Watershed

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North Fork Crow River Watershed Restoration and Protection Strategy Report Update 2023

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

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Key terms and abbreviations

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

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

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

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

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

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

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

PTMApp (Prioritize, Target, Measure). Model used in 1W1P process to target implementation strategies.

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.

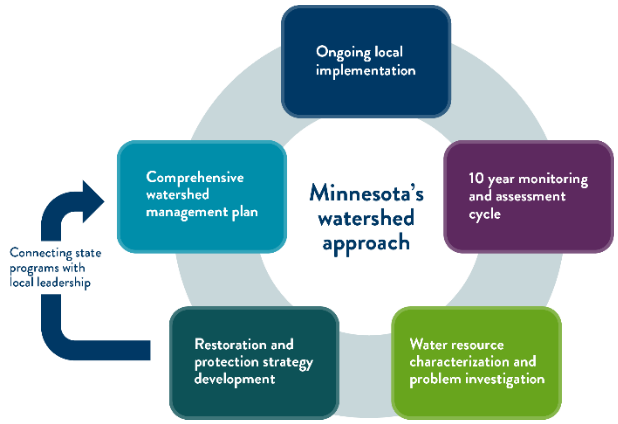
Source (or pollutant source): This term is distinguished from 'stressor' to mean only those actions, places or entities that deliver/discharge pollutants (e.g., sediment, phosphorus, nitrogen, pathogens).

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 (WLA) for point sources, a load allocation (LA) for nonpoint sources (NPS) and natural background, an allocation for future growth (i.e., reserve capacity [RC]), and a margin of safety (MOS) as defined in the Code of Federal Regulations.

Minnesota's Watershed Approach

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



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

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

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

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

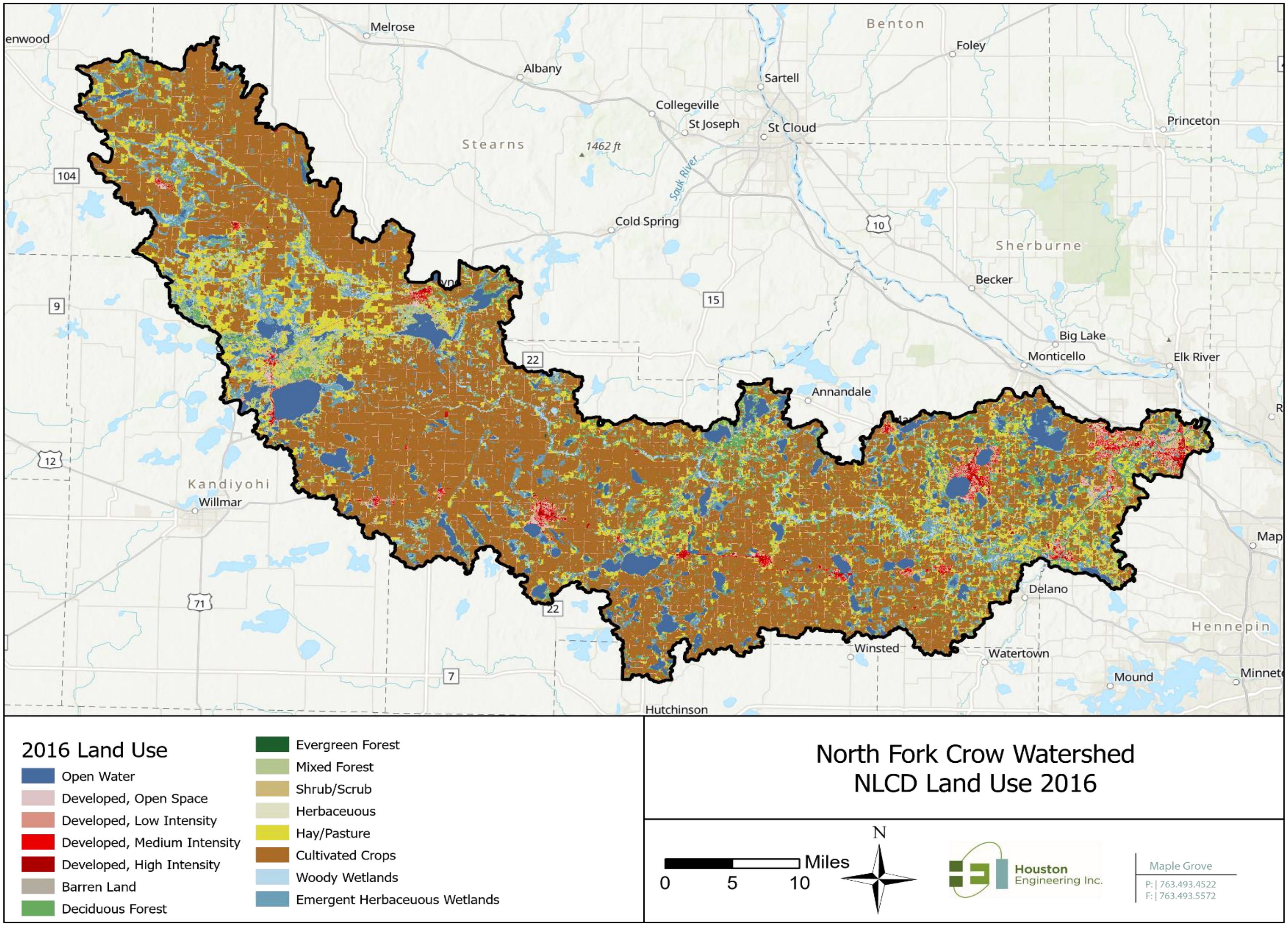
Minn. Stat. § 114D, also known as the Clean Water Legacy Act, sets out the policy framework for the Watershed Approach, including requiring the development and updating of WRAPS for all watersheds of the state. The Clean Water, Land and Legacy Amendment approved by Minnesota voters in 2008 directs dollars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

Executive summary

Setting

The North Fork Crow River Watershed (NFCRW), 8-digit Hydrologic Unit Code [HUC-8] 07010204, is located in south central Minnesota and covers approximately 950,000 acres. The NFCR travels east from Pope County to Wright County where it joins the Mississippi River via the Crow River.

Figure 1. The North Fork Crow River Watershed.



Key WRAPS Update findings

Water quality conditions

The MPCA initially began to evaluate the lakes and streams within the watershed in 2007-2008, and returned in 2017-2018 to re-evaluate these resources. The MPCA also maintains on-going pollutant load monitoring stations in the watershed. Statistical trend tests on total suspended solids (TSS), total phosphorus (TP), and nitrate N concentrations at the NFCRW outlet were used to determine if changes over time were statistically significant. Only TP showed a statistically significant change, decreasing about 4% each year. This difference could be due in part to the 2007 drought year where there were significantly reduced flows. Also, during this time period numerous best management practices (BMPs) were implemented to reduce impacts to the river and its tributaries.

Improving water quality conditions:

- Slight decrease in phosphorus
- More lakes improving in clarity than declining
- Overall improvement in biological health (both fish and invertebrate IBI) since 2007; SID shows most common stressors are poor habitat and low DO

Biological diversity has improved slightly in the watershed overall, both fish and bug populations in streams have shown an overall improvement. However, fish communities generally do not meet standards designed to protect aquatic life. While stream reaches and lakes in the upper portion of the watershed have fish communities that are in good condition, the majority of streams and lakes in the remainder of the watershed have fish communities that are severely degraded.

While some improvements were seen, overall water quality conditions in the watershed are still degraded and in need of improvement. The NFCRW is still a significant source of nutrients and sediment pollutants to the Mississippi River.

Strategy development

In order to advance water quality goals, the MPCA and partners determined that the approach of this WRAPS Update process would be to: focus on evaluating five smaller areas (roughly the size of HUC-12 subwatersheds) that are representative of larger areas of the watershed; develop lake protection reports and identify vulnerable waters; and compete additional TMDLs to help address impaired waters. Also, three subwatersheds have been selected in the past few years for participation in the Clean Water Act Section 319 implementation program as Focus Watersheds.

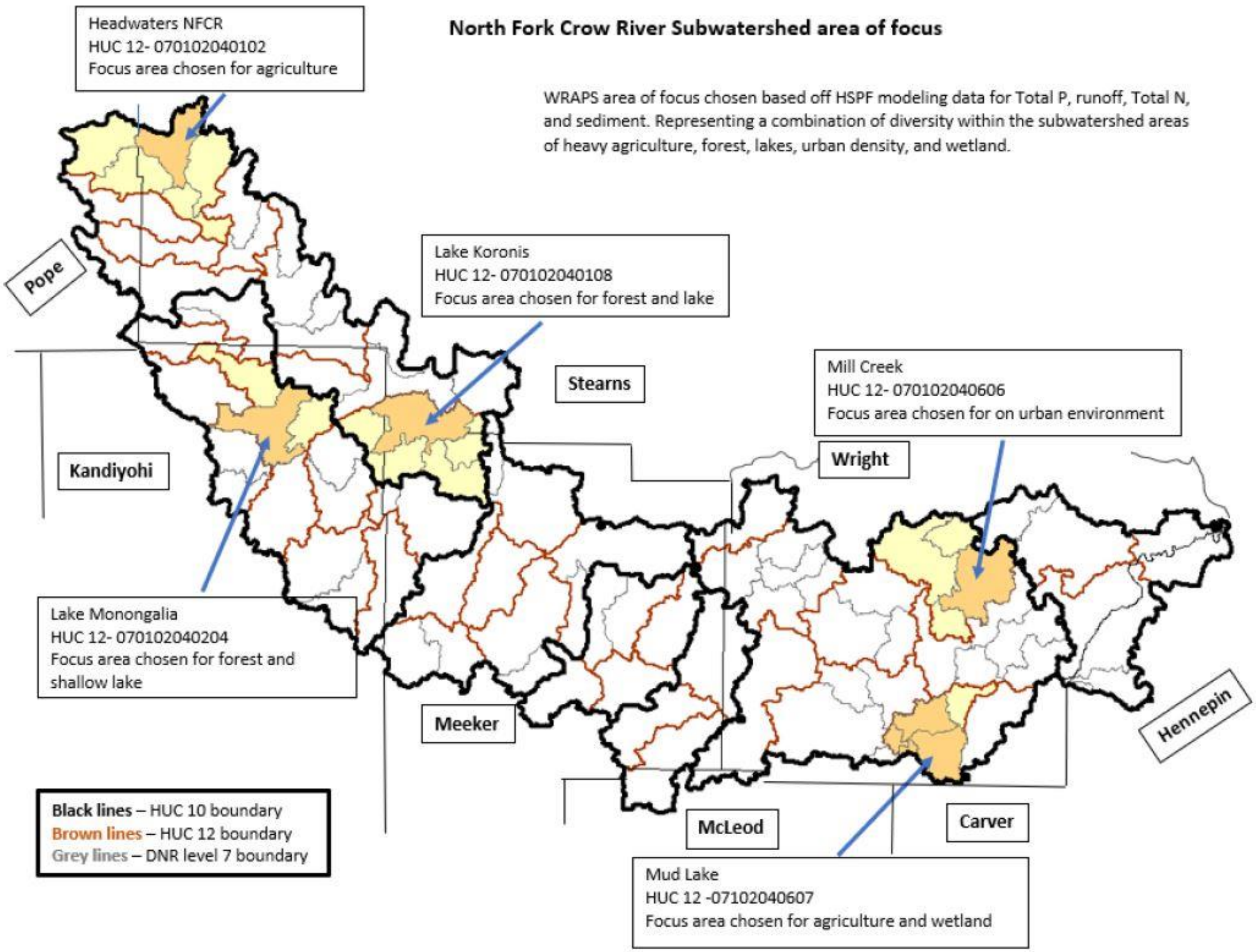
Strategies to help water quality:

- Evaluated 5 subwatersheds representative of different conditions in the watershed, determined BMP acceptability
- Developed protection strategy report for 5 high-priority lakes
- Identified 8 waters particularly vulnerable to becoming impaired, in need of vigilance
- Developed TMDLs for 16 impairments in 11 stream reaches and 4 impairments in 4 lakes

BMP subwatershed study areas

Understanding changes in water quality over time and the connection of improvements to BMPs implemented since the initial WRAPS is important to enable adaptive management. To better understand water quality and BMP effectiveness, the MPCA and Middle Fork Crow River Watershed District (MFCRWD) staff conducted analyses of five aggregated HUC-12 subwatersheds that were been identified as representative of larger areas of the watershed of similar land use, typography or land cover, including ones that are primarily agricultural (Headwaters NFCR), mostly forest and lake (Lake Koronis), primarily urban (Mill Creek), focused on forest, urban, and a shallow lake (Lake Monongalia), and characterized by an impaired wetland (Mud Lake). Developing a more detailed understanding of the characteristics of each of these will lead to a better understanding of how to address water quality concerns in similar areas across the NFCRW.

Figure 2. North Fork Crow River Watershed areas of focus.



The five chosen areas were examined through field visits, conversations with landowners, and desktop modeling reviews, and by looking at water quality data and aerial photographs. The examination was done to determine what types of water-quality concerns are specific to certain land use types, and what types of BMPs tend to work well, or tend not to work well under certain conditions, and why. Social conditions were also evaluated through the willingness or unwillingness to implement or maintain practices that contribute to water quality improvement or degradation.

Due to the COVID-19 pandemic, the plans that the core team originally made to do 10 to 12 field tours decreased to 3 tours, impacting our analyses. Nonetheless, the tours revealed a number of consistencies regarding the types of practices that are most acceptable to farmers and lakeshore owners, including alternative tile intakes, wood-chip bioreactors, water and sediment control basins (WASCOBs) for farmers, raingardens, grassed swales, and buffers for lakeshore owners. There is still hesitancy to implement many of the most effective practices such as cover crops and reduced tilling practices on agricultural lands, or replacing large heavily managed turfgrass lawns on lakeshore properties with native vegetation and water detention practices. Education and successful implementation by landowners will be important to change current practices and convince more people to adopt the more effective water quality improvement practices.

BMP implementation findings:

Adopted practices

- Alternative tile intakes
- Woodchip bioreactors
- Water and soil control basins
- Rain gardens and grass swales
- Buffers for lakeshore owners

More effective solutions to consider:

- Cover crops
- Reduced tilling
- Replace lakeshore turfgrass lawns with native vegetation

Protection strategies

In addition to the review of the subwatersheds, this WRAPS report includes a protection report for five high quality lakes (Grove, Koronis, Calhoun, Minnie-Belle, and Washington) that are not listed as impaired on the Minnesota 2020 impaired waters list. The protection report recommends commonly used BMPs that were suggested by local partners based on their knowledge of the lakeshed. The report calculated the potential nutrient reductions for each lake based on the selected BMPs, and found that the most commonly utilized practices could be effective in preventing the lakes from becoming impaired. Further, eight waters of particular concern, in need of protection, are highlighted in this report.

TMDLs

A body of water is considered "impaired" if it fails to meet one or more water quality standards. Minnesota water quality standards protect lakes, rivers, streams, and wetlands by defining how much of a pollutant can be in water before it is no longer drinkable, swimmable, fishable, or useable in other, designated ways, called "beneficial uses". TMDLs are created to set pollutant-reduction goals needed to restore impaired waters. In this WRAPS Update process, TMDLs were developed for 16 impairments in 11 stream reaches and 4 impairments in 4 lakes.

Impairments in the NFCRW for which TMDLs were completed in this WRAPS update process include:

- P and other nutrients that grow algae

- Sediment that clouds water and negatively affects fish and invertebrates/bugs
- Bacteria that can make water unsafe for swimming
- Chloride levels that are toxic for fish and aquatic bugs

Subwatershed implementation

Three subwatersheds of the 35 Clean Water Act Section 319 Small Watersheds Focus Program participants selected statewide are in this watershed, addressing water quality in Rice Lake, TwelveMile Creek, and Green Lake. This will provide additional funding for these small subwatersheds, focusing on comprehensive water quality restoration and protection. These subwatersheds were recently selected are in the early stages of project work at this time.

1. Watershed background and WRAPS Update process description

Watershed background

The NFCRW is located in the Upper Mississippi River Basin and includes parts of the eight counties of Wright, Meeker, Kandiyohi, Stearns, Pope, Hennepin, McLeod, and Carver. The watershed is approximately 1,485 square miles, or 950,000 acres, and is predominantly in the North Central Hardwood Forests ecoregion with a very small portion crossing into the Western Corn Belt Plains ecoregion. Although land use in the watershed is primarily comprised of agriculture/crop land, there are also areas of forests, residential and commercial development, and many wetlands, and lakes. There are 31 municipalities located completely or partially within the boundaries of the NFCRW; some of the largest cities include Buffalo (2018 population 16,355), Litchfield (2019 population 6,631), St. Michael (2018 population 17,128), and Rockford (2017 population 4,488). The NFCR flows from its western headwaters to its confluence with the South Fork Crow River (SFCR) near Rockford, before joining the Mississippi near Dayton.

The MPCA 2015 NFCRW WRAPS Report states, “From the perspective of the Upper Mississippi River Basin, the NFCR is one of its major tributaries from a water and nutrient loading standpoint. On average, discharges from the NFCR, dependent on flow, account for up to 46% of the P and up to 53% of the sediment in the Mississippi.”

Since settlement began, the NFCRW has seen the following shifts in land uses:

- an increase from 13% to 73% for crops/pasture;
- a decrease from 48% to 10% for forest/shrub; and
- an increase from 4% to 6% for developed land.

This shift is directly tied to altered hydrology within the watershed and its related impacts. The term “altered hydrology” describes the landscape and watercourse changes associated with surface water runoff (decreased wetlands and forest, increased impervious surfaces, tiling and ditching). Excess surface water runoff leads to flood damages, accelerated bank erosion and stream channel movement, increased sediment movement, and the loss of aquatic habitat. Excess surface runoff can also lead to road overtopping and washouts, and damage to land and buildings.

Additionally, according to the 1W1P 2018 comprehensive local water plan, 40% of the cropland acres in the NFCRW consists of land exceeding Sediment and Phosphorus Vulnerability Criteria, meaning the amount of sediment and P leaving fields is high relative to the rest of the watershed. In addition, according to the North Fork Crow River Comprehensive Watershed Plan, over 40% of the watershed likely does not meet rural stewardship standards developed by the planning partnership. The criteria are determined using sediment/P delivery and loss rates to surface waters from Prioritize, Target and Measure Application (PTMApp), nutrient management principles from the 4R (Right Source, Right Rate, Right Time, Right Place) approach, nutrient stewardship certification, soil health as defined by acres subject to no-till, ridge till, and mulch-till, manure management, pesticide application, and irrigation.

WRAPS Update process

The first WRAPS cycle for the NFCRW began with water quality monitoring in 2007-2008 and was completed with the NFCR WRAPS in 2015. The WRAPS included assessments and stressors for a number of water bodies in the watershed, TMDLs, HSPF model outputs, and strategies recommended to achieve reductions for various pollutants in the watershed.

In 2018, stakeholders and agencies working in the NFCRW completed the NFCR 1W1P comprehensive local water plan. The process and plan created prioritized and targeted implementation strategies that would result in measurable water resource improvements in the watershed. In some areas of the watershed, the types and numbers of BMPs were estimated to achieve specified reduction goals. A pilot project for the 1W1P process, partners and stakeholders spent nearly three years developing the 1W1P, and as the 1W1P development was ending, the WRAPS update process that would create this report was just beginning.

The WRAPS Update process discussion centered around how to make the WRAPS a useful product that would inform the ongoing 1W1P process. Stakeholders felt it was important to eliminate redundancy and maximize the development of useful data while staying within the limits of funding and staff resources.

To that end, as a key part of the WRAPS process, partners in the NFCRW created a SharePoint site to organize efforts throughout the watershed. The SharePoint contains calendars, descriptions, and evaluations of all civic engagement activities in the NFCRW, maps and descriptions of installed BMPs, photos, continual data input from the partners on implemented practices, erosion sites, community outreach activities, progress on 1W1P, and virtually any other information gathered on water quality in the watershed. Moving forward, this SharePoint will function as the storehouse for data that will serve to inform future WRAPS and 1W1P processes and help to streamline future water quality related efforts.

A major goal for this WRAPS update is to fill some data gaps that have been identified in the 1W1P process, and to inform future 1W1P activities. As a key activity to help accomplish this, the MPCA and MFCRWD staff conducted analyses of five aggregated HUC-12 subwatersheds that have been identified as representative of larger areas of the watershed. This strategy was chosen to try and get a closer look at what types of water-quality concerns are specific to certain land use types, what types of BMPs tend to work well, or tend not to work well under certain conditions, and why. Additionally, staff looked to discover what social conditions contribute to water quality improvement or degradation, or a willingness or unwillingness to implement or maintain practices intended to address degradation of water quality. The five subwatersheds are discussed further in the Restoration and Protection Strategies section of this document.

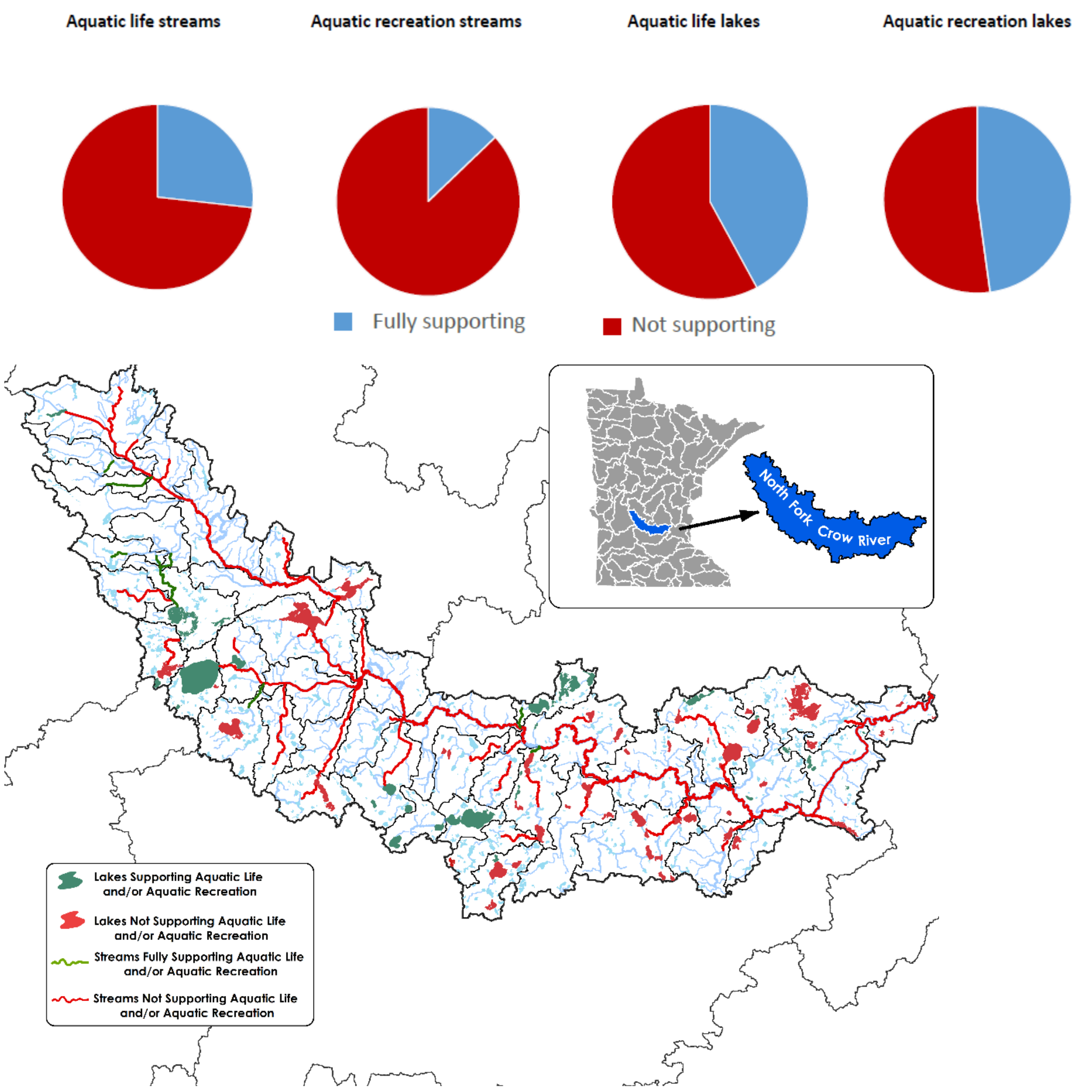
This WRAPS Update also included assessing changes in watershed conditions and water quality since the initial WRAPS report, developing protection strategies for five lakes, identifying eight vulnerable waters of importance to the watershed, and completion of 20 additional TMDLs.

