up for the Open Lot Agreement, runoff reduction designs for more than 1,500 feedlots were completed along with 545 feedlot improvement projects. The goal of the

2019 grant was to implement runoff conservation practices on 30 open lot feedlots, mostly under 500 animal units through technical assistance and cost-share funding for relatively low-cost solutions. During the 2019 though -2022 grant, 16 feedlot fixes were completed with an average fecal coliform reduction of 92% per feedlot fix. Continued funding and support for small feedlot improvements is needed in the MRLPT Watershed.

3.3 Nutrients: Nitrogen and phosphorus

Minnesota's Nutrient Reduction Strategy compiles the latest science, research, and data and recommends the most effective strategies to reduce nutrients in our waters from both point and nonpoint sources (MPCA 2014). The strategy serves as a framework that outlines voluntary and regulatory actions to reduce nutrient pollution to meet long-term goals. Reductions in Minnesota's nitrogen and phosphorus pollution are needed to reach our in-state water quality goals and the 2040 goals that aim to restore the Gulf of Mexico, Lake Winnipeg, and Lake Superior. The MPCA and partners are currently developing the 10-year update for Minnesota's Nutrient Reduction Strategy, which is expected to be published the winter of 2025-2026. Visit MPCA's Nutrient Reduction Strategy webpage for more information. The 2020 five-year progress report for the Nutrient Reduction Strategy calculated fair-share load reductions needed from each watershed in the state (MPCA 2020). Minnesota's Nutrient Reduction Strategy fair-share total phosphorus load reduction goal for the MRLPT Watershed is 29.6 MT/year, or a 25.9% reduction. The total nitrogen fair-share load reduction goal for the watershed is 1,137 MT/year, or a 38.2% reduction.

The 2019 Mississippi River- Lake Pepin HSPF modeling scenario report provides nine BMP scenarios and the associated percent reduction in loads delivered to Lake Pepin. These scenarios provide a starting point for strategies to reduce nutrients. The most aggressive strategy modeled involves converting 50% of conventional tillage cropland to conservation tillage, 30% of cropland to grow cover crops, and 30% of cropland to drain to sedimentation ponds. This scenario resulted in 14.6% reduction in total phosphorus and 16% reduction in total nitrogen delivered to Lake Pepin. These reductions are roughly half of the fair-share nutrient reduction strategy goals.

The Nitrogen BMP Scenarios Spreadsheet is another tool developed by the University of Minnesota to estimate nitrogen reductions associated with BMP implementation. This tool was used to evaluate BMP scenarios designed by MPCA staff and local partners for the MRLPT Watershed. Referenced in the 2015 WRAPS, the following BMPs and levels of adoption resulted in a 27% reduction of nitrogen load:

- 100% of suitable corn acres receive target nitrogen rate
- 100% of suitable acres switch to split spring/side dressing nitrogen application
- 1% of suitable acres treated with saturated buffers
- 100% of riparian buffers implemented
- 20% of suitable acres have cereal rye cover crop planted after corn grain and before soybeans
- 100% of suitable short season crop acres planted with rye cover crop

Since the 2015 WRAPS report, all landowners in the MRLPT Watershed are in compliance with the state's riparian buffer law, this means 100% of riparian buffers have been implemented. According to MPCA's Healthier Watersheds BMPs Implemented, 1.63% of the Watershed's cultivated acres have been planted with cover crops and roughly 1.6% have nutrient management BMPs being implemented. There are likely more cover crops and more nutrient management on the landscape though, as this only represents BMPs that were implemented using state cost-share funds. Even with these values of implementation, phosphorus and nitrogen have been reduced 2,480 and 32,204 lbs/year or one and 14 MT, respectively, according to MPCA's Watershed Pollutant Load Reduction Calculator.

3.3.1 MN's Groundwater Protection Rule

Minnesota's Groundwater Protection Rule, managed by the Minnesota Department of Agriculture (MDA), minimizes potential sources of nitrate pollution to the state's groundwater and protects our drinking water. The rule became effective in June 2019. The rule is intended to promote appropriate nitrogen fertilizer BMPs and to involve local farmers and agronomists in adopting the most current science-based and economically viable practices that can reduce nitrate in groundwater. There are two parts to the rule and each part contains separate criteria and requirements. Depending on the location, none, one, or both parts of the rule may apply.