2. Watershed conditions and analyses

2.1 Water body assessment results

The MPCA and local partners monitored water quality conditions in 2007 and 2008 and again 10 years later in 2017 and 2018. Additional chemistry data collected by local partners between 2008 and 2017 were also used for assessment. These data are used to assess the condition of Minnesota water bodies, which is focused on whether or not water bodies are meeting water chemistry, aquatic life, recreation, and consumption standards. While some improvements were seen, most waters in the NFCRW are not supporting aquatic life and aquatic recreation.

Figure 3. Water body assessment results.



Stream Assessments

The following two tables indicate the 2019 assessment status for stream reaches in the NFCRW. Table 1 is for more natural watercourses, while Table 2 is specific to channelized streams.

Table 1. Assessment status of stream reaches in the NFCRW, presented (mostly) from west to east (MPCA 2019).

	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Phosphorus
07010204-504, Crow River, North Fork, Lk Koronis to M Fk Crow R	EXS	MTS	IC	MTS	MTS
07010204-553, Unnamed creek (County Ditch 4), Unnamed cr to Lk Koronis	EXS	MTS	IC	IC	EXS
07010204-576, County Ditch 5, Unnamed cr to N Fk Crow R			IC	MTS	IC
07010204-578, County Ditch 32, Unnamed ditch to N Fk Crow R			NA	IC	EXS
07010204-579, Sedan Brook, CD 36 to N Fk Crow R			NA	IF	IF
07010204-580, County Ditch 7, Unnamed ditch to N Fk Crow R	IC		IC	IC	EXS
07010204-581, County Ditch 7 (County Ditch 37), Unnamed ditch to N Fk Crow R	MTS	MTS	IC	MTS	MTS
07010204-582, Judicial Ditch 1, Unnamed ditch to Grove Lk			NA	MTS	MTS
07010204-584, Judicial Ditch 1, Unnamed ditch to N Fk Crow R			IF	NA	
07010204-584, Judicial Ditch 1, Unnamed ditch to N Fk Crow R	MTS	MTS	MTS	IC	EXS
07010204-687, Crow River, North Fork, Rice Lk to Lk Koronis			NA	NA	NA
07010204-698, Unnamed creek, Headwaters to Sedan Bk			NA		NA
07010204-699, Unnamed creek, Headwaters to Sedan Bk			IF		IF
07010204-700, County Ditch 36, CD 38 to Sedan Bk	MTS		IF	IF	IF
07010204-717, Unnamed creek, Headwaters to Rice Lk				NA	NA
07010204-511, Crow River, Middle Fork, Green Lk to N Fk Crow R	EXS	MTS	MTS	IC	MTS
07010204-532, County Ditch 47, Headwaters to M Fk Crow R	EXS	MTS	IF	IF	IF
07010204-536, County Ditch 37, Unnamed cr to M Fk Crow R	EXS	MTS	IF	IF	MTS
07010204-537, Crow River, Middle Fork, Headwaters to Monongalia (Mud) Lk			NA	MTS	MTS
07010204-539, Crow River, Middle Fork, Monongalia (Mud) Lk to Nest Lk	EXS	MTS	IC	MTS	MTS
07010204-541, Crow River, Middle Fork, Nest Lk to Green Lk			NA	NA	NA
07010204-569, County Ditch 26, Unnamed ditch to Lk Calhoun			IF	IF	IF
07010204-577, County Ditch B6, Unnamed cr to M Fk Crow R	MTS	MTS	IF		
07010204-589, Unnamed creek, Unnamed cr to Diamond Lk			NA	NA	NA
07010204-590, Unnamed creek, Diamond Lk to CD 28			EXS	EXS	IF
07010204-600, Unnamed creek, Unnamed ditch to M Fk Crow R	MTS	NA	IF	IF	IF
07010204-652, County Ditch 26, Unnamed ditch to Unnamed ditch	EXS		IF	IF	IF
07010204-672, Unnamed creek, Headwaters to Wheeler Lk			NA	NA	NA
07010204-673, Unnamed creek, Headwaters to Green Lk				NA	NA
07010204-704, Unnamed creek, Headwaters to Unnamed cr			IF	IC	MTS
07010204-711, Unnamed creek, Schultz Lk to Wheeler Lk			NA	NA	NA

	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Phosphorus
07010204-722, Unnamed creek, Headwaters (Unnamed lk 34-0046-00) to Diamond Lk			NA	NA	
07010204-723, Unnamed creek, Hubbard Lk to Diamond Lk			NA	NA	NA
07010204-724, Unnamed creek (Alvig Slough), Unnamed lk (34-0113-00) to Green Lk			NA	NA	NA
07010204-506, Crow River, North Fork, Jewitts Cr to Washington Cr	MTS	MTS	IF	EXS	IC
07010204-507, Crow River, North Fork, M Fk Crow R to Jewitts Cr	MTS	MTS	IF	IC	IC
07010204-535, Unnamed creek, Town Slough to Grove Cr					
07010204-548, Unnamed creek, Unnamed cr to Unnamed cr					
07010204-572, Stag Brook, Headwaters (Unnamed lk 73-0153-00) to N Fk Crow R	EXS		IF	IF	IF
07010204-585, Jewitts Creek (County Ditch 19, 18, and 17), Headwaters (Lk Ripley 47-0134-00) to N Fk Crow R	MTS	EXS	EXS	MTS	EXS
07010204-614, County Ditch 19, Chicken Lk to Jewitts Cr					
07010204-642, Grove Creek, Unnamed cr to Unnamed cr	EXS	EXS	IF	IF	IF
07010204-643, County Ditch 26, Unnamed lk to Long Lk				NA	
07010204-643, County Ditch 26, Unnamed lk to Long Lk	EXS	EXS	IF	IF	IF
07010204-696, Unnamed creek, Long Lk to Unnamed cr	EXS	EXS	IF	IF	IF
07010204-706, Unnamed creek, Unnamed cr to Grove Cr			IF		IF
07010204-748, Grove Creek, Unnamed cr to T120 R32W S36, north line	EXS	MTS	IF	IF	IF
07010204-749, Grove Creek, T120 R32W S25, south line to N Fk Crow R	EXS	MTS	EXS	EXS	IF
07010204-757, Unnamed creek (Battle Creek), T120 R31W S32, south line to -94.542 45.203			IF	IF	IF
07010204-758, Unnamed creek (Battle Creek), -94.542 45.203 to Jewitts Cr	EXS	EXS	IF	IF	IF
07010204-554, Sucker Creek, Unnamed cr to Lk Manuella		NA	NA		NA
07010204-669, Lake Minnie Belle Outlet, Lk Minnie Belle to T118 R31W S12, east line					IF
07010204-728, Unnamed creek, Headwaters to Lk Minnebelle					IF
07010204-750, Washington Creek (County Ditch 9), Washington Lk to -94.342 45.108			IF		
07010204-751, Washington Creek (County Ditch 9), -94.342 45.108 to -94.314 45.146	MTS	EXS	IF	IF	IF
07010204-752, Washington Creek (County Ditch 9), to -94.314 45.146 to CD 36					

	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Phosphorus
07010204-753, Washington Creek (County Ditch 9), CD 36 to T120 R29W S27, east line	EXS		IC	IC	IF
07010204-755, County Ditch 36, Powers Lk outlet to -94.333 45.167	EXS	EXS	IF	IF	IF
07010204-546, Unnamed creek (Big Swan Lake Outlet), Big Swan Lk to N Fk Crow R			NA	NA	NA
07010204-557, Silver Creek, Unnamed cr to Collinwood Lk	MTS	EXS	IF	IF	IF
07010204-604, Collinwood Creek, Unnamed cr (Unnamed lk 47-0031-00 outlet) to Big Swan Lk			IF	NA	
07010204-604, Collinwood Creek, Unnamed cr (Unnamed lk 47-0031-00 outlet) to Big Swan Lk	EXS	EXS	EXS	MTS	EXS
07010204-707, Unnamed creek, Headwaters to Little Swan Lk				NA	
07010204-720, Unnamed creek (Collinwood Lake Inlet), Maple Lk to Collinwood Lk					
07010204-729, Unnamed creek, Lk Jennie to Wolf Lk					
07010204-503, Crow River, North Fork, Mill Cr to S Fk Crow R	EXS	IC	IC	EXS	EXS
07010204-509, Eagle Creek, Unnamed cr to N Fk Crow R	MTS	MTS	IF	IF	IF
07010204-515, Mill Creek, Buffalo Lk to N Fk Crow R	MTS	EXS	EXS	EXS	IF
07010204-524, Mill Creek, Ramsey Lk to Buffalo Lk	MTS	MTS	IF	IC	IF
07010204-543, Unnamed creek, Headwaters to Unnamed cr			IF		
07010204-544, Unnamed creek, Unnamed cr to Unnamed cr			IF		
07010204-556, Crow River, North Fork, Meeker/Wright County line to Mill Cr	EXS	IC	IF	EXS	EXS
07010204-559, County Ditch 10, Unnamed ditch to Grass Lk					NA
07010204-560, County Ditch 10, Grass Lk to Unnamed ditch					NA
07010204-561, Unnamed ditch, Headwaters to CD 10					NA
07010204-563, County Ditch 10, Unnamed ditch to Unnamed ditch					IF
07010204-564, County Ditch 10, Unnamed ditch to Lk Ann					IF
07010204-565, Unnamed creek, Lk Emma to Twelvemile Cr					NA
07010204-593, Unnamed creek, Long Lk (86-0194-00) to CD 10					IF
07010204-595, Unnamed creek, Headwaters to Howard Lk					
07010204-596, Unnamed creek, Headwaters to Howard Lk					
07010204-656, Unnamed creek, Headwaters (Granite Lk 86-0217-00) to Unnamed cr					
07010204-667, Unnamed creek, Woodland WMA wetland (86-0085-00) to N Fk Crow R	EXS	EXS	EXS	MTS	EXS

	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Phosphorus
07010204-668, Unnamed creek, Unnamed cr to Woodland WMA wetland (86-0085-00)			MTS	MTS	EXS
07010204-674, Unnamed creek, Headwaters to CD 10					IF
07010204-676, Unnamed creek, Headwaters to Unnamed cr					NA
07010204-677, Unnamed creek, Headwaters to Unnamed cr					IF
07010204-678, Unnamed creek, Headwaters to CD 10					NA
07010204-679, Twelvemile Creek, Dutch Lk to Little Waverly Lk	EXS	EXS	IF	IF	IF
07010204-681, Twelvemile Creek, Little Waverly Lk to N Fk Crow R			EXS	IC	IF
07010204-682, Sucker Creek, Cokato Lk to N Fk Crow R		MTS	IF	IF	IF
07010204-716, Unnamed creek, Headwaters to Mill Cr			IF		
07010204-759, French Creek, French Lk to T120 R28W S15, west line	EXS	EXS	NA	NA	NA
07010204-761, Sucker Creek, Headwaters to 53rd St SW			IF	IF	IF
07010204-762, Sucker Creek, 53rd St SW to Cokato Lk	EXS	EXS	IF	IF	IF
07010204-502, Crow River, S Fk Crow R to Mississippi R	EXS	EXS	IC	EXS	IF (SSS)
07010204-542, Unnamed creek (Regal Creek), Unnamed cr to Crow R	EXS	EXS	IC	MTS	EXS
07010204-627, Unnamed creek, Headwaters to Lk Sarah				NA	NA
07010204-628, Sarah Creek, Lk Sarah to Crow R			IC	MTS	EXS

EXS = exceeds or violates standard, IC = Inconclusive IF=insufficient information MTS=meets WQ or biological standard NA=not assessed

Table 2. Assessment status in channelized stream reaches in the NFCRW.

				Aquatic Life					Aquatic Recreation
HUC-10 Subwatershed	**AUID**	**Water body Name**	**Reach Description**	**Fish IBI**	**Invert IBI**	**Dissolved Oxygen**	**TSS**	**Phosphorus**	***E. coli***
Lake Koronis-North Fork Crow River	07010204-504	Crow River, North Fork	Lk Koronis to M Fk Crow R	EXS	MTS	IC	MTS	MTS	MTS
	07010204-531	Skunk River	Headwaters to N Fk Crow R	--	--	--	--	--	MTS
	07010204-553	Unnamed creek	Unnamed cr to Lk Koronis	EXS	MTS	IC	IC	EXS	EXS

			Aquatic Life						Aquatic Recreation
HUC-10 Subwatershed	AUID	Water body Name	Reach Description	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Phosphorus	*E. coli*
		(County Ditch 4)							
	07010204-576	County Ditch 5	Unnamed cr to N Fk Crow R	--	--	IC	MTS	IC	EXS
	07010204-578	County Ditch 32	Unnamed ditch to N Fk Crow R	--	--	NA	IC	EXS	EXS
	07010204-580	County Ditch 7	Unnamed ditch to N Fk Crow R	IC	--	IC	IC	EXS	EXS
	07010204-581	County Ditch 7 (County Ditch 37)	Unnamed ditch to N Fk Crow R	MTS	MTS	IC	MTS	MTS	IF
	07010204-582	Judicial Ditch 1	Unnamed ditch to Grove Lk	--	--	NA	MTS	MTS	IF
	07010204-584	Judicial Ditch 1	Unnamed ditch to N Fk Crow R	MTS	MTS	MTS	IC	EXS	EXS
	07010204-700	County Ditch 36	CD 38 to Sedan Bk	MTS	--	IF	IF	IF	--
	07010204-743	Judicial Ditch 1	Unnamed ditch to Unnamed ditch	--	--	IC	IC	EXS	EXS
	07010204-763	Crow River, North Fork	Headwaters (Grove Lk 61-0023-00) to CD 32	--		IC	MTS	MTS	EXS
	07010204-764	Crow River, North Fork	CD 32 to Rice Lk	MTS	MTS	IC	MTS	IC	EXS
Middle Fork Crow River	07010204-511	Crow River, Middle Fork	Green Lk to N Fk Crow R	EXS	MTS	MTS	IC	MTS	EXS

			Aquatic Life						Aquatic Recreation
HUC-10 Subwatershed	**AUID**	**Water body Name**	**Reach Description**	**Fish IBI**	**Invert IBI**	**Dissolved Oxygen**	**TSS**	**Phosphorus**	***E. coli***
	07010204-532	Judicial Ditch 17	Headwaters to M Fk Crow R	EXS	MTS	IF	IF	IF	--
	07010204-536	County Ditch 37	Unnamed cr to M Fk Crow R	EXS	MTS	IF	IF	MTS	--
	07010204-537	Crow River, Middle Fork	Headwaters to Monongalia (Mud) Lk	--	--	NA	MTS	MTS	--
	07010204-539	Crow River, Middle Fork	Monongalia (Mud) Lk to Nest Lk	EXS	MTS	IC	MTS	MTS	MTS
	07010204-577	County Ditch B6	Unnamed cr to M Fk Crow R	MTS	MTS	IF	--	--	--
	07010204-600	Unnamed creek	Unnamed ditch to M Fk Crow R	MTS	NA	IF	IF	IF	--
	07010204-652	County Ditch 26	Unnamed ditch to Unnamed ditch	EXS	--	IF	IF	IF	--
	07010204-704	Unnamed creek	Headwaters to Unnamed cr	--	--	IF	IC	MTS	--
Jewitts Creek-North Fork Crow River	07010204-506	Crow River, North Fork	Jewitts Cr to Washington Cr	EXS	MTS	IF	EXS	IC	EXS
	07010204-507	Crow River, North Fork	M Fk Crow R to Jewitts Cr	EXS	MTS	IF	IC	IC	EXS
	07010204-585	Jewitts Creek (County Ditch 19, 18, and 17)	Headwaters (Lk Ripley 47-0134-00) to N Fk Crow R	EXS	EXS	EXS	MTS	EXS	EXS
	07010204-642	Grove Creek	Unnamed cr to Unnamed cr	EXS	EXS	IF	IF	IF	--

				Aquatic Life					Aquatic Recreation
HUC-10 Subwatershed	**AUID**	**Water body Name**	**Reach Description**	**Fish IBI**	**Invert IBI**	**Dissolved Oxygen**	**TSS**	**Phosphorus**	***E. coli***
	07010204-643	County Ditch 26	Unnamed lk to Long Lk	EXS	EXS	IF	IF	IF	--
	07010204-696	Unnamed creek	Long Lk to Unnamed cr	EXS	EXS	IF	IF	IF	--
	07010204-748	Grove Creek	Unnamed cr to T120 R32W S36, north line	EXS	MTS	EXS	IF	IF	EXS
	07010204-749	Grove Creek	T120 R32W S25, south line to N Fk Crow R	EXS	EXS	EXS	EXS	IF	EXS
	07010204-758	Unnamed creek (Battle Creek)	-94.542 45.203 to Jewitts Cr	EXS	EXS	IF	IF	IF	--
Washington Creek	07010204-751	Washington Creek (County Ditch 9)	-94.342 45.108 to -94.314 45.146	MTS	EXS	IF	IF	IF	--
Washington Creek	07010204-753	Washington Creek (County Ditch 9)	CD 36 to T120 R29W S27, east line	EXS	--	IC	IC	IF	EXS
Washington Creek	07010204-755	County Ditch 36	Powers Lk outlet to -94.333 45.167	EXS	EXS	IF	IF	IF	--
Big Swan Lake	07010204-546	Unnamed creek (Big Swan Lake Outlet)	Big Swan Lk to N Fk Crow R	--	--	NA	NA	NA	MTS
Big Swan Lake	07010204-557	Silver Creek	Unnamed cr to Collinwood Lk	MTS	EXS	IF	IF	IF	--
Big Swan Lake	07010204-604	Collinwood Creek	Unnamed cr (Unnamed lk 47-0031-00 outlet) to Big Swan Lk	EXS	EXS	EXS	MTS	EXS	EXS

				Aquatic Life					Aquatic Recreation
HUC-10 Subwatershed	AUID	Water body Name	Reach Description	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Phosphorus	*E. coli*
	07010204-503	Crow River, North Fork	Mill Cr to S Fk Crow R	EXS	EXS	IC	EXS	EXS	EXS
	07010204-509	Eagle Creek	Unnamed cr to N Fk Crow R	MTS	MTS	IF	IF	IF	--
	07010204-515	Mill Creek	Buffalo Lk to N Fk Crow R	MTS	EXS	EXS	EXS	IF	EXS
	07010204-524	Mill Creek	Ramsey Lk to Buffalo Lk	MTS	MTS	IF	IC	IF	EXS
	07010204-543	Unnamed Creek	Headwaters to Unnamed cr	--	EXS	--	--	--	--
	07010204-556	Crow River, North Fork	Meeker/Wright County line to Mill Cr	EXS	EXS	IF	EXS	EXS	EXS
	07010204-667	Unnamed creek	Woodland WMA wetland (86-0085-00) to N Fk Crow R	EXS	EXS	EXS	MTS	EXS	EXS
	07010204-668	Unnamed creek	Unnamed cr to Woodland WMA wetland (86-0085-00)	--	--	MTS	MTS	EXS	EXS
	07010204-679	Twelvemile Creek	Dutch Lk to Little Waverly Lk	EXS	EXS	IF	IF	IF	EXS
	07010204-681	Twelvemile Creek	Little Waverly Lk to N Fk Crow R	--	--	EXS	IC	IF	EXS
	07010204-682	Sucker Creek	Cokato Lk to N Fk Crow R	--	MTS	IF	IF	IF	IF
	07010204-759	French Creek	French Lk to T120 R28W S15, west line	EXS	EXS	NA	NA	NA	--
North Fork Crow River	07010204-762	Sucker Creek	53rd St SW to Cokato Lk	EXS	EXS	IF	IF	IF	--

			Aquatic Life						Aquatic Recreation
HUC-10 Subwatershed	**AUID**	**Water body Name**	**Reach Description**	**Fish IBI**	**Invert IBI**	**Dissolved Oxygen**	**TSS**	**Phosphorus**	***E. coli***
Crow River	07010204-502	Crow River	S Fk Crow R to Mississippi R	EXS	EXS	IC	EXS	IF	EXS
	07010204-542	Unnamed creek (Regal Creek)	Unnamed cr to Crow R	EXS	EXS	EXS	MTS	EXS	EXS
	07010204-628	Sarah Creek	Lk Sarah to Crow R	--	--	IC	MTS	EXS	EXS

EXS = exceeds or violates standard
MTS = meets WQ or biological standard
Sup = found to meet the water quality standard,
Imp = does not meet the water quality standard and, therefore, is impaired,
IF = the data collected was insufficient to make a finding,
NA = not assessed,
IC = Inconclusive
LS=Limited Support

Lakes

1W1P PLANNING REGION (HUC 10)	ABBREVIATION
Crow River	CR
North Fork Crow River	NFCR
Big Swan Lake	BSL
Washington Creek	WS
Jewetts Creek NFCR	JC
Middle Fork Crow River	MFCR
Lake Koronis NFCR	LK

The 1,400 square mile North fork Crow River Watershed (HUC-8) is made up of seven smaller watersheds (HUC-10) that each have their own planning implementation profiles and goals that are outlines in the NFCRW 1W1P, which is managed by Technical Advisory Committee partners. Which can be viewed in the 1W1P report from pages 4-16 to 4-58 and in Tables 4-4 and 4-5.

TROPHIC STATE INDEX	Range
Oligotrophic	**< 40**
Mesotrophic	**40-50**
Eutrophic	**50-70**
Hypereutrophic	**> 70**

The Trophic State Index (TSI) is a number that summarizes a lake's overall nutrient richness. Nutrient richness ranges from clear lakes, low in nutrients (oligotrophic), to green lakes, with very high nutrient levels (hypereutrophic).

Land Cover % (Level 1 General): is calculated as Planted/Cultivated for an area within 1000' of the basin (this is considered shoreland) that includes the selected lake feature. Note that the Minnesota LakeBrowser splits some lakes into components. Values are determined using the National Land Cover Database (2016) (NLCD). Additionally, open water within 1000' of the basin is excluded as shorelines change over time.

INVASIVE SPECIES	ABBREVIATION
Euraion Water Mifloil	**EWM**
Starry Stonewort	**SS**
Zebra Mussel	**ZEB**
Currly-Leaf Pondweed	**CLP**
Flowering Rush	**FR**

List of Invasive Species reports can be found at the DNR Lake Finder website or by contacting a counties Aquatic Invasive Species Coordinator if available.

SURVEY	ABBREVIATION
Fish Survey	F Survey
Fish Survey and Stock	FSS
Aqutic Plant Survey	APS

All reports and information for each Fisheries Lake Survey, Aquatic Plants Surveys, and Fish Stocking can be found in the DNR Lake Finder website

Lakes of Phosphorus Sensitivity Significance Score: Phosphorus sensitivity was estimated for each lake by predicting how much water clarity would be reduced with additional phosphorus loading to the lake. The lake's phosphorus sensitivity significance (LPSS) score from 0 to 100 (low to high priority) is analyzed to classify lakes based on sensitivity to nutrient pollution.