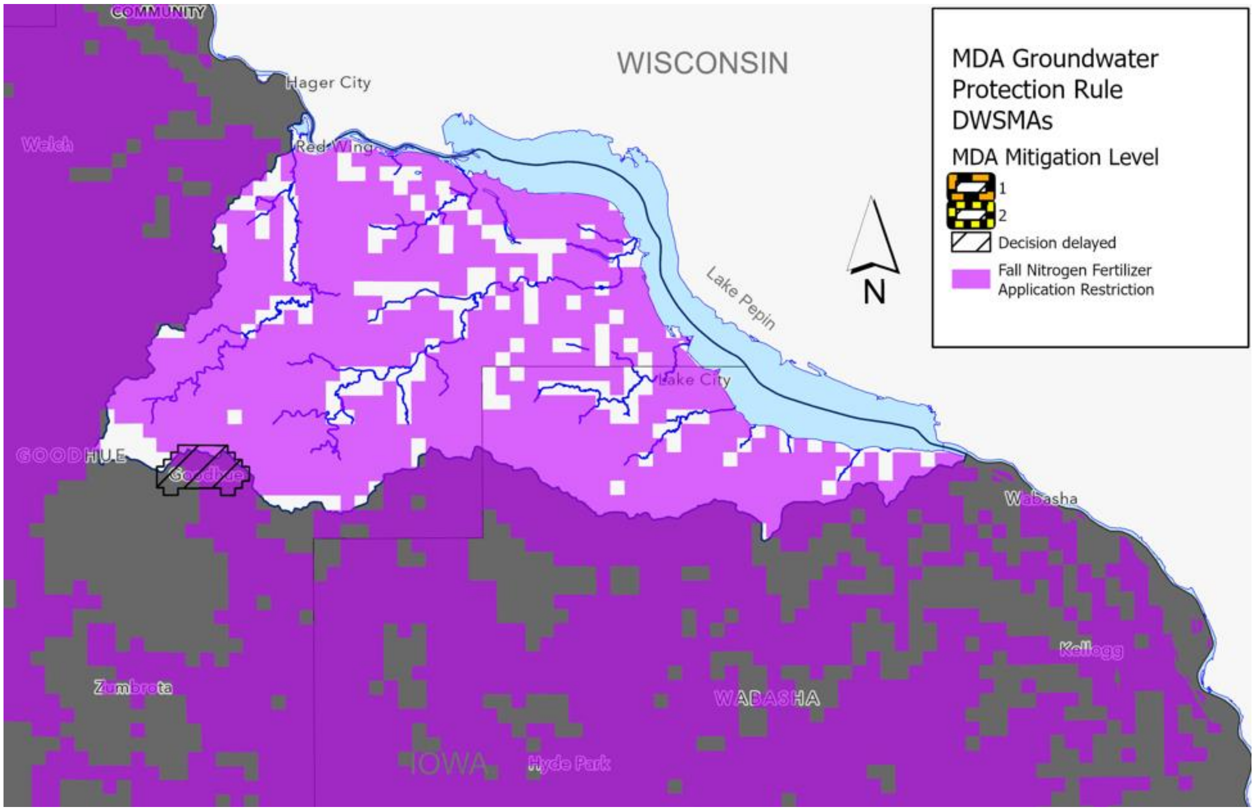
Part 1 of the rule restricts the application of nitrogen fertilizer in the fall and on frozen soils if located in one of the following areas:

- Vulnerable groundwater areas (coarse textured soils, shallow bedrock, or karst geology), a map of these areas is released annually in January.
- Protection areas around a municipal public well (DWSMA), with high nitrate.

Part 2 of the rule applies to DWSMAs, which already have elevated nitrate. The goal is to take action to reduce nitrate in groundwater before a public well exceeds the health standard for nitrate. The rule is structured using a sliding scale of voluntary and regulatory actions based on the concentration of nitrate in the well and the use of the BMPs. The MDA will form a local advisory team with farmers, agronomists, and other community members. This team will be involved in reviewing, considering, and advising the MDA on appropriate practices or requirements to reduce nitrate in the DWSMA.

Nearly all of the MRLPT Watershed falls within the current zone of restricted fall application of nitrogen fertilizer. Additionally, a small portion of the watershed is within the Goodhue DWSMA. The Goodhue DWSMA has elevated nitrate and MDA is investigating to determine agricultural impacts to soil and groundwater (MDA).

Figure 24. MDA Groundwater Protection Rule Fall Nitrogen Fertilizer Restriction areas and DWSMAs.



More information on MDA's Groundwater Protection Rule can be found at: https://www.mda.state.mn.us/nfr

While the MDA is investigating the Goodhue DWSMA, the City of Goodhue and Goodhue SWCD received state funding to help landowners who farm within the DWSMA adopt conservation practices that help slow the leaching of nitrogen to the drinking water supply. Funding was received in January of 2023 and meetings were held to discuss how landowners, local government units, and private companies like Ag Partners of Goodhue could help address the rising nitrate concentration in the city's water supply. Since March of 2023, these landowners have taken massive efforts to not only reduce the nitrogen leaching to the groundwater, but also to improve soil health. They have enrolled more than 1,000 acres into the cost share program which incentivizes cover crops, reduced tillage, and perennial crops along with secondary practices like the use of nitrogen inhibitors, split nitrogen application, planting green, and low disturbance manure application (Goodhue SWCD). Seventy-six percent of row crop acres in the DWMSA are enrolled in the program to protect the city of Goodhue's drinking water. More information is available on Goodhue SWCD's webpage.

3.4 Climate protection co-benefit of strategies

Many agricultural BMPs, which 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, other tree and shrub establishment, and shelterbelt establishment. Practices with a medium-high potential to mitigate GHG emissions include: contour buffer strips, riparian forest buffers, vegetative buffers and shelterbelt renovation. A longer, more detailed assessment of cropland BMP effects on GHG emission can be found at NRCS, *et al*., "COMET-Planner: Carbon and Greenhouse Gas Evaluation for NRDC Conservation Practice Planning.

3.5 Public participation

In the early 1990s, Wells Creek was selected by the DNR as a test site for comprehensive watershed planning. At the time, DNR's newly adopted ecosystem-based management initiative included outreach programs with citizens and local units of government, one product of that outreach was the formation of the Wells Creek Watershed Partnership (WCWP). The formation of the WCWP brought together local citizens and natural resource professionals as a prototype watershed management effort to share ideas and information, and to develop a vision for the future of the watershed. Several events were held to inform the community about Wells Creek, quarterly newsletters were sent to all watershed residents, surveys were conducted, and a volunteer monitoring network was developed by the WCWP.

Figure 25. Wells Creek Watershed annual picnic fish shocking demonstration.

Since the formation of WCWP in the 1990s, an annual meeting and picnic has been held every year for residents in the watershed. These gatherings regularly draw up to 100 residents to share and learn about Wells Creek. DNR staff provide a fish electro-fishing demonstration and other staff share information about available programs and data.

The WCWP and watershed residents have been included throughout the process of applying for the now received 319 Small Watershed Focus grant. Presentations have been made at three WCWP annual meetings, and an information meeting was held in the spring of 2023. The Goodhue SWCD has also repeated one of the early WCWP surveys, asking residents about the current and desired condition of Wells Creek. The WCWP will be an important companion in the implementation of the 319 grant, pursuant of the same goals present in this report. The Wells Creek 319 workplan includes several outreach activities: watershed tours, field day events, workshops, and more.

Figure 26. Wells Creek Watershed annual picnic sharing information.

Throughout 2020, as IWM data were reviewed and analyzed, a series of articles were published by Lake Pepin Legacy Alliance to communicate the history and monitoring results of the watershed.

Water protection efforts proceed in Miller Creek, even as E. coli situation baffles 03/05/2020

Gilbert Creek: now proposed as exceptional water body 05/28/2020

Wells Creek: a dynamic stream with many trout, but rising sediment concerns 08/05/2020

Bullard Creek: Upland water storage limits erosion, but its sediment still impacts Wacouta Bay 09/14/2020

Hay Creek: Restoration efforts have made it a top-level trout stream 12/07/2020

4. Monitoring

The Watershed Pollutant Load Monitoring Network (WPLMN) is a partnership including state and federal agencies, Metropolitan Council Environmental Services, state universities, and local partners across Minnesota. Since 2007, the network of partners has collected data to understand long-term trends and observe changes over time. The network collects 18 to 25 samples per season from 200 sites. There is one WPLMN site in the MRLPT Watershed on Wells Creek. The site is located near Frontenac on U.S. Highway 61. Discharge, water temperature, turbidity, and dissolved oxygen are collected at this site continuously and instantaneous grab samples are collected for key pollutants including suspended solids, nitrates, and phosphorus. These data are used to calculate the pollutant load, the amount of pollutant that passes a monitoring station over a period of time. Visit the WPLMN webpage for more information and data from the Wells Creek station is available at the MN Cooperative Stream Gauging webpage.

In addition to continued monitoring at the Wells Creek WPLMN site, Goodhue SWCD will be installing additional monitoring stations upstream on Wells Creek through the 319 Small Watershed Focus Grant program discussed in Section 3.1. These stations will be similar to the WPLMN site and will be critical in further understanding the sediment dynamics of this watershed and the influence of the implementation of recommended BMPs.