Sources

MPCA Surface Water data https://webapp.pca.state.mn.us/surface-water/search
DNR Lake Finder https://www.dnr.state.mn.us/lakefind/index.html
University of MN Lake Browser https://lakes.rs.umn.edu

Table 3. Information on lakes of the NFCRW.

Lake ID	LAKE NAME	TMDL #	COUNTY	1W1P PLANNING REGION (HUC 10)	SURFACE AREA (acres)	MAX DEPTH (feet)	% LITTORAL	TROPHIC STATE INDEX	NUTRIENTS (TP)(ug/L)	CHL-a (ug/L)	CLARITY (m)	LAND COVER % DEVELOPED	LAND COVER % FOREST	LAND COVER % HERBACEOUS	LAND COVER % PLANTED/ CULTIVATED	LAND COVER % WETLAND	INVASIVE SPECIES	Sanitary Sewer Hook-Up	WILD RICE LAKES	DNR PRIORITY SHALLOW LAKES	LAKE ASSOC.	LAKE ASSESS.	FISH SURVEY, FISH STOCK, AQUATIC PLANT	Lakes of Phosphorus Sensitivity Significance Score
27-0123-00	Laura		Hennepin	CR	35	Shallow		65	101	120	1 ↓	7.7	9.7	2	75.9	4.7		no						
27-0169-00	Cowley	PRJ06872-001	Hennepin	CR	46	2		81	543	214	1 →	20.7	3.8	0.1	57.7	17.7		Older lots on south & west not, new development				X		
27-0170-00	North Twin Lake		Hennepin	CR	39	Unknown		NA										no						
27-0171-00	Sylvan	PRJ06872-001	Hennepin	CR	110	10		76	306	21	1 →	11.8	3	0.8	77.7	6.7		no						0
27-0172-00	Whiteford		Hennepin	CR	30	Unknown		NA																
27-0177-00	Prairie		Hennepin	CR	27	Shallow		53	27	16	2 →	0	30.1	1.8	57.7	9.3		no						
27-0191-01	Sarah- West	PRJ06172-001	Hennepin	CR	342	59		66	90	58	1 ↑	15.9	23.3	0.8	38.9	20.9	EWM	1-2 holdouts, otherwise 100%			X	X		2
27-0191-02	Sarah- East	PRJ06172-001	Hennepin	CR	199	59		65	87	48	1 ↓	15.9	23.3	0.8	38.9	20.9	EWM	1-2 holdouts, otherwise 100%			X	X		2
27-0194-00	Schwappauf		Hennepin	CR	40	Shallow		56	49	9	1	1.2	4.6	0	79.2	15		no						
27-0196-00	Schandell		Hennepin	CR	40	29	70	NA				1.8	20.1	0.2	38.9	39		no					F survey	
27-0197-00	Schauer		Hennepin	CR	39	Unknown		NA										no						
27-0199-00	Hafften	PRJ07722-001	Hennepin	CR	40	44	70	59	44	13	1 ↑	10.2	17.4	0.9	55.8	15.7		no			X	X	F survey	8
27-0200-00	Rattail		Hennepin	CR	12	63		58	44	16	1 ↓	0	56	20.9	19.2	1.5		no						21
86-0001-00	Foster	PRJ07722-001	Wright	CR	129	10	100	73	173	85	1 →	32.2	32.6	0.1	24.5	13.5		no			X	X	F Survey	0
86-0002-00	Rice		Wright	CR	48	Unknown		NA				2.2	48	0.7	17	32		no	X	X				
86-0008-00	Unnamed		Wright	CR	22	Unknown		NA				5.3	6.2	3.5	76.2	8.6		no						
86-0009-01	Martha		Wright	CR	98	22	77	55	39	22	2 ↓	20	30.9	3	38.5	7.4		partially - St. Michael WWTF				X	FSS, APS	24
86-0010-00	Wagner		Wright	CR	110	Unknown		NA				4.3	31.6	0.3	49.8	13.7		no						
86-0011-00	Charlotte		Wright	CR	243	46	37	40	15	3	5 →	9.7	41.5	1.9	41.8	3.1	EWM	partially - St. Michael WWTF				X	FSS, APS	
86-0015-00	School		Wright	CR	109	Unknown		NA																
86-0017-00	Uhl		Wright	CR	86	Shallow		60	NA	NA	1 ↓	1.4	12.4	0.5	85.2	0.2		no						
86-0019-00	Gonz		Wright	CR	180	3		NA				0.2	6.9	1	40	51.6		no	X					
86-0020-00	Wilhelm		Wright	CR	103	Shallow		69	128	58	1 →	34.4	3.6	0.1	60.4	1.4		no						0
86-0021-00	Mud		Wright	CR	70	Unknown		NA										no						
86-0022-00	Steele		Wright	CR	136	Unknown		NA				12.5	15.1	1.4	60.8	9.4		no						
86-0023-00	Beebe	PRJ07722-001	Wright	CR	297	24		58	41	27	2 ↓	6.3	23.7	1.1	63	5	EWM	no			X	X	FSS	25

Lake ID	LAKE NAME	TMDL #	COUNTY	1W1P PLANNING REGION (HUC 10)	SURFACE AREA (acres)	MAX DEPTH (feet)	% LITTORAL	TROPHIC STATE INDEX	NUTRIENTS (TP)(ug/L)	CHL-a (ug/L)	CLARITY (m)	LAND COVER % DEVELOPED	LAND COVER % FOREST	LAND COVER % HERBACEOUS	LAND COVER % PLANTED/ CULTIVATED	LAND COVER % WETLAND	INVASIVE SPECIES	Sanitary Sewer Hook-Up	WILD RICE LAKES	DNR PRIORITY SHALLOW LAKES	LAKE ASSOC.	LAKE ASSESS.	FISH SURVEY, FISH STOCK, AQUATIC PLANT	Lakes of Phosphorus Sensitivity Significance Score
86-0029-00	Schmidt		Wright	CR	237	Unknown		NA				5.1	46.2	2.7	39.9	5.4	EWM	no						
86-0031-00	Pelican	PRJ07722-001	Wright	CR	3461	9		63	118	56	2	3.6	11.2	0.8	44	40.1	EWM	no	X	X		X	F Survey	1
86-0050-00	Wrens Slough		Wright	CR	46	Unknown		NA				8.3	13.1	0	44.9	33.8								
86-0051-00	Constance	PRJ07722-001	Wright	CR	166	23	50	64	79	62	1 →	13.8	26.4	2.6	53.8	3.5	EWM	no				X	FSS	3
86-0056-00	Washington		Wright	CR	125	12	100	NA				2	36.9	3.1	49.9	6		no			X			
86-0061-00	Pohl		Wright	CR	36	10		NA				4.4	18.2	0.7	73.8	2		no						
86-0063-00	Green Mountain		Wright	CR	159	Shallow		73	176	89	1 →	7.9	19.9	0.6	62.3	8.6		no		X				0
86-0064-00	Gilchrist		Wright	CR	251	9		NA				4.8	25.5	2.4	32.1	35		no	X					
86-0075-00	Holkers Slough		Wright	CR	35	Unknown		NA				2.1	7.9	1.2	77.4	11.4		no						
86-0078-00	Slough		Wright	CR	26	Unknown		NA				18.3	3	3.9	71.1	2.8		no						
86-0082-00	Paradise		Wright	CR	33	Unknown		NA				4.1	20.9	4.9	64.7	4.9		no						
47-0002-00	Francis	PRJ07770-001	Wright/ Meeker	NFCR	1049	17	82	50	22	9	2 →	13.7	27.4	8.5	26.5	23.4	ZEB	no			X	X	FSS, APS	17
47-0004-00	Byron		Meeker	NFCR	338	Unknown		NA				2.6	9	0	78.4	9.9		no						
47-0040-00	Mud		Meeker	NFCR	67	26		52	29	10	2 →	8.8	25.7	1.1	39.3	22.5		no					FSS	3
86-0027-00	Potanski		Wright	NFCR	62	Unknown		NA				4.6	39.5	0	41.4	13.3		no						
86-0028-00	Moore		Wright	NFCR	183	Unknown		NA				4.3	32.3	1.6	50.6	10		no						
86-0033-00	Unnamed		Wright	NFCR	133	Unknown		NA				5.8	7.9	1.9	43	41.5		no						
86-0039-00	Unnamed		Wright	NFCR	11	Unknown		NA										no						
86-0041-00	Dean	PRJ07722-001	Wright	NFCR	173	20	71	73	237	80	1 ↑	8.7	11	0.3	59.2	20.1		no				X	FFS	0
86-0043-00	Sheridan (Rooney)		Wright	NFCR	60	Unknown		NA										no						
86-0044-00	Mud		Wright	NFCR	28	Unknown		NA				1.1	14.5	0	16	67.3		no		X				
86-0046-00	Crawford		Wright	NFCR	107	19	99	48	37	5	3	12.6	12	2.9	60.7	11.7		no				X	FSS	8
86-0048-00	Cook		Wright	NFCR	72	Unknown		NA				1.9	28.3	5.6	36.1	27.8		no						
86-0049-00	Mary		Wright	NFCR	337	6		NA				10.8	12.8	1.1	59.7	15.6		partially - Buffalo WWTF	X					
86-0053-01	Little Pulaski		Wright	NFCR	43	87		48	24	6	3 →	66.3	12	0.8	16.8	4	EWM	100%						
86-0053-02	Pulaski - Main	PRJ07770-001	Wright	NFCR	719	87	15	46	18	6	3 ↑	66.3	12	0.8	16.8	4	EWM	100%				X	FSS	80
86-0085-00	Mud (Woodlan Wildlife Management Area)		Wright	NFCR	617	Unknown		NA				1	0	0	13.6	85.4		no		X				
86-0086-00	Fountain	PRJ07722-001	Wright	NFCR	422	15		74	137	106	0	9.1	9	0.1	55.7	26		no		X		X	Survey, AP	3
86-0087-00	Faust Slough		Wright	NFCR	63	Unknown		NA																
86-0088-00	Mink		Wright	NFCR	89	36	61	NA				31.5	24.8	2.6	21	18.9	EWM						F Survey	
86-0089-00	Tamarack		Wright	NFCR	58	26	75	74	128	88	0	3.5	9.7	1.3	74	11.4		no					F Survey, AP	0
86-0090-00	Buffalo	PRJ07722-001	Wright	NFCR	1532	33		67	76	61	1 →	53	17.1	0.5	14.7	14.4	EWM	100%				X	FSS	2

Lake ID	LAKE NAME	TMDL #	COUNTY	1W1P PLANNING REGION (HUC 10)	SURFACE AREA (acres)	MAX DEPTH (feet)	% LITTORAL	TROPHIC STATE INDEX	NUTRIENTS (TP)(ug/L)	CHL-a (ug/L)	CLARITY (m)	LAND COVER % DEVELOPED	LAND COVER % FOREST	LAND COVER % HERBACEOUS	LAND COVER % PLANTED/ CULTIVATED	LAND COVER % WETLAND	INVASIVE SPECIES	Sanitary Sewer Hook-Up	WILD RICE LAKES	DNR PRIORITY SHALLOW LAKES	LAKE ASSOC.	LAKE ASSESS.	FISH SURVEY, FISH STOCK, AQUATIC PLANT	Lakes of Phosphorus Sensitivity Significance Score
86-0091-00	Varner		Wright	NFCR	85	Unknown		NA				32.5	10.3	0.5	54.2	2.1		no		X				
86-0097-00	Carrigan		Wright	NFCR	132	Unknown		80	633	170	1	28.2	6.5	0	56.7	8.4		partially - Montrose/Waverly WWTF	X					
86-0100-00	Lauzers		Wright	NFCR	72	Unknown		NA				2.7	10.1	0.3	78.8	7.7		no						
86-0102-00	Pooles		Wright	NFCR	75	6		NA				4.3	0.5	0.1	71.5	23.6		no	X					
86-0106-00	Little Waverly	PRJ07722-001	Wright	NFCR	335	12	100	76	442	87	1 →	21	12.7	0.3	61	4.9	ZEB, EWM	no		X		X	F Survey	0
86-0107-00	Deer	PRJ07722-001	Wright	NFCR	169	27	74	65	59	45	1 →	9.2	20.7	3.1	48.8	18.1	EWM	no				X	F Survey	0
86-0108-00	Goose		Wright	NFCR	49	14	100	NA				8.7	2.6	1.5	80.7	6.4	EWM	no					FSS	
86-0109-00	Fadden		Wright	NFCR	18	48	55	NA				8.6	31.4	0.6	40.3	18.6		no					F Survey	
86-0112-00	Malardi	PRJ07722-001	Wright	NFCR	97	Shallow		84	478	238	0	2	4.1	0	68.6	25.4		no	X	X		X		
86-0114-00	Waverly	PRJ07770-001	Wright	NFCR	487	71	29	53	35	14	2 ↑	32	11.7	0.1	49.5	6.7	ZEB, EWM	partially - Montrose/Waverly WWTF				X	FSS	54
86-0116-00	Birch		Wright	NFCR	102	31	64	NA				11	15.5	0.7	55.7	17.2		no					F Survey	
86-0119-00	Sullivan		Wright	NFCR	70	58	58	55	39	21	2 ↓	11.3	22.5	0.7	36.4	26.2		no					F Survey, APS	12
86-0120-00	Ramsey	PRJ07722-001	Wright	NFCR	306	82	43	59	47	24	1 →	12.6	14.6	0.7	53.1	18		no				X	F Survey, APS	3
86-0122-00	Light Foot	PRJ07722-001	Wright	NFCR	63	22	84	74	196	113	1	3.8	30.2	0.9	51.9	13.2		no				X	F Survey	0
86-0123-00	North Twin		Wright	NFCR	45	58	51	NA				7.2	39	3.4	38.5	9	EWM	no					F Survey	
86-0124-00	Unnamed (Pauman)		Wright	NFCR	20	Unknown		NA										no						
86-0126-00	South Twin		Wright	NFCR	36	19	81	NA				8.1	20.7	0.6	46.1	23.6		no					F Survey	
86-0127-00	Albert	PRJ07722-001	Wright	NFCR	52	47	50	68	109	83	1	9.8	18.8	2.7	62.6	3.9		no				X	F Survey	0
86-0129-00	Albert		Wright	NFCR	30	Unknown		NA				24.5	2.6	2.5	70.3	0.1								
86-0132-00	Abbie		Wright	NFCR	112	Unknown		NA				10.8	23.5	1.3	56.5	7.4		no						
86-0133-00	Angus		Wright	NFCR	64	Unknown		NA				1.3	19.4	1.6	68.9	7.9								
86-0134-01	Upper Maple		Wright	NFCR	620	10	54	47	20	7	3 ↑	17.3	16.9	0.1	49.7	14.3	ZEB, EWM, FR	no				X	FSS	80
86-0134-02	Mud		Wright	NFCR	114	76		NA				17.3	16.9	0.1	49.7	14.3	ZEB, EWM, FR	no						
86-0134-03	Maple -NE		Wright	NFCR	105	76		54	33	16	2 ↑	17.3	16.9	0.1	49.7	14.3	ZEB, EWM, FR	no						
86-0177-00	Yaeger		Wright	NFCR	96	27	72	NA				1.2	10.6	0	58	30		no						
86-0178-00	Dog		Wright	NFCR	101	25	75	59	46	24	1	3.3	5.8	0	50	40.8		no					F Survey	15
86-0179-00	Mains		Wright	NFCR	13	Unknown		NA										no					F Survey	
86-0180-00	School Section		Wright	NFCR	35	2		NA				2.7	0.9	0.5	38	57.6		no	X	X				
86-0181-00	Little Rock		Wright	NFCR	43	51	57	NA				8.2	29.4	3.3	35	24.1		no					F Survey	

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86-0182-00	Rock	PRJ07722-001	Wright	NFCR	180	37	54	60	50	30	2 ↑	12.4	13.4	0.7	63.6	8.2	EWM	no				X	FSS, AP	16
86-0184-00	Dutch	PRJ07722-001	Wright	NFCR	157	21	69	71	134	59	1	25	10.7	1.6	41.5	21.1	EWM	partially - Annandale/ Maple/ Lake/Howard Lake WWTF				X	F Survey	0
86-0185-00	Mallard Pass		Wright	NFCR	36	4		NA				73.4	7.1	0	5.7	13.8								
86-0187-00	Milky		Wright	NFCR	30	Unknown		NA				4.7	25.8	0	59.7	9.7								
86-0188-00	Emma	PRJ06384-001	Wright	NFCR	180	14	95	68	118	53	1	8.7	23.9	0.1	56.3	10.5	EWM	no				X	F Survey	0
86-0190-00	Ann	PRJ07770-001	Wright	NFCR	373	19	79	71	220	61	1	14.2	12.3	0.2	56.6	16.2		no				X	F Survey	0
86-0191-00	Unnamed (Drained lake)		Wright	NFCR	153	Unknown		NA										no		X				
86-0192-00	Round		Wright	NFCR	43	29	76	NA				10.9	11	1.1	72.1	4.9	EWM	no		X			F Survey	
86-0193-00	Mary	PRJ07770-001	Wright	NFCR	182	46	45	49	23	8	3 ↑	14.5	12.1	0.1	66.7	6.1		no				X	F Survey	80
86-0199-00	Howard	PRJ07722-001	Wright	NFCR	729	36	42	62	68	38	2 ↑	41	5.9	0.1	38.6	14.4	EWM	partially - Annandale/ Maple/ Lake/Howard Lake WWTF			X	X	FSS	1
86-0200-00	Spring		Wright	NFCR	55	Unknown		NA				8.8	3.1	0	78.1	9.9		no	X					
86-0202-00	Junkins		Wright	NFCR	51	Unknown		NA				1.6	6.8	2.6	70.5	17.4								
86-0203-00	Unnamed		Wright	NFCR	111	Unknown		NA				5.1	10.5	1.2	82.3	0.9		no						
86-0204-00	Taylor		Wright	NFCR	48	Unknown		NA				5.6	10.6	2.3	65.2	16.3		no	X					
86-0206-00	Doefler		Wright	NFCR	90	Unknown		NA				4.3	10.2	0	76.3	8.4		no						
86-0209-00	Willima (East Twin)		Wright	NFCR	259	Shallow		73	255	NA	1	5.8	21.4	5.9	34.2	29.6		no	X	X				
86-0214-00	White		Wright	NFCR	116	Shallow		50	22	3	1	7.8	8.8	0	61.6	21.4		no	X	X				
86-0217-00	Granite	PRJ07722-001	Wright	NFCR	354	34		58	52	23	2 ↑	14.4	12.3	1.6	58.2	12.6	EWM, Flowering Rush	no			X	X	FSS, APS	5
86-0218-00	Maxim		Wright	NFCR	47	18	91	NA				9.4	7.8	0.6	50.9	26.5		no					F Survey	
86-0221-00	Camp	PRJ07722-001	Wright	NFCR	119	52	33	60	83	29	2 ↓	13.9	9.6	0.1	73	3.4	EWM	no	X		X	X	F Survey, APS	0
86-0250-00	Smith	PRJ07722-001	Wright	NFCR	182	5	100	80	207	182	0	6.2	2.6	0.6	69.9	20.7		no	X	X		X	F Survey	0
86-0255-00	Shakopee		Wright	NFCR	114	2		57	52	5	1	3.8	5	0.1	79.5	11.7		no		X				11
86-0257-00	Grass		Wright	NFCR	64	35	86	48	22	6	3 →						ZEB	no		X			F Survey	
86-0263-00	Cokato	PRJ07722-001	Wright	NFCR	546	52	33	61	64	45	2 ↑	10.2	16.4	0.3	64.8	8.3		no			X	X	FSS	0
86-0264-00	Brooks	PRJ07722-001	Wright	NFCR	97	21	58	62	61	36	1 ↑	32	2.4	0.2	58.6	6.7		partially - Cokato WWTF				X	F Survey	7
86-0271-00	Moose		Wright	NFCR	79	43	72	43	14	5	4 →	8.2	50.6	7.9	9.5	23.8	ZEB	no					F Survey	3
86-0273-00	French	PRJ07722-001	Wright	NFCR	338	50	45	57	37	18	1 →	9.3	10.8	0.6	58.6	20.2	EWM	no				X	FSS	10
86-0274-00	Dans		Wright	NFCR	73	27	63	77	352	105	1	2.4	10.1	0	82.4	5		no					F Survey	0
86-0277-00	Unnamed (French Lake Waterfowl Production Area)		Wright	NFCR	8	Unknown		NA				3.6	2.2	0	62.8	31.2		no		X				
86-0278-00	Goose		Wright	NFCR	88	6		58	99	4	NA	13.1	11.1	6	60.5	9.3		no						1

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86-0279-00	West Lake Sylvia	PRJ07770-001	Wright	NFCR	890	88	27	36	8	3	6 ↑	17.3	49.4	8	12.4	12.5	ZEB, EWM, SS	no			X	X	FSS, APS	80
86-0288-00	John	PRJ07770-001	Wright	NFCR	395	28	89	48	21	8	3 →	11.5	17.2	2	52.1	17.1	EWM	no			X	X	FSS, APS	43
86-0289-00	East Lake Sylvia	PRJ07770-001	Wright	NFCR	670	78	25	38	10	3	5 ↓	15	43	2.4	30.8	8.7	ZEB, EWM	no			X	X	FSS, APS	80
86-0442-00	Unnamed		Wright	NFCR	8	Unknown		NA										no		X				
43-0068-00	O'mera		McLeod	BSL	9	Unknown		NA																
43-0070-00	Longanans		McLeod	BSL	64	Unknown		NA				0.9	7.6	0	85.8	5.6		no						
43-0071-00	Todd		McLeod	BSL	214	6		NA				6.2	10.6	0.1	67.5	15		no						
43-0073-00	Hook	PRJ07722-001	McLeod	BSL	324	18	98	81	454	556	1 ↑	13.1	12.2	0.2	64.9	9.7		no				X	FSS	0
43-0074-00	Emily		McLeod	BSL	77	Unknown		NA				5.8	15.7	0.1	70.1	8.3		no						
43-0081-00	Echo		McLeod	BSL	83	Unknown		NA				1.8	22	0.3	67.1	8.9		no		X				
43-0102-00	Dettmans		McLeod	BSL	15	Unknown		NA				5.9	12.1	0	78.8	3.2		no						
43-0107-00	Schluter's Slough		McLeod	BSL	24	Unknown		NA				5.9	12.1	0	78.8									
43-0108-00	Campbells		McLeod	BSL	27	Unknown		NA				6	8.2	0.6	79.3	5.8		no						
47-0001-00	Maple		Meeker	BSL	135	7	100	NA				8.5	9.6	1	65.9	14		no					F survey	
47-0005-00	Butternut		Meeker	BSL	77	Unknown		NA				7.7	5.3	1.4	79.9	5.2		no						
47-0007-00	Unnamed		Meeker	BSL	20	Unknown		NA										no						
47-0008-00	Pigeon		Meeker	BSL	250	Unknown		NA				3.5	10.2	0	58.5	27.8		no						
47-0009-00	Unnamed		Meeker	BSL	78	Unknown		NA				4.3	11.5	0.2	47.7	36.3		no						
47-0014-00	Spencer		Meeker	BSL	140	Shallow		65	87	25	1	8.3	11.6	1	65.2	13.9		no		X				
47-0015-00	Jennie	PRJ07722-001	Meeker	BSL	1057	14	99	61	66	34	2 →	10.3	14.8	0.5	55.1	19		no			X	X	FSS	8
47-0016-00	Wolf		Meeker	BSL	263	11	100	71	131	102	1 →	5.5	21.2	0.2	53.2	18	EWM	no		X	X		F survey	0
47-0017-00	Collins Lake		Meeker	BSL	57	Unknown		NA				7	10.3	1.2	68.3	13.2		no						
47-0019-00	Little Wolf		Meeker	BSL	62	Unknown		NA				9.4	3.2	1.9	78.7	6		no					F survey	
47-0025-00	Little Swan		Meeker	BSL	50	31	39	53	32	10	2 →	10.4	24.7	1.3	42.9	19.7		no					F survey	5
47-0026-00	Long	PRJ07722-001	Meeker	BSL	162	28	65	50	30	9	3 →	15.2	27.4	1.7	48.7	6.4		no				X	FSS	17
47-0031-00	Mud		Meeker	BSL	95	Unknown		NA				1.4	9.7	0.6	80.2	8.1		no						
47-0032-00	Spring	PRJ07722-001	Meeker	BSL	198	30	82	60	55	24	1 ↑	32.9	8.7	0.8	51	5.5		20 homeowners are hooked up, rest are not.			X	X	F survey	3
47-0033-00	Unnamed		Meeker	BSL	10.6	Unknown		NA										no						