A long-term demonstration project has been established in this watershed to measure the effects of cover crops on subsurface nitrate loss under a range of conditions. The study field is located five miles west of the city of Goodhue. Water from this field flows toward Hay Creek, a high value trout stream. In May 2023, monitoring equipment was installed on two plots, each approximately 10 acres. Instrumentation at each plot includes tile drainage control structures with v-notch weir, tile stage (water height) sensor to calculate water flow through the v-notch weir, water temperature, continuous nitrate sensors, and soil temperature and moisture at 6-inch and 24-inch depths. In addition, the east plot has a weather station that measures total rainfall, wind direction and speed, air temperature, humidity, and solar radiation. Project partners include Ed and Jane McNamara, Goodhue SWCD, AgPartners in Goodhue, MDA, and MPCA. Provisional data is served in near real time to the project dashboard.

Goodhue SWCD will also be promoting the volunteer water monitoring program to increase the number of people collecting regular clarity, temperature, and observations of stream conditions throughout the watershed. More information is available on the Volunteer Water Monitoring program webpage.

Continued monitoring of temperature, biologic communities, and pollutants is necessary to understand and protect this dynamic, cold-water watershed.

Public notice for comments

Providing an opportunity for public comment is an important part of the MPCA's watershed work and public expectations. An opportunity for public comment on the draft WRAPS report was provided via a public notice in the *State Register* from September 3, 2024, through October 3, 2024. There were two comments received and responded to as a result of the public comment.

5. References and further information

Barr, 2021, Comprehensive Watershed Management Plan: 2022-2031 Prepared for the Watershed Alliance for the Greater Zumbro, https://www.olmstedcounty.gov/sites/default/files/2021-12/Zumbro_CWMP_Final_11242021.pdf

Baxter-Potter, W, and M. Gilliland. 1988 "Bacterial Pollution in Runoff from Agricultural Lands," J. Environmental Quality, 17(1): 27-34

Bureau of Land Management General Land Office records, https://glorecords.blm.gov/search/default.aspx

Bureau of American Ethnology, 1895, Annual report of American Ethnology to the Secretary of the Smithsonian Institution, https://archive.org/details/annualreportofbu218smit/page/726/mode/2up?view=theater

DNR, 2019, Climate Summary for Watersheds Mississippi River – Lake Pepin, https://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/climate_summary_major_38.pdf

DNR, 2021, Wells Creek Watershed Assessment of River Stability and Sediment Supply (WARSSS)

DNR, 2022, Wells Creek Watershed Sediment Reduction Strategies

Gebert, W.A., Krug, W.R., 1996. Streamflow trends in Wisconsin's driftless area. Water Resources Bulletin 32: 733-744.

Goodhue SWCD, City of Goodhue's Drinking Water Supply Management Area (DWSMA) Project, https://www.goodhueswcd.org/goodhue-dwsma

Hoffman, D., personal communication, January 4, 2024.

H.R. Rep. No.138, 33d Cong., 1st Sess., 1854, Sioux lands of reservation in Minnesota Territory, https://digitalcommons.law.ou.edu/cgi/viewcontent.cgi?article=2104&context=indianserialset

Hoxmeier, R.J.H., Dieterman, D.J., 2019, Natural replacement of invasive brown trout by brook charr in an upper Midwestern United States stream. *Hydrobiologia* 843, 309-317. https://doi.org/10.1007/s10750-019-3912-0

Johnson, F.L., 2022, "Half-Breed" Tract, https://www.mnopedia.org/place/half-breed-tract

Juckem, P.F., Hunt, R.J., Anderson, M.P., Robertson, D.M., 2008. Effects of climate and land management change on streamflow in the driftless area of Wisconsin. Journal of Hydrology 355: 123-130.

Kjelland, M.E., Woodley, C.M., Swannack, T.M. A review of the potential effects of suspended sediment on fishes: potential dredging-related physiological, behavioral, and transgenerational implications. *Environ Syst Decis* **35**, 334–350 (2015). https://doi.org/10.1007/s10669-015-9557-2

Lake City Historical Society, Half-Breed Tract- A Reservation Created by Treaty in 1830, https://www.lakecityhistoricalsociety.org/half-breed-tract.html

Lenhart, C.F., Peterson, H., Nieber, J., 2011. Increased streamflow in agricultural watersheds of the Midwest: implications for management. Watershed Science Bulletin, spring 2011: 25-31.

LimnoTech Inc. 2013. Representation of Sediment Sources and Dynamics for the Zumbro River Watershed HSPF Model. Technical memorandum

MDA, Groundwater Protection Rule, https://www.mda.state.mn.us/nfr

MDA, Goodhue Paired Cover Crop Demonstration dashboard, https://mda.onerain.com/dashboard/?dashboard=80ad9a04-fd98-462f-8201-852185c49725

MPCA, Minimizing fish kills in Minnesota, https://www.pca.state.mn.us/business-with-us/minimizing-fish-kills-in-minnesota

MPCA, Nitrogen, https://www.pca.state.mn.us/pollutants-and-contaminants/nitrogen

MPCA, 1999 Fecal Coliform Bacteria in Rivers.