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47-0036-00	Little Spring		Meeker	BSL	70	Unknown		NA				9.6	11	0.2	71.9	7.3		no						
47-0037-00	Boo		Meeker	BSL	36	Unknown		NA				7.3	5.9	0	75.8	11.1		no						
47-0038-00	Big Swan	PRJ07722-001	Meeker	BSL	646	32	49	66	98	45	1 ↑	11.9	10.3	1.8	47.2	24.9		no			X	X	FSS	0
47-0043-00	Heenan Lake		Meeker	BSL	28	Unknown		NA				3.5	3	0	93.3	0.2		no					FSS	
47-0044-00	Jewitt		Meeker	BSL	252	5		NA				4.7	7.9	1.2	75.7	10.4		no					F survey	
47-0045-00	Fallon		Meeker	BSL	221	5		NA				1.7	9.9	0.5	67.1	20.9		no						
47-0057-00	Porter		Meeker	BSL	101	Unknown		NA				5.7	4.7	0.2	87.1	2.2		no						
47-0064-00	Erie	PRJ07770-001	Meeker	BSL	185	34	43	53	26	11	2	4.9	13.6	0.2	76.1	4.9	EWM	no				X	F Survey	75
47-0066-00	Long		Meeker	BSL	65	NA		NA																
47-0338-00	Unnamed		Meeker	BSL	29	Unknown		NA										no						
86-0256-00	Chelgren		Wright	BSL	60	23	69	NA				0	20.7	0.4	58	19.3							F Survey	
86-0261-00	Unnamed		Wright	BSL	79	Unknown		NA																
86-0293-00	Collinwood	PRJ07722-001	Wright/ Meeker	BSL	624	28	55	65	99	51	1 →	9.5	17.7	1.7	66.6	3.4		no			X	X	FSS, APS	0
86-0295-00	Swan		Wright/ Meeker	BSL	134	2		NA				0.9	4.6	0.4	26.1	67.9		no		X				
86-0296-00	Beaver Dam		Wright	BSL	20	Unknown		NA				12.2	6	0	50.7	30.4		no	X	X				
47-0023-00	Arvilla	PRJ07770-001	Meeker	WC	131	9	100	63	90	29	1 ↓	7.3	14.3	1.3	58.2	17		no		X	X		FSS	0
47-0024-00	Maynard		Meeker	WC	135	Unknown		NA																
47-0029-00	Hart		Meeker	WC	56	Unknown		NA										no					F survey	
47-0035-00	Sellards		Meeker	WC	99	9		60	55	24	2 ↑	18.4	5.4	0.8	62.7	12		no					F survey	
47-0046-00	Washington	PRJ07770-001	Meeker	WC	2420	17	93	55	28	12	1 ↑	17.1	18.6	1.2	48.9	12.7	ZEB,EWM	no			X	X	FSS, APS	39
47-0047-00	Unnamed		Meeker	WC	39	Unknown		NA										no						
47-0048-00	Powers		Meeker	WC	330	Unknown		88	330	NA	0	2.3	10.6	0.4	78.1	7.9		no					FSS, APS	
47-0050-00	Manuella		Meeker	WC	289	50	39	47	18	5	2 ↑	11.8	18.4	2.2	49.7	16.5	EWM	no			X	X	F Survey	14
47-0055-00	Birch		Meeker	WC	50	Unknown		NA				5.3	8.9	0.1	70.7	14.6		no						
47-0056-00	School House		Meeker	WC	49	Unknown		NA				8.9	4.5	2.5	74.9	7.5								
47-0068-00	Stella		Meeker	WC	594	74	38	50	24	8	2 ↑	11	12.6	1.1	51.7	22.8	ZEB, EWM	no			X	X	F Survey	19
47-0069-00	North Buckley		Meeker	WC	14	Unknown		NA										no						
47-0070-00	South Buckley		Meeker	WC	1.6	Unknown		NA										no						
47-0071-00	Mud		Meeker	WC	202	Unknown		NA																

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47-0073-00	East Andrew Nelson		Meeker	WC	40	Unknown		NA				0	6.1	2.7	86	5.1		no						
47-0074-00	Turtle		Meeker	WC	48	Unknown		NA				26.8	36.6	3.2	22.4	7.6		no					APS	
47-0076-00	Darwin		Meeker	WC	156	Unknown		62	54	NA	NA	8.5	23.7	1.2	50.8	13.8		no					APS	
47-0077-00	Stevens		Meeker	WC	26	Unknown		NA										no						
47-0080-00	Casey		Meeker	WC	84	Unknown		NA				7.8	26.5	1.9	60.3	2.4		no						
47-0081-00	Hanon		Meeker	WC	229	5		NA																
47-0082-00	Dunns	PRJ07722-001	Meeker	WC	156	20	56	69	97	58	1	6.7	23.5	3.5	55.5	8.3		no			X	X	F Survey	0
47-0087-00	Rice		Meeker	WC	69	Unknown		93	697	NA	0	2.4	7.3	0	82.7	7.6		no						
47-0088-00	Richardson	PRJ07722-001	Meeker	WC	120	47	38	55	68	32	1 ↓	7.9	24.4	1.8	63.8	0.9		no			X	X	F Survey	0
47-0101-00	Andrew Nelson		Meeker	WC	90	Unknown		NA				2	4.4	0.3	80.2	13.1		no						
47-0119-00	Minnie-Belle	PRJ07770-001	Meeker	WC	591	49	28	43	20	4	4 ↑	20.8	0.4	44.1	7		ZEB, EWM	no			X	X	FSS, APS	80
47-0085-00	Mud		Meeker	JC	123	Unknown		69	90	NA	NA	2.3	28	0.5	45.6	23.3		no						
47-0102-00	Round		Meeker	JC	262	8	100	52	26	9	2	11.4	3	0.2	59.6	25.9		no		X			F Survey	
47-0116-00	Hoosier		Meeker	JC	105	Shallow		55	38	10	NA	2.4	16.4	0	67.1	12.4		no						
47-0131-00	Stone		Meeker	JC	194	2		NA										no		X				
47-0132-00	Unnamed (Hanson Lake Waterfowl Production Area)		Meeker	JC	30	Unknown		NA										no		X				
47-0133-00	Chicken		Meeker	JC	101	Unknown		NA				0.2	13.4	0	32.6	53.8		no						
47-0134-01	Ripley- East	PRJ07770-001	Meeker	JC	134	18		NA									EWM	no			X			11
47-0134-02	Ripley- West		Meeker	JC	595	18	76	57	43	24	2 ↑	35.7	5.7	0	28.2	30.4	EWM	3/4 covered, 1/4 (south side not hooked up)			X	X	F Survey	
47-0135-00	East Hanson		Meeker	JC	86	Unknown		NA																
47-0136-00	West Hanson		Meeker	JC	80	Unknown		NA				7.8	15.2	0	69.4			no						
47-0137-00	Harold		Meeker	JC	121	Shallow		64	89	15	1	4.3	39.1	0.2	49.9	6.5		no						
47-0138-00	Youngstrom		Meeker	JC	166	5	100	56	38	6	1	1.8	13.3	0.3	41.1	43.5		no		X			F Survey	11
47-0140-00	Minnesota		Meeker	JC	117	Unknown		56	28	NA	1	4.1	6	0	65.7	24.23		no		X				

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47-0142-00	Towers		Meeker	JC	53	Unknown		68	82	NA	NA	9	7.7	0.1	69.7	13.5		no						
47-0143-00	Mary		Meeker	JC	90	Unknown		NA				4.8	1.7	0.5	72.7	20.7		no						
47-0144-00	Half Moon		Meeker	JC	18	Unknown		NA				6	10.4	0	63.7	19.9		no						
47-0146-00	Madsen (Madsen State Wildlife mangamnet Area)		Meeker	JC	6	Unknown		NA										no		X				
47-0147-00	Schultz		Meeker	JC	45	Unknown		NA				0	1	0	65.9	33.1		no						
47-0148-00	Unnamed		Meeker	JC	59	Unknown		NA				0.4	9.3	0	47.8	42.5		no		X				
47-0151-00	Horseshoe (Kalkenbrenner)		Meeker	JC	120	4		64	86	NA	1	4.8	8.9	0.8	55.9	29.1		no		X				0
47-0154-00	Thoen		Meeker	JC	300	Unknown		77	119		0	3	19	0.1	57.3	20.2		no		X				
47-0173-00	Popple		Meeker	JC	40	Unknown		NA				4	10	0.2	61.5	24.1		no		X				
47-0175-00	Nelson		Meeker	JC	24	Unknown		NA				0	2.6	0.2	92.2	3.4								
47-0177-00	Long	Nutrients	Meeker	JC	790	11	99	69	73	NA	0 ↓	7.6	22.6	0.6	56.5	12.2		no		X		X	F Survey	0
47-0178-00	Sather		Meeker	JC	66	Unknown		NA				3.8	32.1	0.1	34.2	29.8		no						
47-0179-00	Moe (Daxton)		Meeker	JC	37	Unknown		NA				0.5	22.3	0	35.4	41.9		no						
47-0183-00	Hope	PRJ07722-001	Meeker	JC	265	10	100	70	102	77	1 →	4.4	29.2	0.2	49	16.9		no				X	F Survey	0
47-0187-00	Unnamed		Meeker	JC	25			NA										no		X				
47-0189-00	Unnamed		Meeker	JC	28			NA				0	14.3	1.2	22.5	62		no		X				
47-0191-00	Unnamed (Grove)		Meeker	JC	31			NA				27.5	0.6	0	61.8	7.7		no						
47-0192-00	Lund		Meeker	JC	110			58	40	10	1	4.1	13.7	0	58.7	23.2		no		X				
34-0023-00	Pay		Kandiyohi	MFCR	31	Unknown		NA				6.9	3.1	0.2	80.2	8.9		no						
34-0027-00	Summit		Kandiyohi	MFCR	136	6		NA				4.1	21.4	2.2	60.6	10.8		no						
34-0028-00	Upper Lake		Kandiyohi	MFCR	21	8		NA				44.2	7.7	1.1	42.5	4.6		no						
34-0040-00	Sperry		Kandiyohi	MFCR	132	Shallow		80	215	96	0	7.9	9.2	0.2	63.2	19.3		no						
34-0044-00	Diamond	PRJ06380-001	Kandiyohi	MFCR	1552	27	39	60	64	38	2 →	15.3	16.6	0.8	51.1	13.6	ZEB, CLP	100%			X	X	FSS	1
34-0046-00	Taits		Kandiyohi	MFCR	25	Unknown		NA				0	42.3	0	33.3	23.6		no						
34-0049-00	Schultz		Kandiyohi	MFCR	156	3		78	212	123	1 ↑	1.8	20	2.1	68.7	4.6		no						
34-0051-01	Wheeler - SW		Kandiyohi	MFCR	84	5		72	169	66	1 →	4.6	17.6	0.2	64.7	10.6		no						
34-0051-02	Wheeler -NE		Kandiyohi	MFCR	173	4		81	379	127	1 →	4.6	17.6	0.2	64.7	10.6	CLP	no						

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34-0056-00	Unnamed		Kandiyohi	MFCR	38.5	Unknown		NA				0	9.5	0	71.9	18.6		no						
34-0060-00	Jesse		Kandiyohi	MFCR	76	Shallow		80	170	195	1	6.8	62.6	0	18.5	10.2		no						
34-0062-00	Calhoun	PRJ07770-001	Kandiyohi	MFCR	619	13	100	54	28	10	1 ↑	8.3	6.4	0.3	36.9	47	ZEB, EWM	no		X	X	X	FSS	12
34-0066-00	Long	PRJ07770-001	Kandiyohi	MFCR	313	45	39	45	17	6	4 →	11.7	43.2	3.8	30.8	10.3		no			X	X	FSS	11
34-0078-00	Bass		Kandiyohi	MFCR	48.5	30.5	54	NA				8.3	20.6	0	67.8	2		no					F survey	
34-0079-00	Green		Kandiyohi	MFCR	5533	110	36.5	42	14	5	4 ↑	40.1	23	1.4	19.3	12.1	ZEB, EWM	100%			X	X	FSS	27
34-0112-00	Woodcock		Kandiyohi	MFCR	113.5	Unknown		74	125	34	0	7.4	31.9	0.2	47.3	10.6		no						
34-0114-00	Carlson		Kandiyohi	MFCR	28			NA				1.2	16.6	12.7	42.3	26		no						
34-0119-00	Elkhorn		Kandiyohi	MFCR	73	40	38	42	16	4	4 →	20	24.7	1.9	44.2	8.8	ZEB, EWM	no			X	X	FSS	24
34-0120-00	Alvig		Kandiyohi	MFCR	72	Unknown		82	152	52	0	14	15.7	2	54.2	13.2		no						
34-0126-00	Gina		Kandiyohi	MFCR	50	Unknown		NA				7.1	5	0.2	84.1	3.7		no						
34-0141-00	Woodcock		Kandiyohi	MFCR	171	8		NA				14.4	31.8	1.4	44.9	6.5		no						1
34-0142-00	George	PRJ07770-001	Kandiyohi	MFCR	223	32	49	42	15	3	4 ↑	30.1	27.6	1	931.9	9.4	ZEB	100%			X	X	FSS	80
34-0146-00	Eight		Kandiyohi	MFCR	54	Unknown		NA				2.2	26.5	4.1	24.5	40.7		no	X					NA
34-0148-00	Bear		Kandiyohi	MFCR	139	18	85	NA				1.1	17.5	1.3	51.8	28.2		no	X				F survey	NA
34-0151-00	Fields - Unnamed		Kandiyohi	MFCR	14	Unknown		NA				0	52	1.3	41.1	5.6		no						NA
34-0154-00	Nest	PRJ07722-001	Kandiyohi	MFCR	967	40	54	56	39	22	2 ↑	20.3	30	2.1	33.2	11.6	ZEB	100%			X	X	FSS, APS	5
34-0156-00	Unnamed (Allen Waterfowl Production Area)		Kandiyohi	MFCR	20	Unknown		NA				1.3	40.7	3.1	29.4	25.6		no						
34-0157-00	Unnamed (Allen Waterfowl Production Area)		Kandiyohi	MFCR	35	Unknown		NA				1.3	40.7	3.1	29.4	25.6		no						
34-0158-01	Monongalia - Main		Kandiyohi	MFCR	1384	8	99	60	52	8	1	16.3	31.8	2.6	21.7	27.5		not 100%	X	X		X	FSS, APS	2
34-0158-02	Monongalia - MFCR		Kandiyohi	MFCR	813	8	99	53	33	8	2 →	16.3	31.8	2.6	21.7	27.5		not 100%	X	X		X	FSS, APS	2

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34-0158-03	Crow River Mill Pond - East		Kandiyohi	MFCR	28	8		51	31	8	2 →	16.3	31.8	2.6	21.7	27.5		not 100%				X		
34-0158-04	Crow River Mill Pond- Mid		Kandiyohi	MFCR	17	8		53	35	7	2 ↓	16.3	31.8	2.6	21.7	27.5		not 100%				X		
34-0158-05	Crow River Mill Pond- West		Kandiyohi	MFCR	5	8		NA										not 100%						
34-0161-00	Unnamed (Burbank Waterfowl Production Area)		Kandiyohi	MFCR	25	Unknown		NA				3.8	0	0	14.8	81.5		no		X				
34-0166-00	Unnamed (Burbank State Wildlife Mangment Area)		Kandiyohi	MFCR	134	Unknown		NA										no		X				
34-0243-00	Skull		Kandiyohi	MFCR	47	Unknown		NA				0	75.7	0.2	5.4	18.7		no						
34-0391-00	Unnamed		Kandiyohi	MFCR	15	Unknown		NA				5.5	68.5	1.1	13.1	11		no					APS	
34-0527-00	Unnamed		Kandiyohi	MFCR		Unknown		NA										no		X				
34-0611-00	Unnamed (Dietrich Lange State Wildlife Mangangemt Area)		Kandiyohi	MFCR	41	Unknown		NA				8.3	6.4	0.3	36.9	47		no		X				
34-0612-00	Unnamed		Kandiyohi	MFCR	313	Unknown		NA										no		X				
47-0193-00	Wilcox		Meeker	MFCR	181	Unknown		65	59		1	3.3	16.2	0.1	67.1	11.9		no						
47-0194-00	Miller		Meeker	MFCR	80	Unknown		NA				0	3.6	1	83.7	11.7		no		X				
47-0198-00	Peterson		Meeker	MFCR	133	15	100	73	116			4.9	26.9	0.1	64.2	3.9		no		X			F Survey	0
47-0199-00	Helga		Meeker	MFCR	116	Unknown		NA				1.6	25.2	0	69.8	3.3		no						
47-0205-00	Whitney		Meeker	MFCR	55	Unknown		NA				4.9	11.9	0	50.6	32.3		no						
73-0279-00	Crow		Stearns	MFCR	224	3		NA				0.8	11.4	1.3	43.2	43.3		no	X					
73-0281-00	Fish		Stearns	MFCR	172	4		NA				1	2.8	1.1	77.3	17.8		no	X					
34-0068-00	Raemer		Kandiyohi	LK	17	Unknown		NA																
34-0069-00	Hawick Creamery Slough		Kandiyohi	LK	24	Unknown		NA																

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34-0510-00	Unnamed (Follies State Wildlife Management Area)		Kandiyohi	LK	17	Unknown		NA										no		X				
47-0155-00	Pigeon		Meeker	LK	26	Unknown		NA				3.5	10.2	0	58.5	27.8		no						
47-0201-00	Emma		Meeker	LK	59	Unknown		NA				0	10.1	0.6	63.3	26		no						
47-0202-00	West		Meeker	LK	52	Unknown		NA				4.6	10.2	0.1	52.4	32.7								
61-0017-00	Unnamed (Bangor Waterfowl Production Area)		Pope	LK	23	Unknown		NA										no						
61-0019-00	Mud		Pope	LK	267	Unknown		NA										no						
61-0020-00	Lincoln		Pope	LK	26	Unknown		NA										no						
61-0023-00	Grove	PRJ07770-001	Pope	LK	354	31	66	52	32	11	2 ↓	9.2	8.2	1.6	58.3	22.6		no			X	•	F Survey	8
61-0024-00	McCloud		Pope	LK	218	10		NA				5.6	2	2.6	74.8	14.8		no						
61-0310-00	Unnamed		Pope	LK	17	Unknown		NA										no						
73-0144-00	Pirz		Stearns	LK	67	Unknown		48	26	9	3 ↑	8.3	23.4	1.4	58	8.8		no			X	•		
73-0196-00	Rice	PRJ07060-001	Stearns	LK	1515	41	63	60	53	28	1 ↓	10.3	41.1	0.1	28.3	18.3	SS	no			X	•	FSS	1
73-0200-01	Koronis - Mud Lake	PRJ07770-001	Stearns	LK	135	Unknown		55	52	3	1		40.4	2.5	21.8	21		no				•		0
73-0200-02	Koronis	PRJ07770-001	Stearns/ Meeker	LK	2492	132	40	54	34	16	2 ↓	14.2	40.4	2.5	21.8	21	SS	no			X	•	FSS	3
73-0201-00	Schultz Slough		Stearns	LK	17	Unknown																		
73-0202-00	Lawn		Stearns	LK	31	Unknown		NA				0	50	2.2	45.3	2.5								
73-0258-00	George		Stearns	LK	314	Unknown		NA				0	20.2	0.1	59.6	20		no						
73-0268-00	Unnamed (Pauda State Wildlife Managment Area)		Stearns	LK	67	Unknown		NA										no		X				
73-0277-00	Unnamed		Stearns	LK	74	Unknown		NA				1.6	5.9	0.5	58.9	33		no		X				
73-0278-00	Tamarack		Stearns	LK	279	4		NA				0.7	8.8	0	26.7	63.8		no		X				
73-0284-00	Sand		Stearns	LK	264	Unknown																		
73-0285-00	Raymond		Stearns	LK	64	Unknown		62	55	NA	1	3.1	26	4.6	32.5	33.8		no		X				

Additional information

Some of the water bodies in the NFCRW are impaired by mercury; however, this WRAPS report does not cover toxic pollutants. For more information on mercury impairments, see the statewide mercury TMDL on the MPCA website at: https://www.pca.state.mn.us/business-with-us/statewide-mercury-tmdl.

A table of waters newly listed in 2020 as impaired is found in Appendix B.

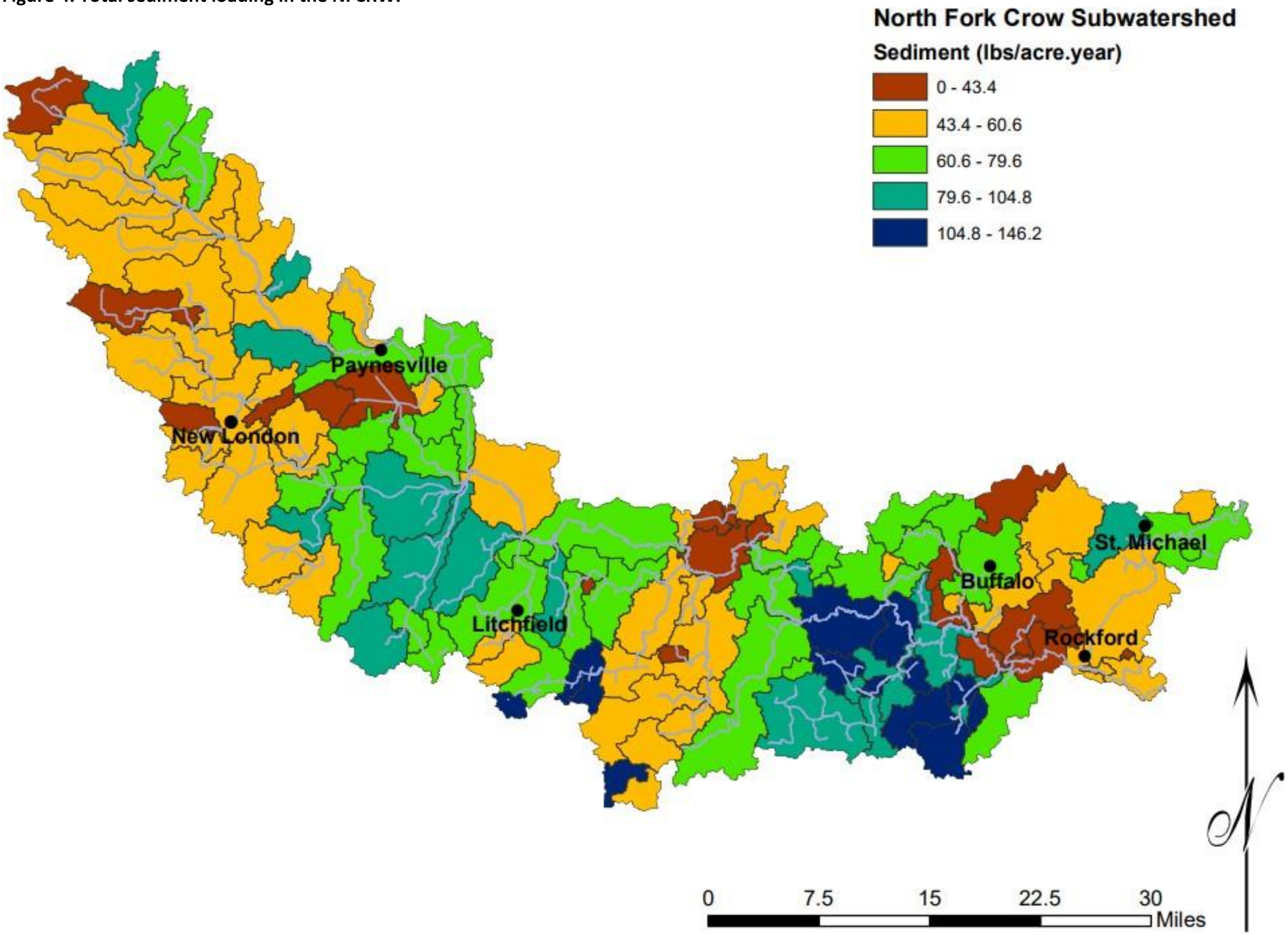
2.2 Subwatershed pollutant loading and condition status

Information on subwatershed levels of three key water chemistry pollutants, sediment, P, and N, and associated runoff volumes in the watershed are provided below. Sensitive areas and the NFCRW biology conditions are also discussed below.

Subwatershed sediment loading

Sediment and other solids in streams impact fish and macroinvertebrate communities and their habitats. Subwatershed loading varies across the NFCRW, and these levels can be used to help further prioritize implementation activities. Suspended sediment becomes more problematic in the downstream portions of the watershed. Sediment levels are not showing a trend of either increasing or decreasing.

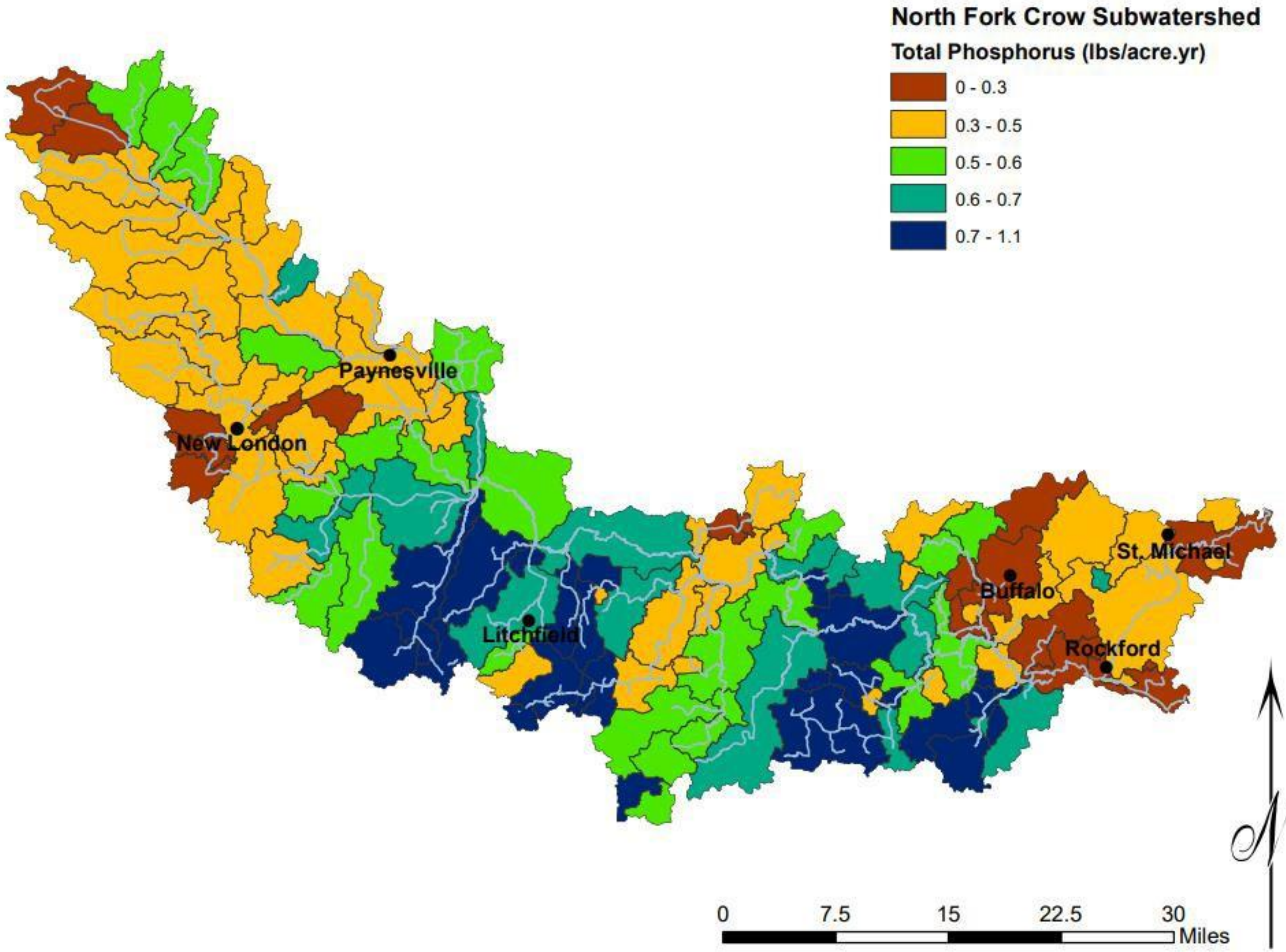
Figure 4. Total sediment loading in the NFCRW.



Subwatershed phosphorus loading

P was found to be decreasing at the mouth of the Crow River. While high P levels continue to be a problem, and are the main lake pollutant causing algae blooms in summer months in the NFCRW, more lakes had increasing clarity than lakes with decreasing clarity.

Figure 5. Total phosphorus loading in the NFCRW.

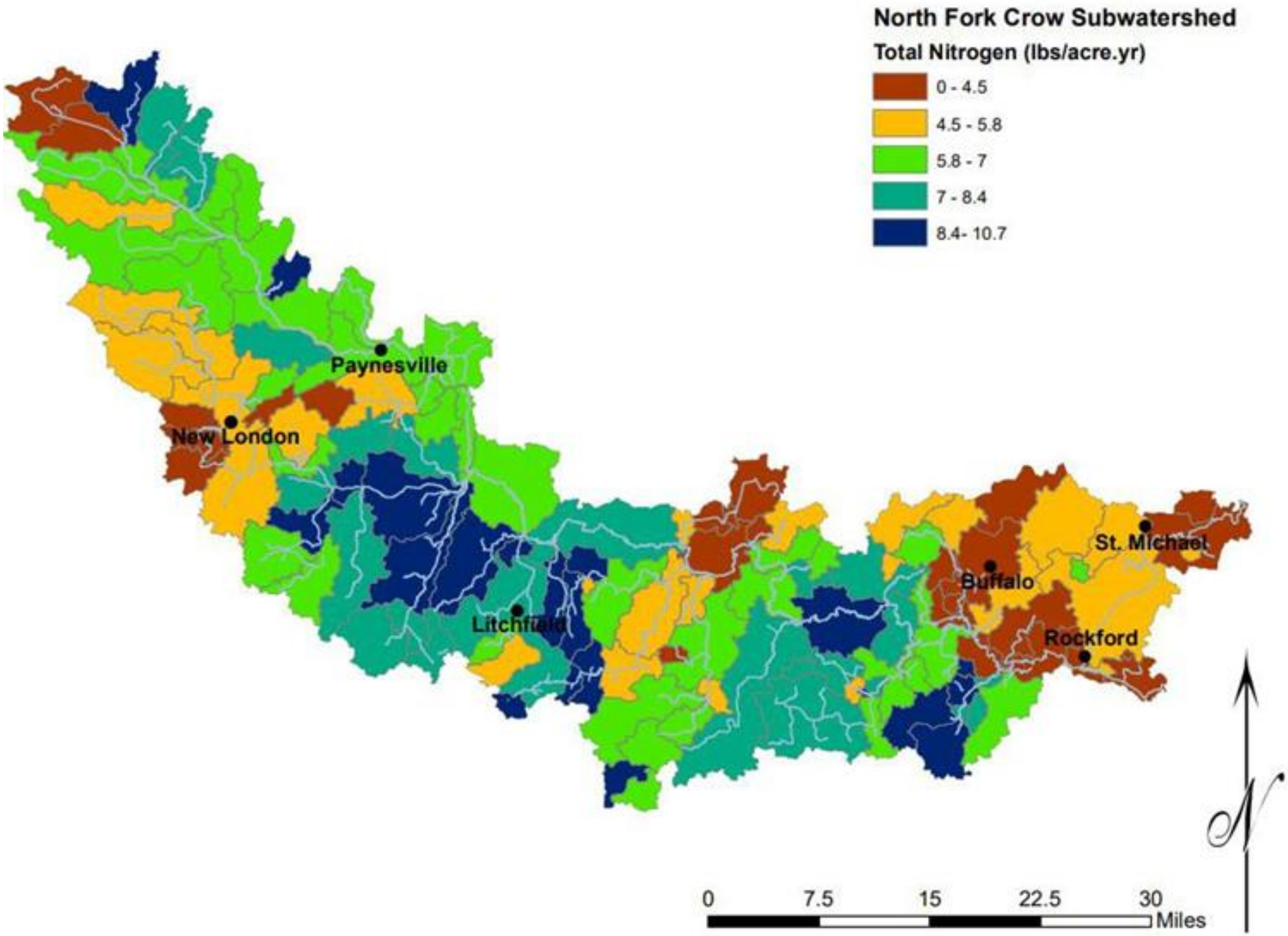


Subwatershed nitrogen loading

High nitrate levels continue to be a problem in the NFCRW. Nitrate levels are generally higher in the western and central portion of the watershed. Levels of nitrate do not show a trend of decreasing or increasing.

Nitrogen is a key pollutant in Minnesota's waters and has impacts both locally and downstream. The primary goals for reducing nitrogen are to: protect groundwater and surface water drinking water sources, protect aquatic life in Minnesota lakes and streams, and improve the waters downstream of Minnesota. To accomplish these goals, Minnesota, in coordination with partners, published a Nutrient Reduction Strategy (NRS) plan in 2040 which established a goal to reduce nitrogen by 45% in 2040. The MPCA is working to update the NRS with a goal to publish in 2024. The NRS contains goals for all watersheds in Minnesota to reduce point and nonpoint source contributions of nitrate in Minnesota Lakes and Streams. More information on this can be found on MPCA website at: https://www.pca.state.mn.us/air-water-land-climate/reducing-nutrients-in-waters.

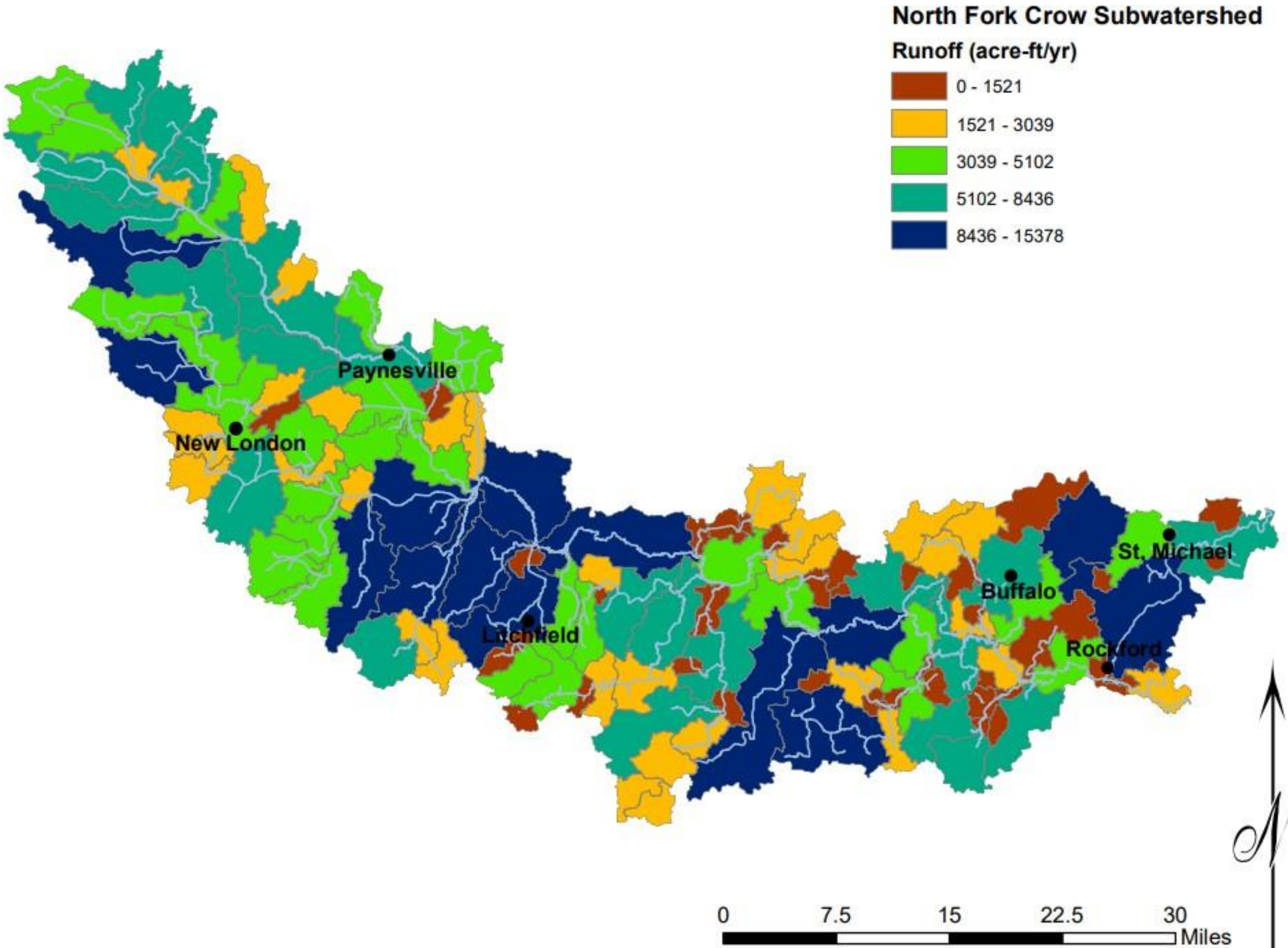
Figure 6. Total nitrogen loading in the NFCRW.



Subwatershed runoff volumes

Annual streamflow (discharge) data is available for the NFCRW since 2009. In that time period, there is no clear trend; although 2016 and 2017 were the highest flow years since 2011. A much longer data record exists for the Crow River downstream of the confluence of the north and south forks. There is an increasing trend in flow on the Crow River; it is not possible to know which fork more strongly influences this trend.

Figure 7. Annual runoff average in the NFCRW.



Sensitive areas

The water quality assessment process was effective in helping to identify sensitive areas in the watershed, where action can be taken to address the water quality in several lakes and streams before they become impaired.

Sensitive areas identified in the watershed:

- The MPCA, DNR, and partners identified several lakes that support aquatic recreation, and healthy fish communities. Thirteen lakes were identified as a high priority for protection including: Rattail, Spencer, Koronis, Martha, Uhl, and Sullivan lakes, due to P; and Manuella, Minnie-Bell, Rice, Charlotte, and Emma lakes, due to vulnerable fish communities; while Nest and Ripley lakes vulnerable to P with fish communities showing signs of stress.
- Grove Lake, the headwaters of the North Fork of the Crow River, has shown improvements in both fish Index of Biological Integrity (FIBI) scores (>20-point increase in Index of Biological Integrity (IBI) from to 2012 through 2017) and nutrient reductions. A trend line of the historical P data suggests a decrease in concentrations over the last two decades, but data are noticeably lower and less variable starting in 2013.
- The fish community in Nest Lake is vulnerable to future aquatic life impairment based on the FIBI for lakes, and although the lake is impaired by nutrients, new seasonal means are near the standard.
- The NFCR upstream of Paynesville supports high-quality fish and insect communities, including several fish species that are intolerant of pollution (e.g. smallmouth bass). This long river stretch should be protected so the communities can continue to thrive.
- Jewitts Creek was once impaired by ammonia, which is toxic to aquatic life, but improvements in wastewater treatment methods significantly decreased the ammonia level, resulting in the creek now meeting the water quality standard for ammonia. Although the improvements have reduced ammonia levels, the aquatic life in the creek has not yet fully recovered, as this will take time.

IBI

Stream IBI

The IBI is a tool that is used to measure a lake, stream, or river's health, utilizing aquatic communities. Fish and aquatic insect IBIs are used by the MPCA in streams and rivers, which this section summarizes. Between the first and second rounds of NFCRW intensive watershed monitoring (IWM), including biological and water chemistry monitoring, the MPCA adopted new rules to assess aquatic life in channelized streams and ditches (https://www.pca.state.mn.us/water/tiered-aquatic-life-uses-talu-framework). The new rules provide reasonable aquatic life protections for water bodies that were legally altered prior to the advent of the Clean Water Act. The most recent assessments include aquatic life use designations and assessment results for 17 legally altered streams segments.

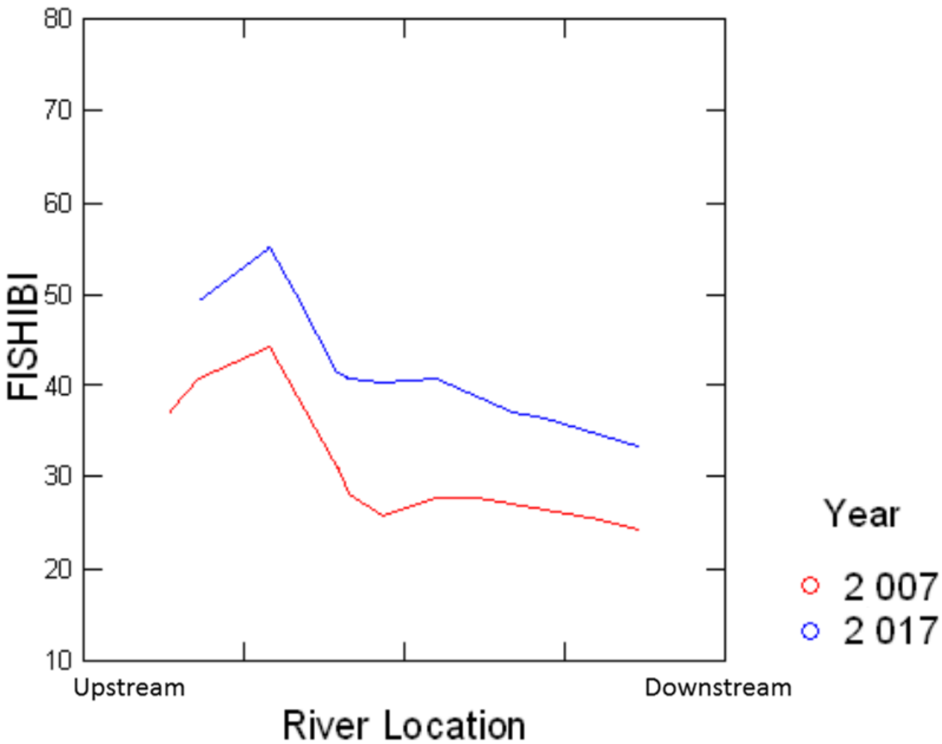
In the NFCRW, fish communities generally do not meet standards designed to protect aquatic life. While stream reaches and lakes in the upper portion of the watershed have fish communities that are in good condition, the majority of streams and lakes in the remainder of the watershed have fish communities that are severely degraded (NFCRW Water Assessment and Trends Update, April 2021). In general, fish communities in the watershed exhibit signs of degradation characterized by a dominance of pollution tolerant species. Most of the lakes with poor fish communities exhibited high watershed disturbance rates, nutrient impairments for aquatic recreation, known infestations of aquatic invasive species, and low to moderate shoreline habitat quality. Lakes with healthy fish communities typically were not nutrient impaired, had lower rates of watershed disturbance, and moderate to high shoreline habitat quality.

Aquatic insect communities tended to be in better condition in the larger rivers but still exhibited significant signs of stress in the smaller streams and headwater reaches. Overall, aquatic insect communities exhibit moderate signs of stress when averaged over the entire watershed.

Although several new biological impairments have been identified within the NFCRW, for both fish and aquatic insect communities, some of the existing impairments are undergoing changes due to methodology. Newer data collected in 2017 has indicated that the previous listings for aquatic insects within five stream reaches and one listing for fish were incorrect, and were corrected. This may have been a result of low water levels during the 2007 sampling or differences in aquatic insect habitat availability. The correction for the fish impairment is a result of the changes within the assessment methodology, and the result of additional monitoring that indicated that these reaches met standards.

The overall change in the health of aquatic communities in rivers and streams was measured by studying the difference in fish and aquatic insect communities of the NFCRW IBI scores between (NFCRW Water Assessment and Trends Update, April 2021) monitoring years. Forty-one stations were monitored in 2007 and again in 2017. Stations that were determined to be on a predominately channelized reach (>50% channelized) were not assessed during the first assessment cycle; however, IBI scores were calculated along these channelized reaches to allow for a direct comparison of channelized and un-channelized (natural) streams between time periods. In general, the stream biological communities of the NFCRW have improved a slightly since 2007.

Figure 8. FIBI scores on the Crow River, North Fork, 2007 vs. 2017. Lines were statistically smoothed (LOWESS) through the data from each year (MPCA 2021).



The average aquatic insect score for the watershed increased by 8.0 points between 2007 and 2017, a statistically significant improvement (paired t-test, P= 0.01024). The average FIBI score for the watershed increased by 5.8 points between 2007 and 2017, which was also statistically significant (paired t-test, P= 0.02028). On the mainstem NFCR, an increase in FIBI score from 2007 to 2017 is apparent (chart above).