MPCA, 2006, Revised Regional Total Maximum Daily Load Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota, wq-iw9-02e

MPCA, 2012, Mississippi River Lake Pepin Watershed Monitoring and Assessment Report, wq-ws3-07040001b

MPCA, 2013a, Mississippi River-Lake Pepin Tributaries Biotic Stressor Identification, wq-ws3-07040001d

MPCA, 2013b, Nitrogen in Minnesota Surface Waters, wq-s6-26a

MPCA, 2015, Mississippi River Lake Pepin Watershed Restoration and Protection Strategy Report, wq-iw9-15n

MPCA, 2015b, Mississippi River – Lake Pepin Tributaries Total Maximum Daily Loads, wq-iw9-15e

MPCA, 2020a, Mississippi River – Lake Pepin Stressor Identification Report (Cycle 2), wq-ws5-07040001a

MPCA, 2020, Five-year progress report on Minnesota's Nutrient Reduction Strategy, wq-s1-84a.

MPCA, 2021, Watershed assessment and trends update Mississippi River – Lake Pepin Watershed

MPCA, Healthier watersheds: Tracking the actions taken – Best management practices implemented by watershed. Online https://www.pca.state.mn.us/water/best-management-practices-implemented-watershed

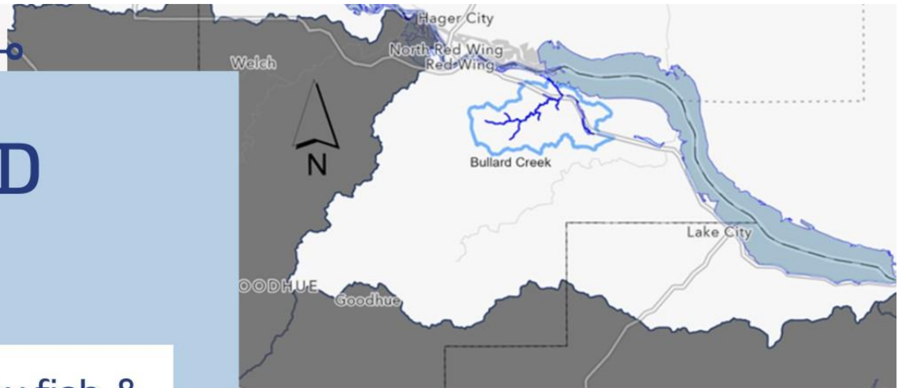
MPCA, 2022, Watershed Pollutant Load Reduction Calculator, https://public.tableau.com/app/profile/mpca.data.services/viz/WatershedPollutantLoadReductionCalculator/WatershedPollutantLoadReductionCalculator

Prairie Island Indian Community, https://prairieisland.org/

Zhi, S et.al., 2016 Evidence of Naturalized Stress-Tolerant Strains of *E. coli* in municipal wastewater treatment plants. DOI: 10.1128/AEM.00143-16.

6. Appendix: Subwatershed factsheets

The following factsheets are provided to summarize data in the five main subwatersheds: Bullard, Gilbert, Hay, Miller, and Wells Creeks. The factsheets cover significant findings of the most recent assessment period, with a focus on suspended sediment and biology. Also covered is a summary of BMPs landowners have voluntarilty implemented to protect and improve their land and waters of the state.



BULLARD CREEK

Protect healthy fish & aquatic insect communities

Suspended sediment concentrations in Bullard Creek are often above the 10 mg/L standard. Fish and aquatic insect communities are healthy, with increased community scores in the latest sampling, as well as increased brook trout density.

Between 2010 and 2023, landowners in Bullard Creek watershed voluntarily implemented a large number of best management practices (BMPs) leading to an estimated sediment reduction of 28 tons/year.

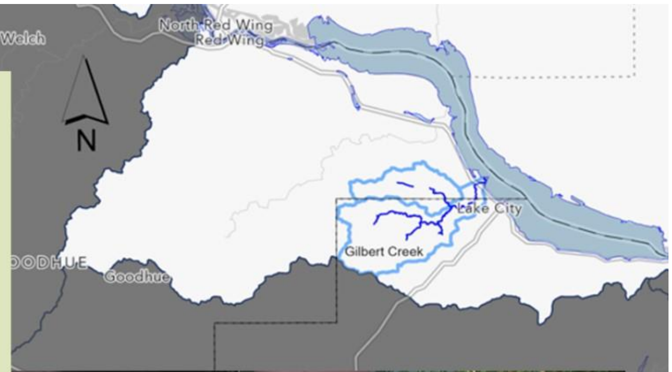
BMPs include:

- Grassed waterways
- Water & Sediment Control Basins
- Terraces
- Grade Stabilization Structures
- Streambank protection & habitat improvement
- Cover Crops
- Reduce & No Till
- Critical area plantings
- Many more!

Continued maintenance and implementation of BMPs will further improve Bullard Creek and support fish and aquatic insects there, as well as improve downstream waters like Lake Pepin and the Mississippi River

An estimated 2 dump trucks of sediment are kept out of Bullard Creek each year because of the practices installed by local landowners!

GILBERT CREEK



REMOVED FROM IMPAIRED WATERS LIST

Conditions in Gilbert Creek improved and section designated exceptional

Originally placed on the Impaired Waters List in 2011 because of struggling fish communities.

New, more comprehensive data shows both fish and aquatic insect community scores have improved since 2010, and brook trout densities have increased indicating improvements in water quality and/or habitat conditions.

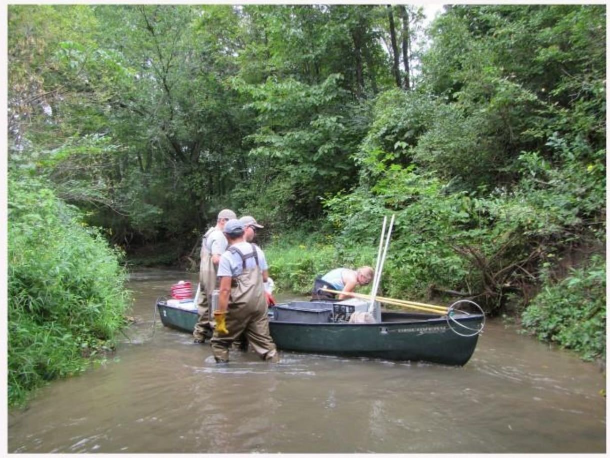
Additionally, in 2022, an exceptional aquatic life use designation was proposed for the upstream section of Gilbert Creek. This designation hold the waterbody to a higher standard and helps to protect the fish and aquatic insect communities in the future.

Several lines of evidence are considered to determine aquatic life uses, including biological and habitat conditions. Both fish and aquatic insect communities must meet the criteria to be eligible for exceptional use.

GILBERT CREEK

RESTORATION & PROTECTION

Landowners are the key to restoration & protection of Gilbert Creek



Between 2010 and 2023, landowners in Gilbert Creek watershed voluntarily implemented a large number of best management practices (BMPs), leading to an estimated sediment reduction of 51 tons/year. This equates to roughly 3 dump trucks of sediment being kept out of Gilbert Creek each year.

BMPs include:

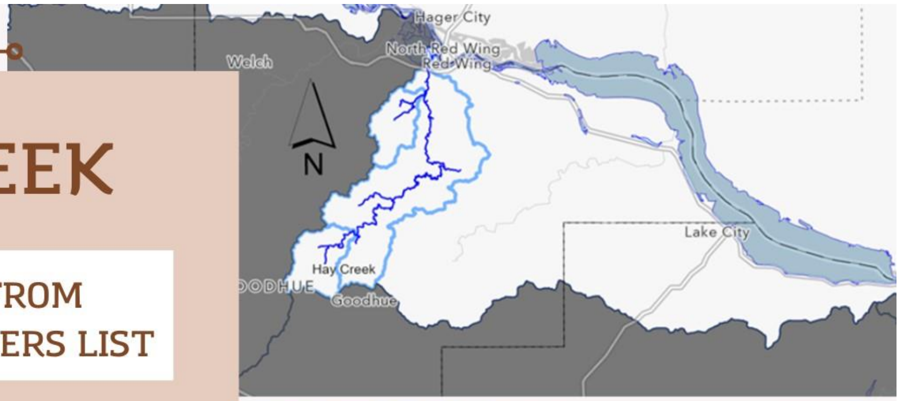
- Grassed waterways
- Water & Sediment Control Basins
- Terraces
- Grade Stabilization Structures
- Streambank protection & habitat improvement
- Cover Crops
- Reduce & No Till
- Critical area plantings
- Many more!

Continued maintenance and implementation of BMPs will further improve Gilbert Creek and support fish and aquatic insects there, as well as improve downstream waters like Lake Pepin and the Mississippi River

An estimated 3 dump trucks of sediment are kept out of Gilbert Creek each year because of the practices installed by local landowners!