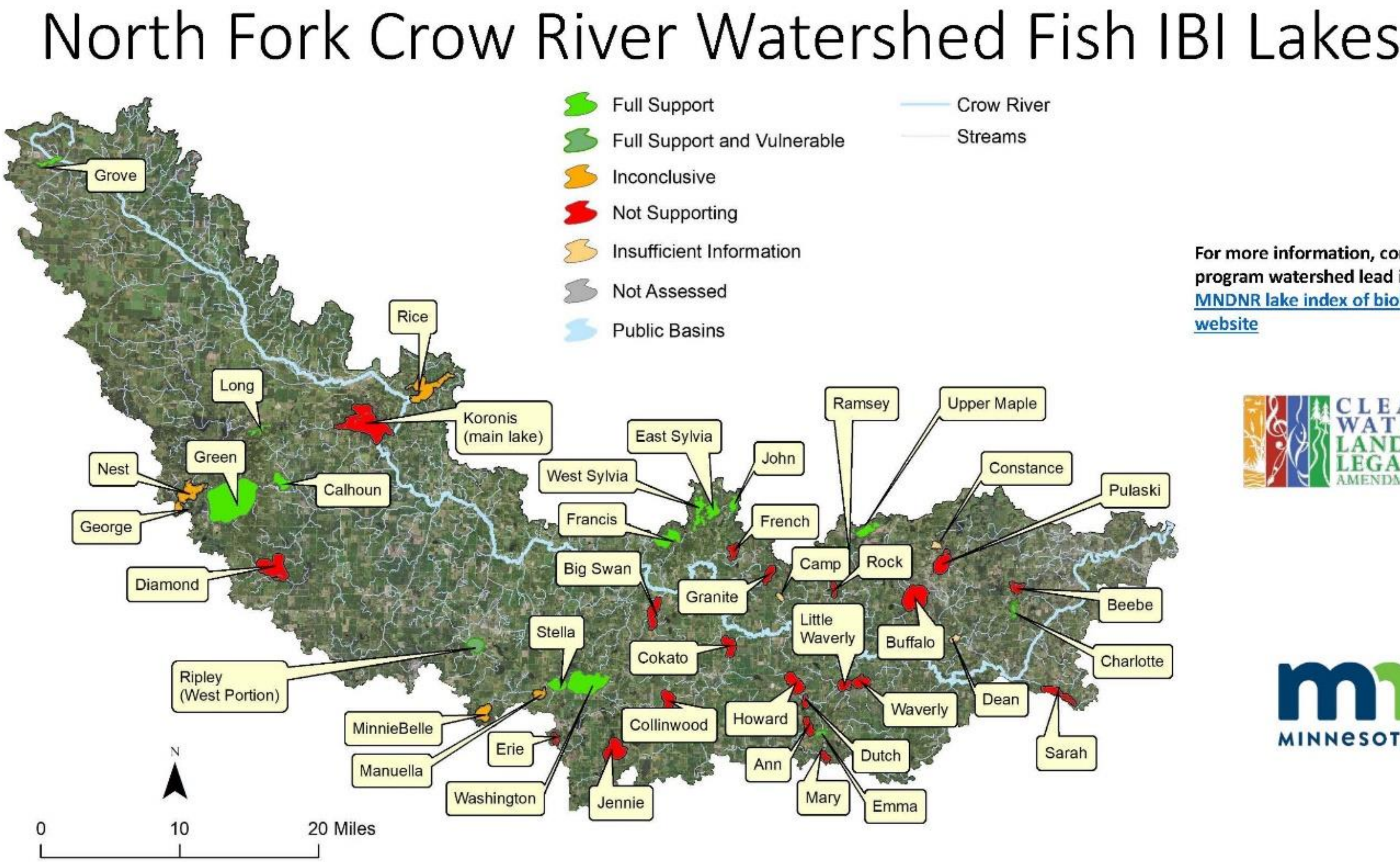
Looking beyond IBI scores to the underlying structure and function of biological communities, it is noteworthy that pollution-sensitive organisms (both fish and aquatic insects) have increased in these streams since 2007; this is a sign that water quality may be improving. In 2017, the average fish community of streams in the watershed included 13% sensitive fish species, an increase from 8% that was observed in 2007. However, the summer of 2007 was characterized by drought conditions; low streamflows, warm water temperatures, and poor DO conditions associated with the drought may also have contributed to the lower percentages of sensitive fish and aquatic insect species that were observed in 2007. Droughts tend to have a larger impact on smaller tributary streams, and could explain the larger changes in IBI scores on the tributary streams within the NFCRW. The increase in IBI scores may be an indicator of the resilience of streams in the NFCRW.

Overall, stream health in the watershed has improved a small amount since 2007. However, there did appear to be a consistent and significant improvement in the main stem of the NFCR.

Lake fish IBI

The DNR uses an IBI tool that uses fish communities for assessing aquatic life in lakes. Over half of the fish communities within the lakes did not meet standards designed to protect aquatic life, and most of the fish communities in the streams and rivers did not meet standards.

Figure 9. NFCRW FIBI Lakes.



For more information, contact IBI program watershed lead identified at: [MNDNR lake index of biological integrity website]

Figure 10. Lakes assessed as either Not Supporting, or vulnerable to Not Supporting, aquatic life (fish).

North Fork Crow River Watershed Lakes

In the North Fork Crow River Watershed 43 lakes were assessed for aquatic life using Fish IBIs. Of those 43 lakes 20 were not supporting the aquatic life use, 12 were fully supporting, three were fully supporting – vulnerable, five were inconclusive and three had insufficient information.

These summary slides focus on the stressor Id's for the lakes that were not supporting in the North Fork Crow River Watershed.

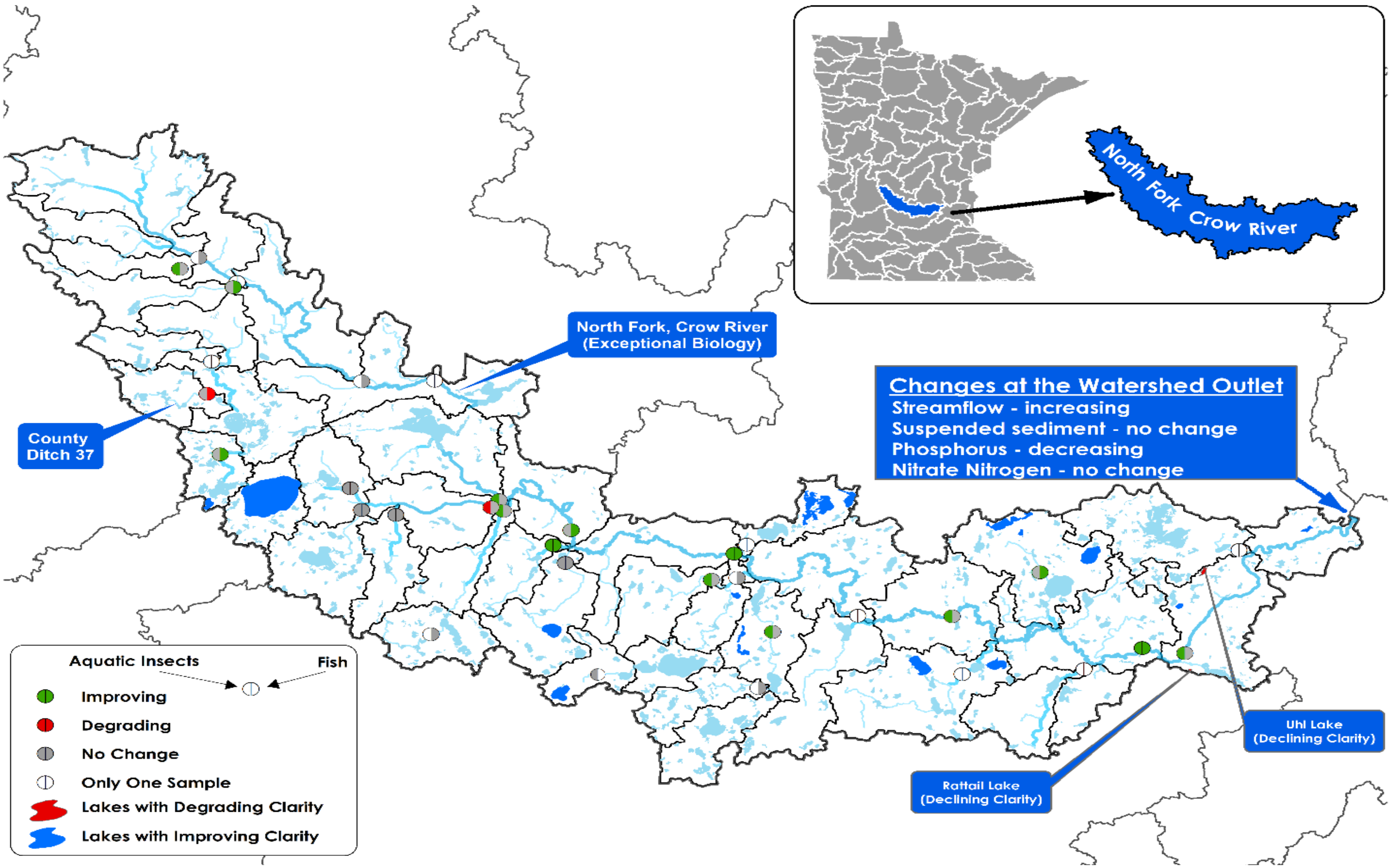
DOW	Lake	Fish IBI Tool	FIBI Scores	Impairment Threshold	Assessment Recommendation
27-0191-00	Sarah	2	19, 35	45	Not Supporting
34-0044-00	Diamond	2	15, 11	45	Not Supporting
34-0142-00	George	4	36	38	Inconclusive
34-0154-00	Nest	2	49, 38	45	Inconclusive - Vulnerable
47-0015-00	Jennie	7	25, 20	36	Not Supporting
47-0038-00	Big Swan	2	34, 31	45	Not Supporting
47-0050-00	Manuella	2	44, 50	45	Inconclusive - Vulnerable
47-0064-00	Erie	2	38	45	Not supporting
47-0119-00	Minnie-Belle	2	42, 41	45	Inconclusive - Vulnerable
47-0134-02	Ripley Lake - West	7	38, 47	36	Fully Supporting - Vulnerable
73-0196-00	Rice	2	57, 38, 53	45	Inconclusive - Vulnerable
73-0200-02	Koronis	2	23	45	Not Supporting
86-0011-00	Charlotte	2	45, 40, 47	45	Fully Supporting - Vulnerable
86-0023-00	Beebe	2	28	45	Not Supporting
86-0053-00	Pulaski	2	40, 36	45	Not Supporting
86-0090-00	Buffalo	2	12, 24	45	Not Supporting
86-0106-00	Little Waverly	7	22	36	Not Supporting
86-0114-00	Waverly	2	24, 29	45	Not Supporting
86-0182-00	Rock	2	19	45	Not Supporting
86-0184-00	Dutch	4	0	38	Not Supporting
86-0188-00	Emma	7	37, 36	36	Fully Supporting - Vulnerable
86-0190-00	Ann	2	5, 16	45	Not Supporting
86-0193-00	Mary	2	33, 25, 32	45	Not Supporting
86-0199-00	Howard	2	9, 15	45	Not Supporting
86-0217-00	Granite	2	12, 20	45	Not Supporting
86-0263-00	Cokato	2	32, 17	45	Not Supporting
86-0273-00	French	2	30	45	Not Supporting
86-0293-00	Collinwood	2	3, 7, 7	45	Not Supporting

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

Short fish IBI reports for many lakes in the watershed are found in Appendix A.

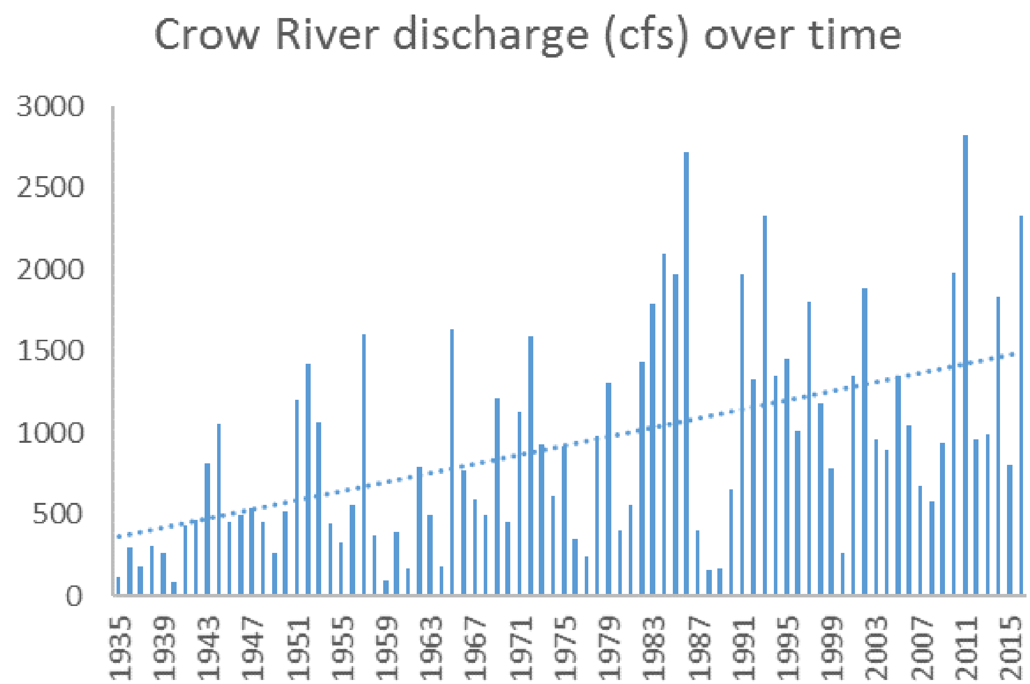
2.3 Water quality and quantity trends

Figure 11. Water quality trends in the NFCRW. Many water bodies are improving slightly in both total phosphorus content and biological diversity.



Both the 10-year interval IWM cycle for biological and stream chemistry monitoring described in the previous section, and the four Watershed Pollutant Load Monitoring Network (WPLMN) stations that operate every year on a long-term basis, provide data for determining water quality changes and trends. One of the WPLMN stations is located above the confluence of the NFCR and SFCR at Rockford, the others at upstream locations near Cokato, Manannah, and Paynesville. All WPLMN stations are on the NFCR except for the Manannah site, which is on the Middle Fork Crow River. The long-term nature of these stations is critical for trend analysis, measuring between-year differences in pollutant loading, and helping determine pollutant sources and their contributions.

Figure 12. Crow River annual flow (cfs; NFCRW assessment and trends update, MPCA, April 2021 https://www.pca.state.mn.us/sites/default/files/wq-ws3-07010204c.pdf).

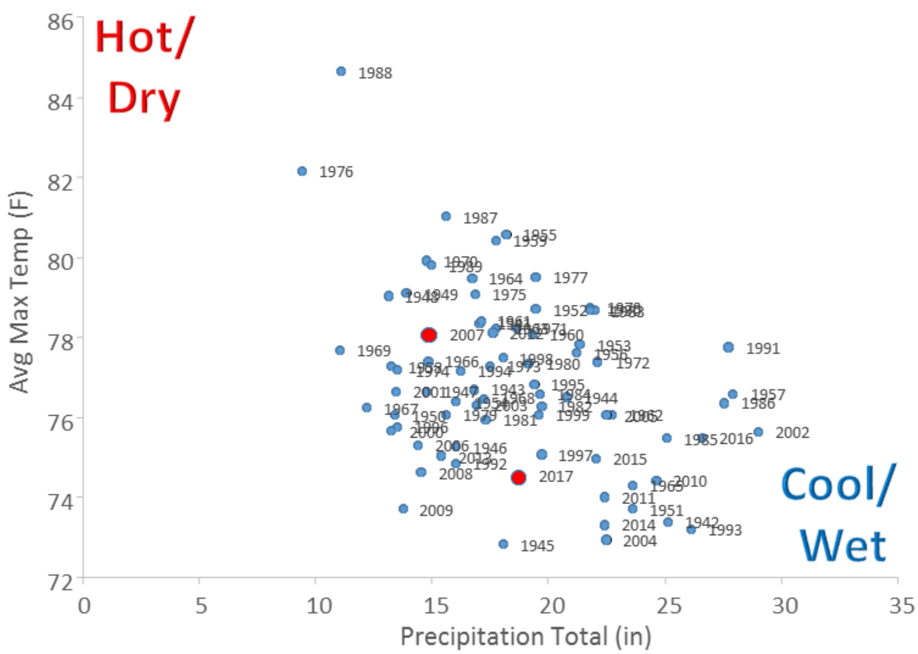


Streamflow and pollutant concentrations

Overall, scientists observed some change in water quality in the NFCRW over the past decade. In general, the health of aquatic communities in the streams and rivers within the NFCRW have improved a small but noticeable amount since 2007. In the streams and rivers of the watershed, modest improvement within the biology was observed. As for water chemistry, little change was observed throughout the watershed, but P was decreasing at the mouth of the Crow River. Lakes within the watershed appear to be trending in a positive direction for clarity, as more lakes had increasing clarity than lakes with decreasing clarity. Although some parameters are showing a positive trend, continued problems include high nitrate and P levels, and low DO levels. Overall, while some improvements have been seen, water quality is unfortunately still generally poor for aquatic life and recreation.

Annual streamflow (discharge) data is available for the NFCR since 2009. In that time period, there is no clear trend; although 2016 and 2017 were the highest flow years since 2011. A much longer data record exists for the Crow River downstream of the confluence of the north and south forks. There is an increasing trend in flow on the Crow River; it is not possible to know if either fork more strongly influences this trend (NFCRW Water Assessment and Trends Update, April 2021). However, flows are likely increasing in the NFCR. Increasing streamflow has implications for stream channel conditions and pollutant loading, namely more channel erosion and possibly more pollutant loading, even if pollutant concentrations are stable. Because loads represent the total amount of a pollutant moving through a system, this way of measuring water quality is important for downstream resources such as Lake Pepin and the Mississippi River, where these pollutants may accumulate. Since 2007, seasonal Kendall trend tests on suspended sediment, P, and nitrate nitrogen concentrations at the NFCR outlet were used to determine if changes over time were statistically significant. Only TP showed a statistically significant change, decreasing about 4% each year. Suspended solids and nitrate nitrogen concentrations are neither increasing nor decreasing according to the test.

Figure 13. Characterization of air temperature and rainfall conditions for May through September period across the historical record for the NFCRW. IWM years in red. Temperature data from Litchfield Coop monitoring station (Source: https://wrcc.dri.edu/summary/mnF.html).



Clarity of lakes

The NFCRW has approximately 250 lakes (greater than 10 acres and not protected by DNR as wetlands), several of which are large, flow-through lakes on the NRCR (e.g. Rice, Koronis) and the Middle Fork Crow (e.g. Nest, Green). About half of the lakes have some level of water quality data available from the Volunteer Lake Monitoring Program (VLMP), which coordinates monitoring and submital of transparency data on a huge network of lakes statewide every year. Those data end up playing a large role in statewide data analysis, which help to inform water quality assessments.

Trend analyses were conducted on 83 lakes in the watershed that had sufficient data (i.e., 50 Secchi measurements and a minimum of 8 years of data). Similar to statewide results, most lakes do not exhibit a trend, and of those showing a trend, more lakes are improving in clarity than declining.

Climate

The NFCRW now receives on average three additional inches of rain in the northwest to two addition inches of rain in the east portion of the watershed from the historical average (1895 through 2018). Furthermore, climate scientists suggest that precipitation events are becoming more intense. In addition, temperatures in the watershed have increased by 1.2 degrees in spring and fall over this time. Increased rainfall and temperature can worsen existing water quality problems. More precipitation and reduced snow cover can increase soil erosion, pollutant runoff, and streamflows. Increased streamflows in turn 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. See the DNR climate summary for the NFCRW here: http://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/climate_summary_major_18.pdf.

More information

For more information on NFCRW water body conditions and trends, go to https://www.pca.state.mn.us/sites/default/files/wq-ws3-07010204c.pdf on the MPCA website.

2.4 Stressors and sources

In order to develop appropriate strategies for restoring or protecting water bodies, the stressors and/or sources impacting or threatening them must be identified and evaluated. Biological SID is conducted for river reaches with either fish or macroinvertebrate biota impairments, and encompasses the evaluation of both pollutant and nonpollutant-related (e.g., altered hydrology, fish passage, habitat) factors as potential stressors. Pollutant source assessments are done where a biological SID process identifies a pollutant as a stressor, as well as for the typical pollutant impairment listings.

The following map and table show the locations of biologically impaired streams in the NFCRW, and the results of SID work on those streams.

The full NFCRW SID Report can be found at: https://www.pca.state.mn.us/sites/default/files/wq-ws5-07010204d.pdf

Stressors of biologically-impaired river reaches

Figure 14. Biological impairments in the NFCRW. 1. Middle Fork Crow River (511) 2. Judicial Ditch 17 3. County Ditch 37 4. Middle Fork Crow River (539) 5. Tributary to Lake Koronis 6. Silver Creek 7. Stag Brook 8. Collinwood Creek 9. County Ditch 26 10. Twelvemile Creek 11. Washington Creek (751) 12. Washington Creek (753) 13. County Ditch 36 14. French Creek.

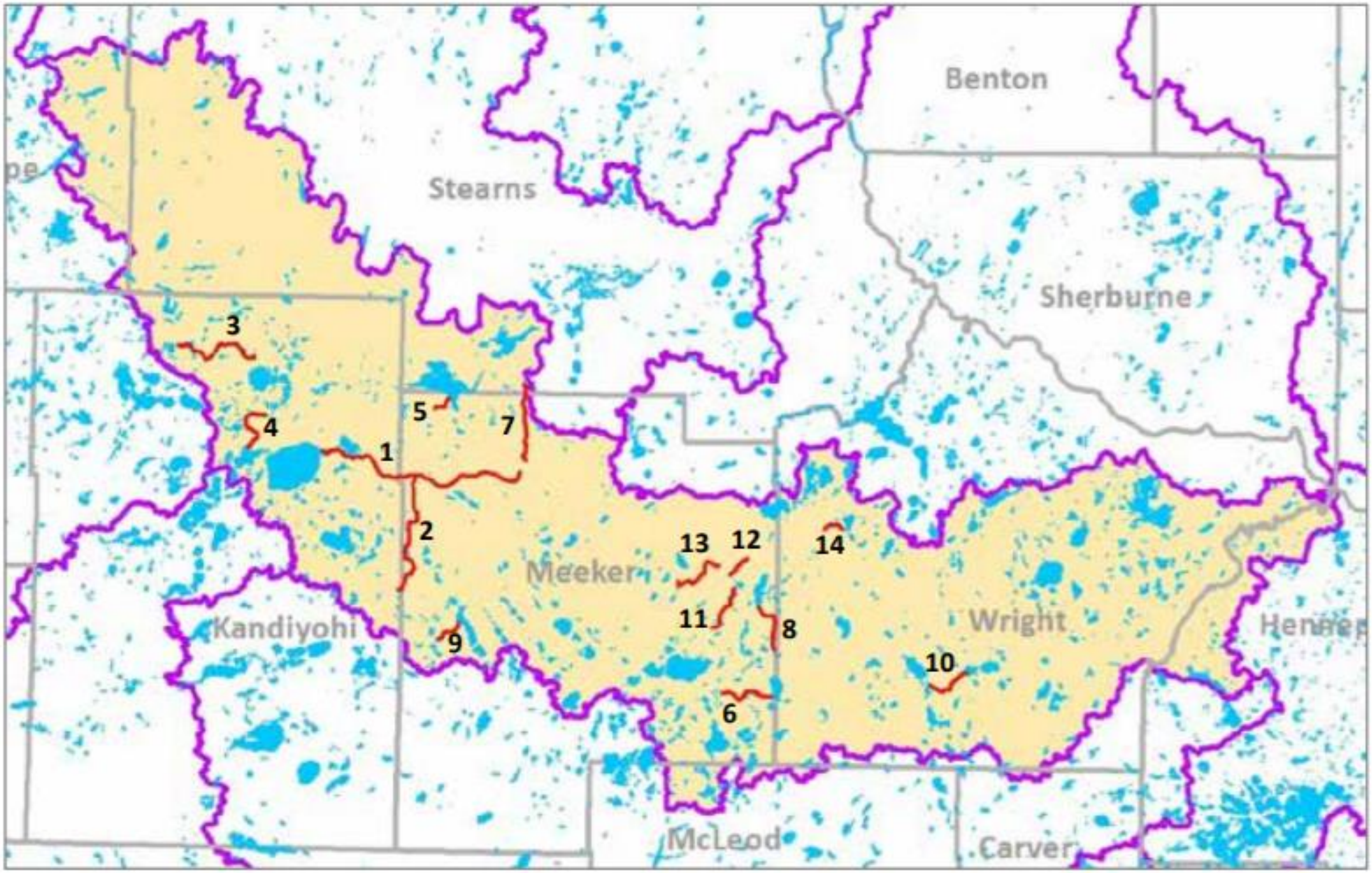


Table 4. Summary of stressors causing biological impairments in NFCRW streams by location (AUID). An empty cell means there is no evidence to suspect that particular stressor.