HAY CREEK

REMOVED FROM IMPAIRED WATERS LIST



Conditions in Hay Creek improved enough to remove it from the Impaired Waters List

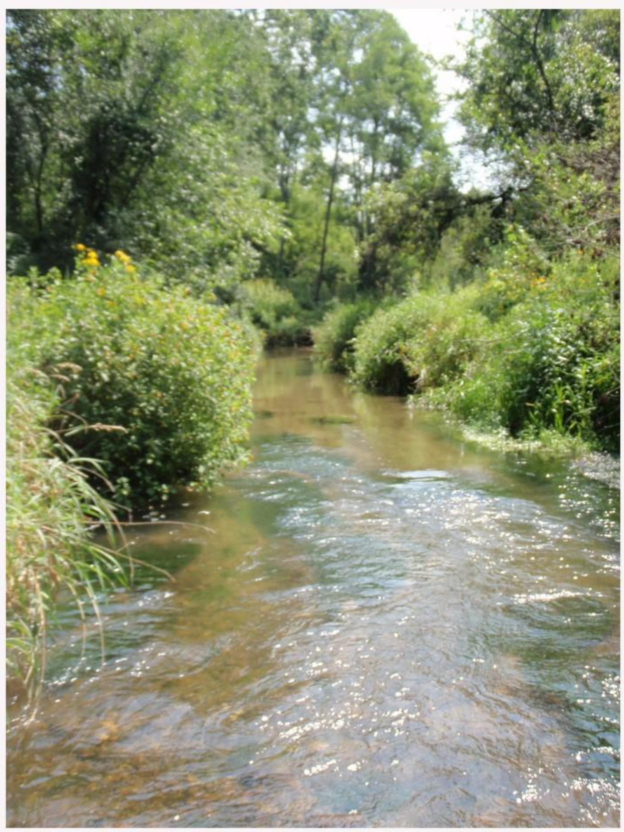
Originally placed on the Impaired Waters List in 2008 for excessive suspended sediment.

New, more comprehensive data shows suspended sediment has declined and fish and aquatic insect communities are very healthy.

One monitoring station produced over 400 brown trout that were captured, measured, and released in 2018.

Monitoring data shows a pattern of good water quality upstream, but higher suspended sediment in the lower portion of Hay Creek.

The Hay Creek Habitat Improvement Project was completed in 2023, resulting in more 12,000 feet of habitat improvement and restoration. Including grading high stream banks, reconnecting the stream to the floodplain, and habitat improvements for trout and non-game species.



HAY CREEK

RESTORATION & PROTECTION

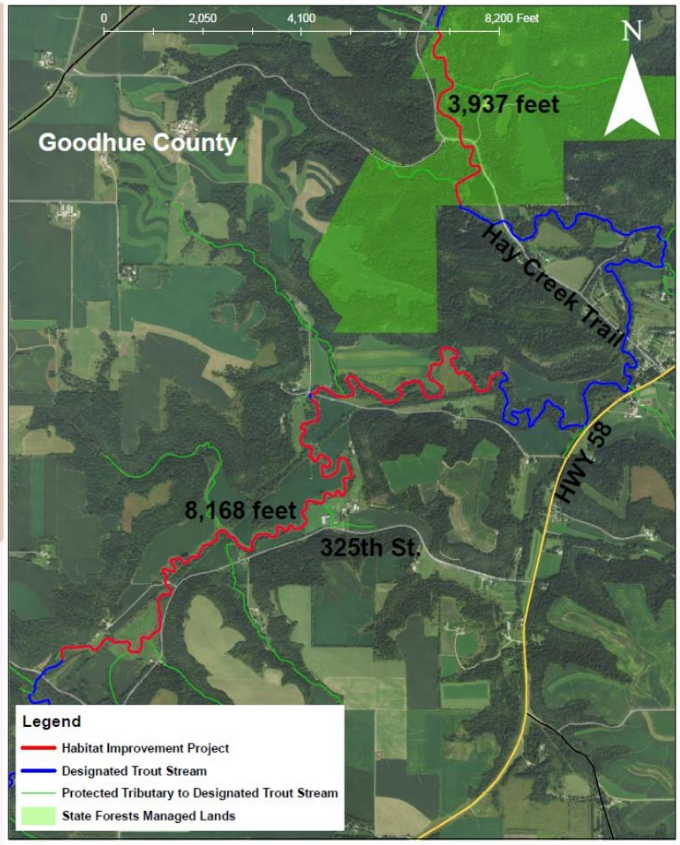
Landowners are the key to restoration & protection of Hay Creek

Between 2010 and 2023, landowners in Hay Creek watershed voluntarily implemented a large number of best management practices (BMPs), leading to an estimated sediment reduction of 20% or 140 tons/year.
This equates to roughly 9 dump trucks of sediment being kept out of Hay Creek each year.
BMPs include:

- Grassed waterways
- Water & Sediment Control Basins
- Terraces
- Grade Stabilization Structures
- Streambank protection & habitat improvement
- Cover Crops
- Reduce & No Till
- Critical area plantings
- Many more!