Water body	last 3 digits	Impairment	Stressor								
			Dissolved Oxygen	Phosphorus	Nitrate toxicity	TSS	Connectivity	Altered Hydrology	Channel alteration	Habitat	Toxic chemicals
Middle Fork Crow R.	511	Fish	?			?		•	♦	•	?
Judicial Ditch 17	532	Fish	•	♦	•				♦	•	
County Ditch 37	536	Fish	?						♦	•	
Middle Fork Crow R.	539	Fish	•	?						•	
Trib. to Lake Koronis	553	Fish			?	•	•				
Silver Creek	559	M-invert	•		•	•		•	♦	•	
Stag Brook	572	Fish, M-invert	•		•		•	?		•	
Collinwood Cr.	604	Fish, M-invert	•	?	•	?	•	?		•	
County Ditch 26	643	Fish, M-invert	•	♦					♦	•	
Twelvemile Cr.	679	Fish, M-invert	?			?					
Washington Creek	751	M-invert	•						♦	•	
Washington Creek	753	Fish	•			?			♦	•	
County Ditch 36	755	Fish, M-invert	•	♦	•	?	•		♦	•	
French Cr.	759	Fish, M-invert	•		?		•		♦	•	

♦ A "root cause" stressor, which leads to consequences that become the direct stressors. Possible contributing root cause.

• Determined to be a direct stressor.

o A stressor, but anthropogenic contribution, if any, not quantified. Includes beaver dams as a natural stressor.

X A secondary stressor.

? Inconclusive

2.5 Point sources and nonpoint sources

Although the majority of pollution in the NFCRW is attributed to nonpoint sources, point sources in the NFCRW do have the potential to contribute. Permitted facilities are mostly feedlots (which are allowed zero discharge) with 951 in the watershed. The MPCA Tableau databases also indicate that for other point sources there are:

- 13 MNG490000 Nonmetallic Mining and Associated Activity NPDES/SDS permitted facilities
- 20 NPDES/SDS permitted wastewater facilities (18 municipal and 2 industrial)
- 26 NPDES/SDS permitted industrial stormwater facilities - these discharges can be addressed with practices described in the Industrial Stormwater BMPs Handbook (MPCA 2015 https://www.pca.state.mn.us/sites/default/files/wq-strm3-26.pdf)
- 15 permitted MS4s (MS4s are addressed in the Minnesota Stormwater Manual (https://stormwater.pca.state.mn.us/index.php/Main_Page)

Figure 15. Total P contribution by source.

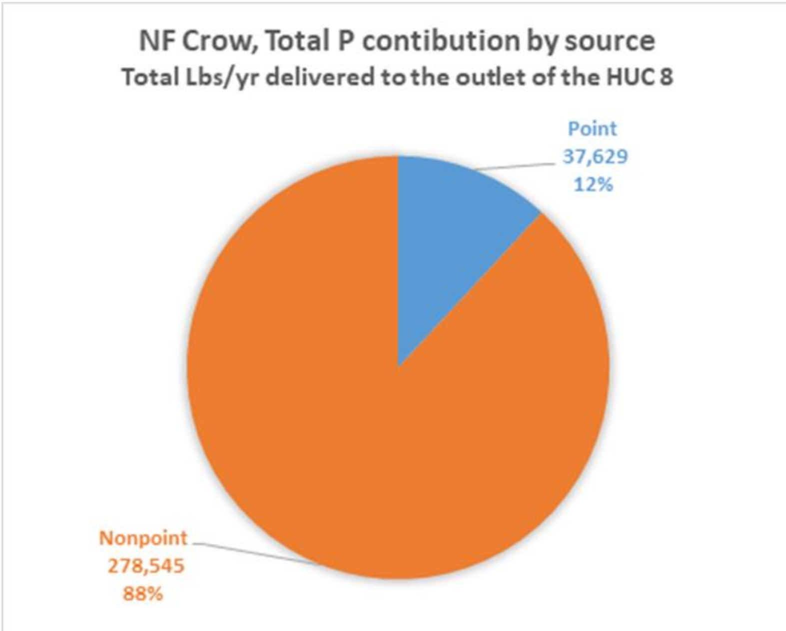
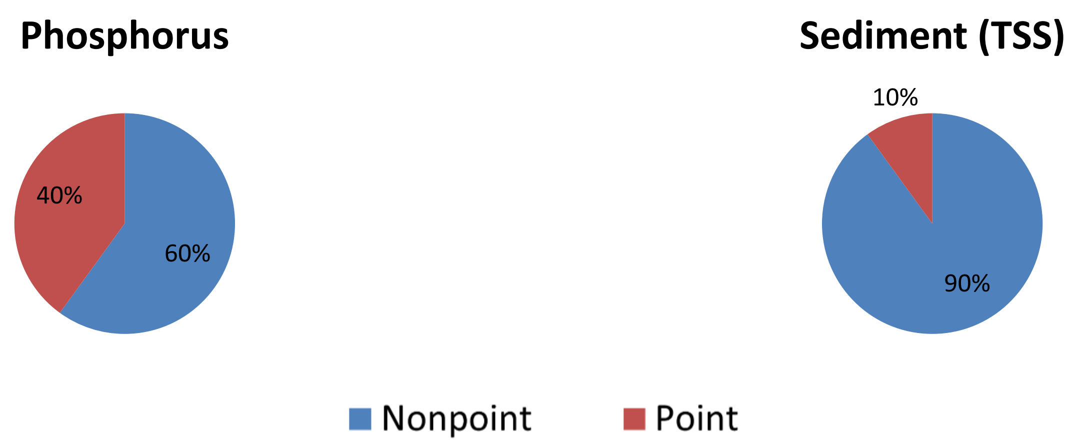


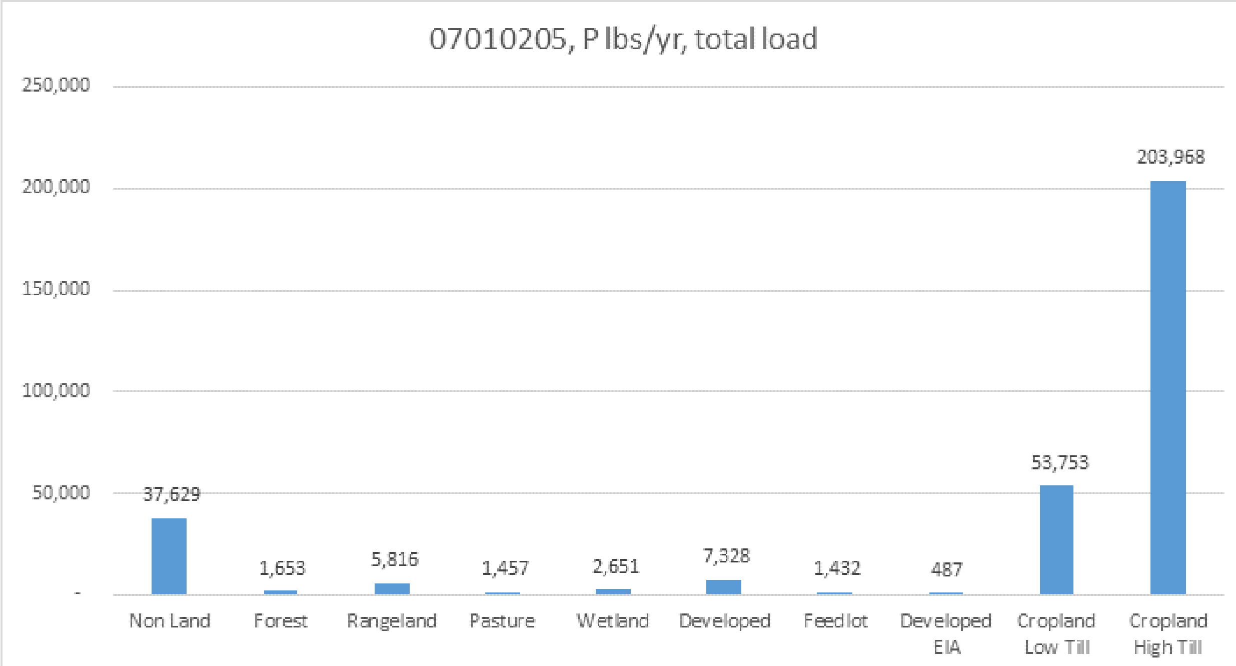
Figure 16. Overall breakdown of nonpoint source vs. point source pollution in NFCRW.



There are also approximately 1,500 construction stormwater permits open at a given time in the NFCRW; however, these sites are temporary and may not be active at any given time, and the permit requires stabilization of the sites if construction activity has ceased for 14 days or more.

As noted above, most of the pollution in the NFCRW is attributed to nonpoint sources. The following figure depicts the breakdown of loading of P of different nonpoint sources in the NFCRW.

Figure 17. Nonpoint sources in the NFCRW.



2.6 TMDL reports

A separate TMDL report for all of these impairments was completed and public noticed concurrently with this WRAPS report. There were 11 stream reaches and 4 lakes that had 20 TMDLs completed as part of this WRAPS update process as shown in Appendix C. Sixteen TMDLs for stream reaches were completed for *E. coli* (8), chloride (1), turbidity/TSS/IBI (3), and P (4). Lake TMDLs were completed for P (4). The allowable pollutant load allocation summary divided among the wasteload allocation (WLA), load allocation (LA), reserve capacity (RC), and margin of safety (MOS) for these TMDLs, and other information, are described in Appendix C.

To access this recently completed TMDL report, and many older TMDL reports in the NFCRW, refer to the TMDL documents on the MPCAs NFCRW webpage (North Fork Crow River | Minnesota Pollution Control Agency (state.mn.us)) and Appendix C.

3. Civic engagement

Civic engagement principles for the NFCRW

Civic engagement and public participation are among the most important aspects of achieving water quality goals. An educated and informed citizen base that responds to sound science and engages in BMPs will achieve great benefits to water resources. Behavioral changes can affect positive outcomes over a large portion of the landscape with no limitation to the effective life of the practices.

A challenge with civic engagement or public participation activities has been with determining their benefit or effectiveness in bringing about intended changes. In many cases, evaluation or reporting on a public participation activity has primarily been done by providing a count of attendees, or completing a survey immediately after the event which asks general questions about the quality or clarity of the materials and presenters. These methods of evaluation, while useful for determining the audience reached, does not measure the attainment of the intended objective of the activity.

The stakeholders in this WRAPS process, in order to better evaluate and improve upon civic engagement and public participation activities, have categorized public participation or outreach activities into eight categories:

1. K-12 Education (education usually taking place in a public school setting or school field trips for outdoor learning at parks, county water fests, Earth day, etc.)
2. Community Education (i.e., opportunity for community to understand, learn, and volunteer their time to assist partners in water conservation and protection)
3. Political (examples are watershed citizen advisory committees)
4. Sales and services (e.g., tree sales, rain barrels)
5. Citizen Science (i.e., encouraging citizen-led initiatives that promote conservation through peer-based outreach; for example, Adopt-a-Drain)
6. Urban Stewardship (i.e., promotion and education on source control within urban areas; for example, chloride reduction)
7. Shoreland Stewardship (i.e., promotion of natural shoreline vegetation)
8. Ag Stewardship (e.g., field tours, education, and financial resources to encourage soil health principles)

It is important to clarify the purpose of an engagement activity prior to determining how to evaluate it. If the purpose of an activity is merely to get people together, than counting attendees is certainly an effective method to evaluate the success of a project. If the purpose is to educate people, then evaluation is somewhat more complicated. Participants may have to express a willingness to take tests to determine if participants gained knowledge of the subject matter during the event. These tests may happen immediately before or after an event, or perhaps several weeks or months after an event has ended. If the goal of a presentation is to effect change in behavior, we also have to understand that it often takes repeated exposures to a new idea before a willingness to change actually takes place. For example, if 10% of the attendees have been exposed to this idea seven times or more previously, 30%

between three and six times, and 60% less than three times, we cannot reasonably expect that the presentation is going to have an equal effect of changing behaviors for all attendees. And if this is a new concept entirely, then expecting *anyone* to immediately change their behavior as a result of one exposure to the idea might be an unrealistic expectation. However, in this instance the presentation or activity should not necessarily be considered a failure, because now that the idea has been presented one time, the likelihood of effecting behavioral change the next time around increases.

To evaluate the success of an event intended to change behaviors, it may be helpful to have the attendees assist in determining the evaluation process for the event. By engaging the attendees in such a way, it may be more likely that they will be willing to provide contact information and follow up with the organizers at a future date, to then determine if, for example, practices described in a workshop have been implemented, or if the attendee was interested enough in the concepts demonstrated that they attended additional workshops or demonstration tours of similar practices. If behavioral changes (i.e., implementation of practices demonstrated in educational workshops or field tours) are observed and documented, determine, if possible, how many workshops or field tours had been attended by the individuals. By following up in this way, we can develop reasonable expectations as to the length of time and exposure required of new concepts before they become accepted, and we can also determine when a training method is exceeding this expectation, and therefore should be modified or eliminated as an educational practice.

Public participation plan

The Public Participation Plan for this WRAPS Update is attached to this document in Appendix D. The plan was developed during the early part of the WRAPS Update process. It was identified as a need during the 1W1P process, and was done within the WRAPS Update process to learn more about how to improve and evaluate civic engagement activities."

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, national origin or income — benefit from equal levels of environmental protection and have opportunities to participate in decisions that may affect their environment or health.

There are a number of tools available to determine where underserved communities could receive the most benefit from watershed work in the NFCRW. Using these tools, the MPCA staff can identify areas of the watershed where low income, linguistically isolated, or minority people are most likely to benefit from the work done in the watershed approach and 1W1P process. The MPCA will work with partners to look for opportunities to engage and offer our assistance in these areas. More information on environmental justice can be found on the MPCA website at https://www.pca.state.mn.us/about-mpca/environmental-justice.

Public notice for comments

An opportunity for public comment on the draft WRAPS report was provided via a public notice in the *State Register* from November 28, 2022 to December 28, 2022. There were two comments received and responded to as a result of the notice.

4. Restoration and protection strategies

The multi-organization partnership for implementing water quality restoration and protection strategies is the NFCR Water Planning Partnership created though BWSR 1W1P process. This planning partnership is an organization of six SWCDs and two WDs aimed at implementing prioritized and targeted actions that achieve in measurable results with money and guidance from BWSR.

Restoration strategies for the NFCRW are detailed in Section 4 of the NFCRW 1W1P (Comprehensive Watershed Management Plan) document https://www.nfcrwd.org/vertical/sites/%7B14D03102-88C8-485B-81E2-631AD7572BCC%7D/uploads/NFCR_Watershed_1W1P_05012018-Final(1).pdf

The targeted implementation schedule, BMP projects, and goals from this group of partners are the driving force for landowner contact on BMP implementation and are updated periodically with the most up to date adjustments of data, policy, and needs for improving water quality conditions.

The many water quality restoration and protection strategies within the NFCRW are identified and guided by the various partnerships of local government units, federal and state agencies, and nonprofits conservation organizations, including SWCDs, WDs, MPCA, DNR, BWSR, US Fish and Wildlife, Pheasants and Qual Forever, Ducks Unlimited, The Nature Conservancy, Lake Associations and more. All institutions provide their own special technical assistance, tools, and expertise to manage and protect land and water resources, and combining these efforts in partnership helps improve prospects that long term conservation goals can be fulfilled.

4.1 BMPs and load reduction goals

Any goal or plan cannot succeed without implementation and guidance from technical staff making sure that the objectives of a plan are being completed, while also adaptively adjusting to site specific issues that arise and from new data that becomes available. A good example of this is from the 1W1P Technical Advisory Committee and local governmental units (LGU) employees working to implement the NFCRW's 1W1P and supported by biannual budget overseen by the BWSR. The planning and monitoring strategies and installed BMPs by the 1W1P partners are the forefront of protection and restoration measures on the landscape resulting in the long-term water quality changes.

The tables below depict estimated number of practices, annualized cost, and progress toward achieving load reduction by planning region, based on implementing the "best", most cost-effective structural practices with the greatest reductions in the annual nutrient (N and P) load delivered to the planning region outlet (regional scale) and the greatest sediment load reduction reaching the catchment outlet (i.e., local scale). Estimates were developed using the PTMApp. Load reduction benefits from practice implementation are cumulative and do not consider implementation of upstream practices, and therefore are likely high. Benefits arising from implementation of management practices are not evaluated in this table.

Table 5. Strategies and load reduction goals from the 1W1P process show the most current top 250 BMPs for each planning region based on updated hydro conditioning modeling from PTMApp, with pollutant load reduction parameters estimating progress towards 10-year goals.

Planning Region	Treatment Group Type & Number of Structural BMPs	Estimated Annualized Cost	Parameter	Unit	Existing Condition at Planning Region Outlet	Load Reduction Goal		Load Reduction Expected from Implementation	Load Reduction Expected from Implementation (%)	Progress towards 10-yr Goal (%)
						Annual Load Reduction (%)	Target Load Reduction			
Lake Koronis- North Fork Crow River	Pond (34) Drain Mgt (183) Wetlands (11) Riparian Cover (22)	$276,670	Sediment	tons/yr	16,903	25%	4,226	2,754	16%	65%
			Total Nitrogen	lbs/yr	410,914	45%	184,911	44,711	11%	24%
			Total Phosphorus	lbs/yr	18,655	12%	2,239	2,347	13%	105%
Middle Fork Crow River	Pond (49) Herb Cover (40) Filter Strip (14) Drain Mgt (121) WaSCoB (1) Wetlands (26)	$434,048	Sediment	tons/yr	22,822	25%	5,706	2,205	10%	39%
			Total Nitrogen	lbs/yr	357,462	45%	160,858	41,887	12%	26%
			Total Phosphorus	lbs/yr	16,302	12%	1,956	2,009	12%	103%
Jewetts Creek- North Fork Crow River	Pond (47) Riparian Cover (12) Filter Strip (7) Grass Waterway (6) Drain Mgt (82) WaSCoB (91) Wetlands (5)	$425,116	Sediment	tons/yr	31,254	25%	7,814	4,947	16%	63%
			Total Nitrogen	lbs/yr	851,960	45%	383,382	34,721	4%	9%
			Total Phosphorus	lbs/yr	41,185	12%	4,942	1,899	5%	38%
Washington Creek	Pond (61) Riparian Cover (12) Filter Strip (7) Drain Mgt (73) WaSCoB (94) Wetlands (3)	$469,752	Sediment	tons/yr	16,571	25%	4,143	6,923	42%	167%
			Total Nitrogen	lbs/yr	134,195	45%	60,388	37,343	28%	62%
			Total Phosphorus	lbs/yr	6,132	12%	736	2,086	34%	283%
Big Swan Lake	Pond (48) Riparian Cover (8) Filter Strip (1) Grass Waterway (5) Drain Mgt (57)	$498,226	Sediment	tons/yr	14,460	25%	3,615	7,823	54%	216%

Planning Region	Treatment Group Type & Number of Structural BMPs	Estimated Annualized Cost	Parameter	Unit	Existing Condition at Planning Region Outlet	Load Reduction Goal		Load Reduction Expected from Implementation	Load Reduction Expected from Implementation (%)	Progress towards 10-yr Goal (%)
						Annual Load Reduction (%)	Target Load Reduction			
	WaSCoB (125)		Total Nitrogen	lbs/yr	129,967	45%	58,485	39,518	30%	68%
	Wetlands (6)		Total Phosphorus	lbs/yr	5,610	12%	673	2,269	40%	337%
	Ponds (83) Riparian Cover (16)	$455,598	Sediment	tons/yr	37,247	25%	9,312	3,860	10%	41%
North Fork Crow River	Grass Waterway (1) Drain Mgt (108) WaSCoB (17)		Total Nitrogen	lbs/yr	994,687	45%	447,609	47,545	5%	11%
	Wetlands (25)		Total Phosphorus	lbs/yr	48,921	12%	5,871	2,476	5%	42%
Crow River	Ponds (27) Riparian cover (14) Grass Waterway (4) Drain Mgt (147)	$317,413	Sediment	tons/yr	25,349	25%	6,337	4,677	18%	74%
	WaSCoB (43)		Total Nitrogen	lbs/yr	916,665	45%	412,499	38,078	4%	9%
	Wetlands (15)		Total Phosphorus	lbs/yr	50,208	12%	6,025	2,166	4%	36%

Red cells indicate achievement of load reduction goal through implementation of all 250 best structural practices

4.2 Select subwatershed studies and field tours

As a part of the WRAPS process, the MPCA staff worked with local partner staff to tour a variety of BMP sites in five select subwatersheds of the watershed (see Figure 2). The purpose of these tours was to find out what types of practices were being used, which ones were functioning the best under what types of conditions, and which ones could have been done differently or have been improved on. These practices included wood chip bioreactors, weirs, settling basins, WASCOBs, limestone filters, shoreline restorations, rain gardens, and other practices. As different conditions require different practices, the tours were conducted to find out what types of practices were best suited for what types of conditions, to help with further effective promotion BMPs. In some instances, the tours included areas outside of the priority areas if they included BMPS that could not be found within the priority areas.

During field tours, staff spoke with farmers and lakeshore owners. Staff found that in many cases, farmers had a better understanding of how water quality is affected by land use than did lakeshore owners that were interviewed. Both lake shore owners and (more frequently) farmers occasionally experienced situations where gully erosion or an influx of invasive species had escalated to nearly irreparable conditions due to a failure to report worsening conditions to local government organizations when they could have been diagnosed and repaired at a much lower cost.

Farmers that spoke with staff expressed an overall willingness to implement practices that would reduce the impact of their activities on surface or groundwater, provided that the practice created minimal impact to their farming activities. BMPs such as alternative tile intakes using small aggregate were well liked because farming equipment could be driven over them without affecting use of the field. Wood chip bioreactors were used, although less technically understood. Soils in some parts of the watershed, such as those in the TwelveMile Creek Subwatershed, have higher clay contents, and thus allow for more stable compaction, important for WASCOBs to hold up in heavy rain events. For some, “farmable” WASCOBs are preferred, or WASCOBs that can be planted around thus taking up less space than grass waterways.

Cover crops are being used in some cases, but there is still uncertainty regarding when and what to plant, and other factors such as the effects of herbicide residue, winter weather, and other issues. With time, experience, and education, many of the current concerns with cover crops can be resolved.

Invasive species such as buckthorn that are frequently found in the vicinity of agriculture would ideally be removed and replaced with native communities. Such work is typically expensive and time consuming, although if methods are found to accomplish this task more effectively, they could be of great importance for improving the function of forest stands in protection of water quality. If farmers were able to identify the presence of certain invasive species before they became problematic, it might be easier to remove them before they kill off native vegetation that works to infiltrate and filter out contaminants.

There are many different BMP options to address site specific areas to reduce pollutants from entering the waterways, keep soils in place or repair erosion, but significant problems are often the willingness of landowners to proactively act or inform LGU of ongoing problems until it gets to a more dire situation, and dollars for costly engineering designs and construction.

Five subwatersheds were chosen for focused study in this WRAPS update (see the two figures below for their locations in reference to pollutant loadings), and include one that is primarily agricultural, one that is mostly forest and lake, one that is primarily urban, one focused on forest and shallow lake, and one characterized by impaired wetland. These five subwatersheds were studied so that developing a more detailed understanding of the characteristics of each of these will lead to a better understanding of how to address water quality concerns in similar areas across the whole NWCRW.

The following two maps show the location of the five select subwatersheds, in relationship to loading of P and TSS.

Figure 18. Total phosphorus loading in the NFCRW. The darker areas have the highest loading. Total loading is different from loading concentration, which reflects sources that have the highest concentration of phosphorus but may have much lower volumes. Priority study areas are highlighted.