Continued maintenance and implementation of BMPs will further improve Hay Creek and support fish and aquatic insects there, as well as improve downstream waters like Lake Pepin and the Mississippi River

Hay Creek Habitat Improvement Projects



An estimated 9 dump trucks of sediment are kept out of Hay Creek each year because of the practices installed by local landowners!

MILLER CREEK

Protect healthy fish & aquatic insect communities

Suspended sediment concentrations in Miller Creek do exceed the 10 mg/L standard. Fish and aquatic insect communities are healthy, with increasing community scores in the latest sampling, as well as increased brook trout density.

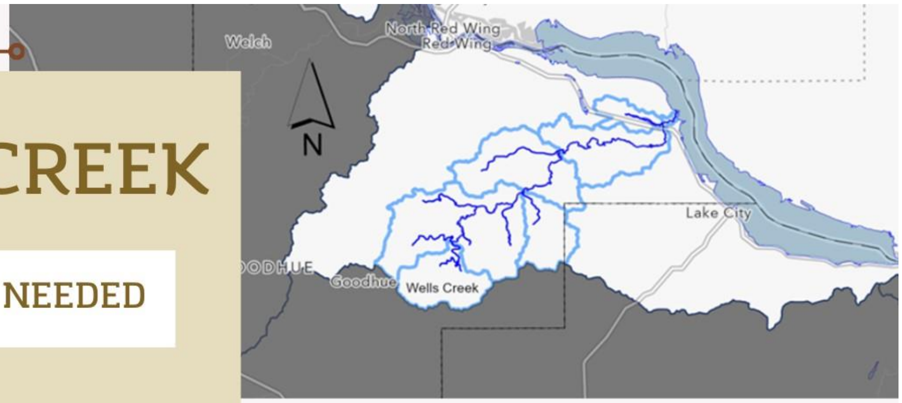
Between 2010 and 2023, landowners in Miller Creek watershed voluntarily implemented a large number of best management practices (BMPs) leading to an estimated sediment reduction of 28 tons/year in Miller Creek.

BMPs include:

- Grassed waterways
- Water & Sediment Control Basins
- Terraces
- Grade Stabilization Structures
- Streambank protection & habitat improvement
- Cover Crops
- Reduce & No Till
- Critical area plantings
- Many more!

Continued maintenance and implementation of BMPs will further improve Miller Creek and support fish and aquatic insects there, as well as improve downstream waters like Lake Pepin and the Mississippi River

An estimated 2 dump trucks of sediment are kept out of Miller Creek each year because of the practices installed by local landowners!



WELLS CREEK

RESTORATION NEEDED

Excess stream bank erosion & suspended sediment causing impairment

Despite soil conservation efforts and continued improvements in landscape sensitive farming techniques, water quality and habitat have fluctuated over time in Wells Creek. Most recently, MPCA's 2020 water quality assessments found healthy fish and aquatic insect communities, but suspended sediment concentrations regularly exceed the limit set to protect aquatic life.

Daily elevated suspended sediment concentrations coupled with a slight decrease in aquatic insect communities, resulted in the addition of Wells Creek to the 303(d) List of Impaired Waters.

Total Suspended Sediment (TSS) concentrations were found to exceed the standard in all seasons of all 10 years of data reviewed.

MPCA and DNR monitoring data show fish in Wells Creek are doing well, but aquatic insect data exhibits a decreasing trend since 2004. This may be a signal that the insect community is becoming stressed.

WELLS CREEK

RESTORATION & PROTECTION

Landowners are the key to restoration & protection of Wells Creek

Between 2010 and 2023, landowners in Wells Creek watershed voluntarily implemented a large number of best management practices (BMPs), leading to an estimated sediment reduction of 97.5 tons/year.
This equates to roughly 6.5 dump trucks of sediment being kept out of Wells Creek each year.
BMPs include:

- Grassed waterways
- Water & Sediment Control Basins
- Terraces
- Grade Stabilization Structures
- Streambank protection & habitat improvement
- Cover Crops
- Reduce & No Till
- Critical area plantings
- Many more!

Continued maintenance and implementation of BMPs will further improve Wells Creek and support fish and aquatic insects there, as well as improve downstream waters like Lake Pepin and the Mississippi River

An estimated 6.5 dump trucks of sediment are kept out of Wells Creek each year because of the practices installed by local landowners!