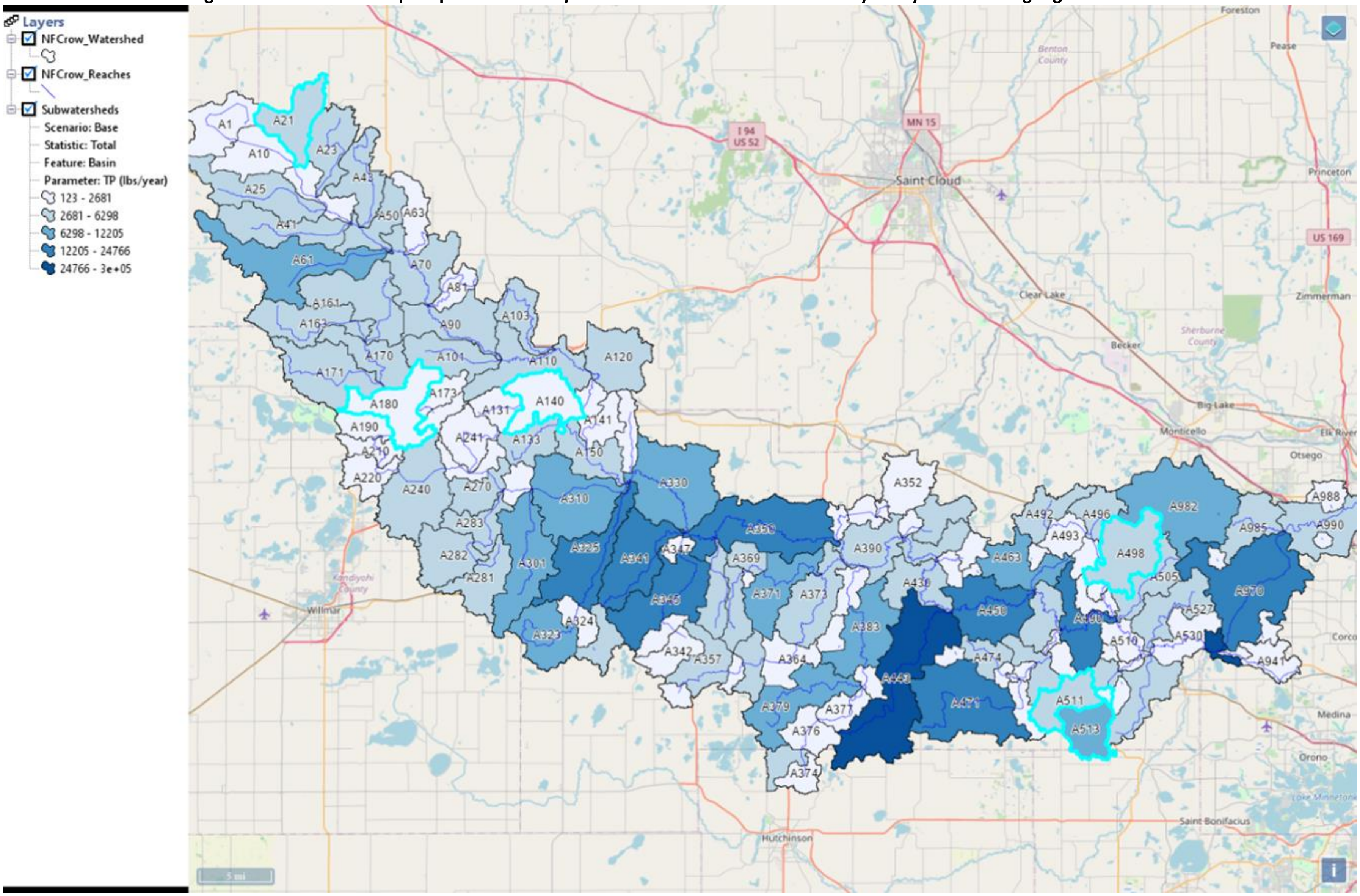
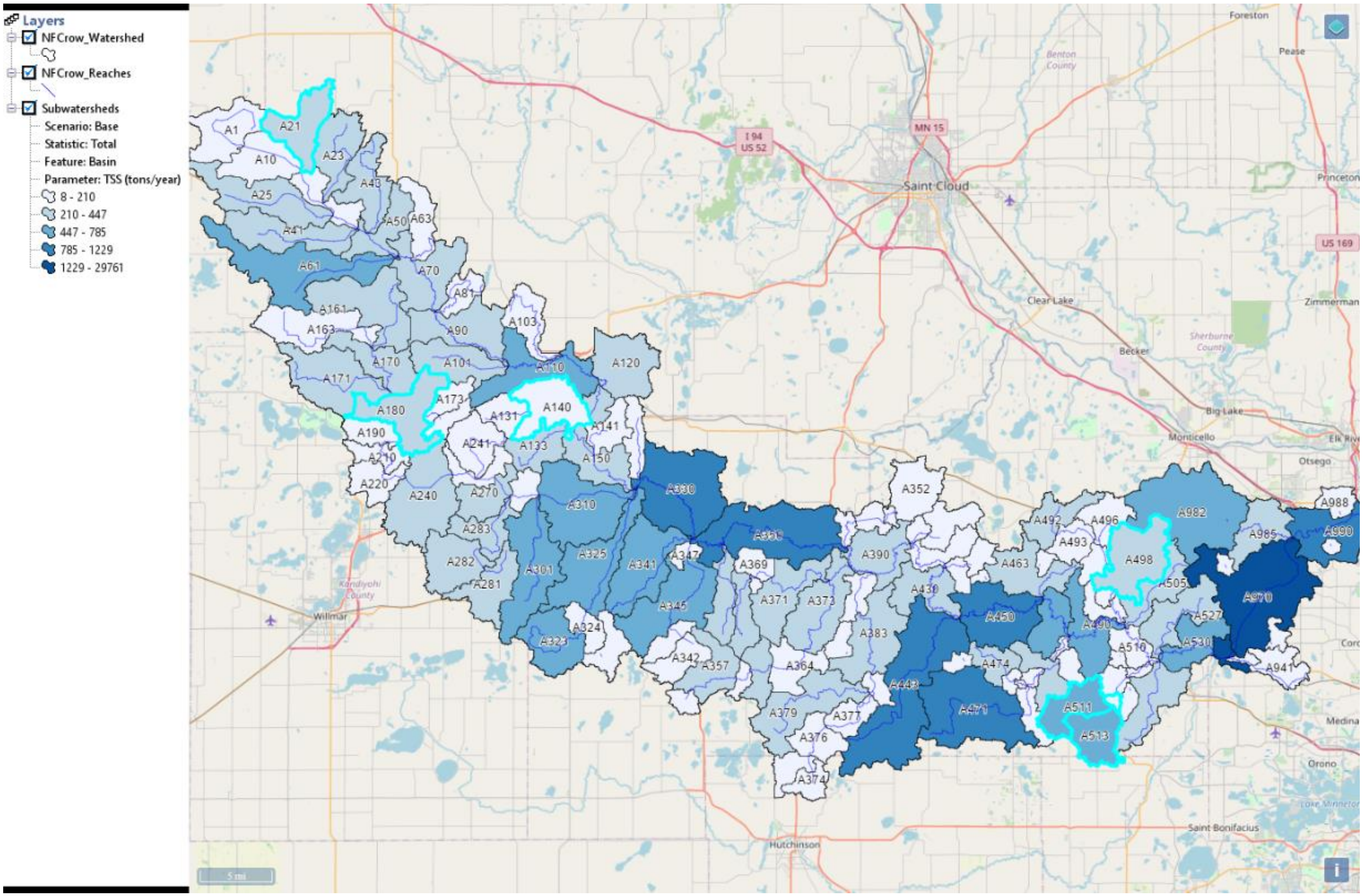


Figure 19. TSS loading in the NFCRW. The darker areas have the highest loading. Total loading is different from loading concentration, which reflects sources that have the highest concentration of TSS but may have much lower volumes. Priority study areas are highlighted.



North Fork Crow River Headwaters Subwatershed (representation of primarily agricultural area)

Figure 20. North Fork Crow River Headwaters.

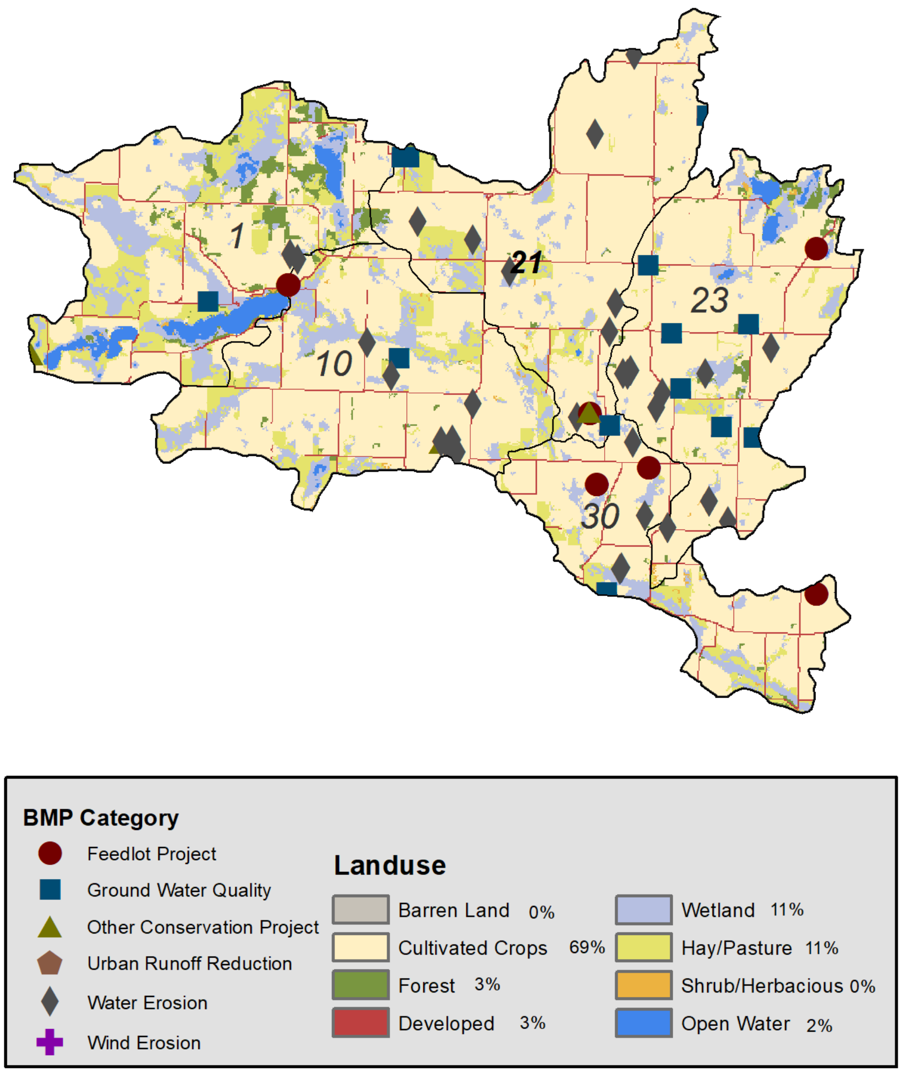


Table 6. Priority Areas: North Fork Crow River Headwaters (070102040102).

Land Use	Percent	Acres
Open Water	2	895
Developed	3	1326
Barren Land	0.01	4
Forest	3	1101
Hay/Pasture	11	4605
Cultivated Crops	69	28954
Wetlands	11	4734

The NFCR Headwaters Subwatershed was chosen for study because of its high amount of agricultural land use. Nearly 29,000 acres of this watershed are being used for row crops, which require specific BMPs for that land use type. The preferred BMP for use in this area is the alternative graveled tile intake (Figure 21), of which 22 have been installed in this subwatershed according to eLINK (eLINK is a database used by local government units to report BMPs, their locations, and reductions associated with said practices funded by Clean Water Funds, Section 319 grants, and Clean Water Partnership loans). Many of the farmers in this area are proponents of alternative drain tile inlets because they can be driven over with equipment, farmed over, and they are inexpensive.

Figure 21. An alternative (rocked) tile inlet that helps filter nutrients before entering drain tile. Photo taken in the North Fork Crow Township, Headwaters NFCR, HUC-12 070102040102.

P and sediment removal have been shown to be reduced by up to 50% by these systems when compared to open tile intakes.

Wood chip bioreactors (Figure 22) have also been installed in this area. A common practice is to use a carbon source (wood chips) to support removal of nitrate under anaerobic conditions (up to 40% in this area) and small amounts of P by a variety of mechanisms. The advantages of these systems include relatively high rates of nitrate removal, small footprints, minimal maintenance, and low installation costs. The system installed on one farm took up very little space, and treated approximately 15 acres. The potential disadvantage of this system is that it requires a sufficient amount of water to competely saturate the wood chips to create anaerobic conditions (to convert nitrate to nitrogen gas), which can result in a slowing or stoppage of water flow through the system. This can lead some farmers to remove the stops in the system to allow water to flow more easily, but this also reduces or eliminates the effectiveness of the system.

Figure 22. This wood chip bioreactor takes up little space and effectively removes nitrates from agricultural runoff. Photo taken in the North Fork Crow Township. Headwaters NFCR, HUC-12 070102040102.

WASCOBs are not frequently used in this area. This is likely in part due to a low clay content in the soils, which are primarily loamy. Clay soils help WASCOBs remain solid and effective during periods of high precipitation, but low clay content makes them more vulnerable to large rain events because they are more difficult to compact and can thus blow out more readily in high flows.

A project that has been implemented in this area is the “Prairie Storm” wetland restoration (Figure 23), which consisted of a weir that created a 22 acre wetland that allowed runoff to settle out before being discharged to a ditch that ultimately discharges to the NFCR. The project was installed on US Fish and Wildlife land, and funded in partnership with the North Fork Crow River Watershed District (NFCRWD), the Board of Water and Soil Resources (BWSR), Clean Water Fund grants, Pheasants Forever, and local landowners. This project has been in place for approximately three years, and has been effective at allowing sediment and P to settle out of the water before reaching the North Fork of the Crow River. However, there have also been maintenance issues caused by beaver activity, plugging the outlet of the wetland, and there has been concern expressed by local landowners that the water volume caused by the project has, or could, affect their cropland in rainy years.

Figure 23. The "Prairie Storm" wetland restoration is located in the NFCR Headwaters. It is installed on a USFW waterfowl production area, and captures the drainage from 600 to 800 acres of farmland and settles out sediment before discharging to a ditch, which ultimately empties into the North Fork of the Crow River. Beaver activity has affected the functionality of the project by plugging the riser in the wetland, which then keeps overflow water from draining to the creek.

Figure 24. The Prairie Storm Project helps to settle sediment and phosphorus out of stormwater before discharging to the North Fork of the Crow River via JD 1. The intake for the water bypass had become plugged with mud due to beaver activity, causing more water to back up behind the weir than perhaps was intended. Photo taken in the Raymond Township Headwaters NFCR, HUC-12 070102040102.

Other practices that have been implemented in this area include nutrient management, septic system upgrades, prescribed grazing, waste management, and storage systems.

Although there are no large lakes in this primary focus area of the watershed, Grove Lake is within the HUC-12, and recieves runoff from agriculture from Judicial Ditch 1. Overall, the lake is relatively clean, with P and chl-*a* levels generally meeting the standard. More information on Grove Lake can be found in the lake protection summary that is an appendix to this document.

Most BMPs that have been implemented in this subwatershed appear to be functioning properly, although more need to be installed, and complimented with soil health improvement practices such as cover crops or no-till. The more complex structural practices such as the installation of the weir at the Prairie Storm site seem to be beneficial, although perhaps not as beneficial as intended. In this specific instance, beavers seem to have plugged the bypass intake with mud, forcing water to back up into farm fields and water to run over the top of the weir and around it. Design elements and proper installation are critical to any BMP, and the more pieces there are to the design the more likely a failure will occur at some point in the project, whether it is due to a flaw in the design, the installation, or some unforeseen complication such as beavers or excessively high rain events.

Lake Koronis Subwatershed (representation of forested areas with deeper lakes)

Figure 25. Lake Koronis Subwatershed.

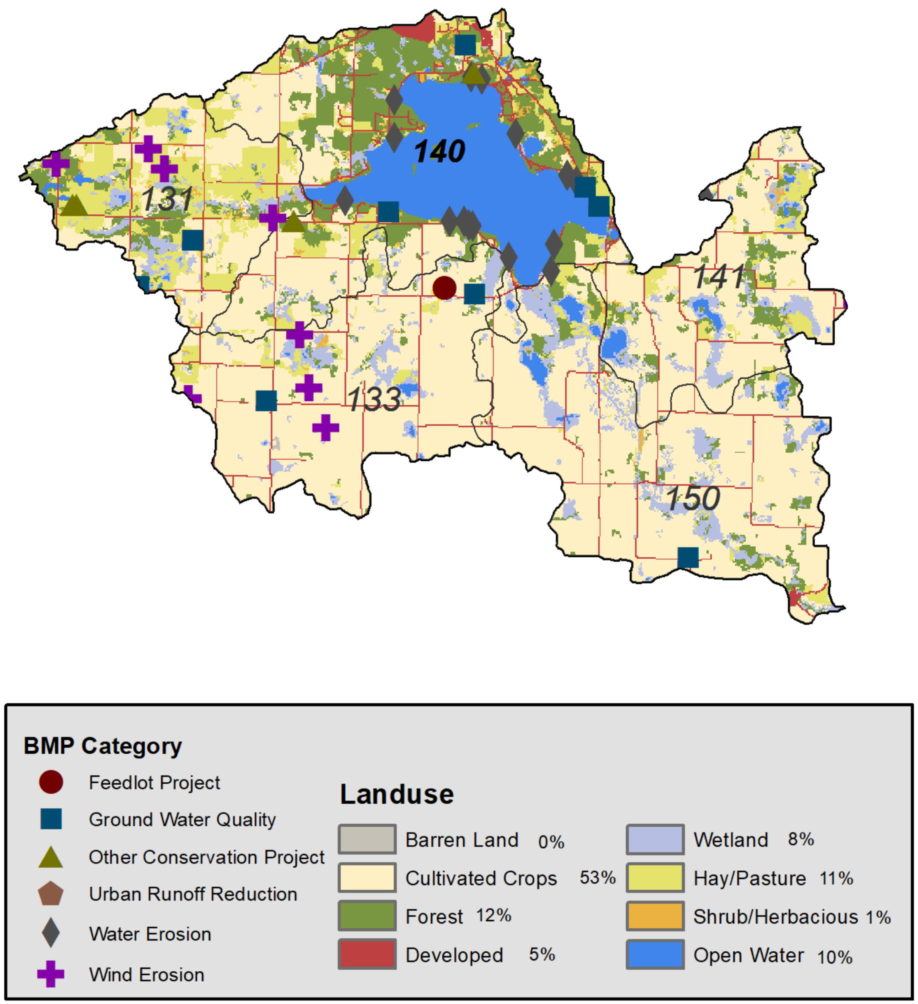


Table 7. Land use in Lake Koronis (070102040108).

Land Use	Percent	Acres
Open Water	10	3409
Developed	5	1553
Barren Land	0.18	58
Forest	12	3868
Hay/Pasture	11	3626
Cultivated Crops	53	17652
Wetlands	8	2681
Shrub/Herbacious	1	267

This subwatershed was chosen to represent forested areas with deeper lakes in the watershed. There are five catchments within the larger subwatershed, with a total of 106 known BMPs implemented within its boundaries. The most commonly implemented BMPs are streambank and shoreline restoration (18), conservation cover (16), windbreak/shelterbelt establishment (9), wetland restoration (8), and well decommissioning (8).

The water in Lake Koronis meets the standards for nutrients, and has been assessed as fully supporting of aquatic recreation. However, the lake IBI scores in recent years have been poor. This is mostly attributable to a relatively high dock density (18 docks/km of shoreline) and altered land cover. Koronis has a maximum depth of 132 feet, and is home to a population of tullibee, so maintaining healthy biological diversity for this lake is of enhanced importance.

There is a significant amount of cropland in this area (almost 18,000 acres), but the effect of the cropland is mitigated somewhat by nearly 4,000 acres of forest land. There is also a significant amount of Conservation Reserve Program (CRP) land west of Lake Koronis (1,000 acres as of 2013), and the combination of the natural forests (Figure 26) with the CRP land likely provide enough protection to keep the water quality from becoming impaired.

Lake Koronis is also likely affected by the impaired status of Rice Lake, which connects to Lake Koronis via the NFCR and Mud Lake. The NFCR north of Paynesville is impaired by *E. coli*, largely due to the high quantity of animal units in the watershed, many of which have direct access to the river (Figure 27). The river then flows through Paynesville, which contributes to reduced water quality because of significant impervious surface and associated runoff. It then flows through the southernmost end of Rice Lake, and down to Mud Lake and into Lake Koronis. Rice Lake is impaired by nutrients, and a TMDL for that Lake was completed in 2012. The following paragraphs describe some recommended practices for implementation to continue to address that TMDL:

- Protect and restore high-value wetlands to prevent P export. Numerous high-value wetlands are present in the watershed. As development or redevelopment occurs, there is the potential to discharge stormwater and additional nutrients and sediment to the wetlands, altering the hydroperiod and natural assimilative characteristics and converting the wetlands from nutrient sinks to nutrient sources. Protecting the wetlands from these impacts will ensure they don't increase nutrient loading to the lake. Furthermore, fixing wetlands that are discharging P will decrease nutrient loads.

- Increase infiltration and filtration in the watershed. This can be accomplished through large scale infiltration areas, removing tile lines, adding buffers, or adding vegetated swales.

The Lake Koronis Subwatershed benefits from Reinvest in Minnesota conservation lands, extensive forest lands, and practices installed on the lakeshore by dedicated lakeshore owners such as raingardens (Figure 29). However, upstream of the lake the NFCR contributes significant quantities of nutrients to the lake, and invasive species such as buckthorn damage the understory of these forests (Figure 28), which can reduce the natural function of these systems to filter and infiltrate runoff (see “Allelopathic Invasive Tree (Rhamnus cathartica) alters native plant communities,” R.J. Warren, Adam Labatore, Matt Candeias, February, 2017). Invasive species control and additional habitat restoration and soil stabilization practices upstream of the lake will help to protect this lake more effectively. Exclusions to help keep cattle out of the river would reduce sediment transport to the lake. There were three practices identified by local government staff partners that are most commonly implemented by farmers in the area, and they are alternative tile intakes, restored tiled wetlands, and WASCOBS. Of these three, alternative tile intakes would reduce the P load the most (198 lbs annually), and for the least cost, according to the Lake Protection Report, which was developed as a part of this NFCRW WRAPS Update process.

Figure 26. Forest land such as this, located to the northwest of Koronis, helps keep water quality clean. Photo taken in the Paynesville Township. Lake Koronis-NFCR, HUC-12 070102040108.

Figure 27. This photo taken upstream of Paynesville on the NFCR shows an area where cattle have eroded the bank by entering the river repeatedly. This is not uncommon along the upper reaches of the NFCR, and likely impacts water quality as it enters Rice Lake before flowing south to Lake Koronis.

Figure 28. The presence of buckthorn or other allelopathic plant species can decimate the understory of forests and reduce the benefits they have to water quality.

Figure 29.This rain garden was part of a treatment train/shoreline restoration project on the north side of Lake Koronis. Practices such as this, although beneficial for water quality, are in themselves insufficient to prevent large algae blooms from occurring nearby in the lake. Protection and restoration often, if not always, require multi-tiered approaches with a variety of BMPs installed.

Middle Fork Crow River (070102040204) Subwatershed-Catchment ID 4378, Lake Monongalia, or Mud Lake (representation of forested areas with shallow lakes and urbanization)

Figure 30. Lake Monongalia Subwatershed.

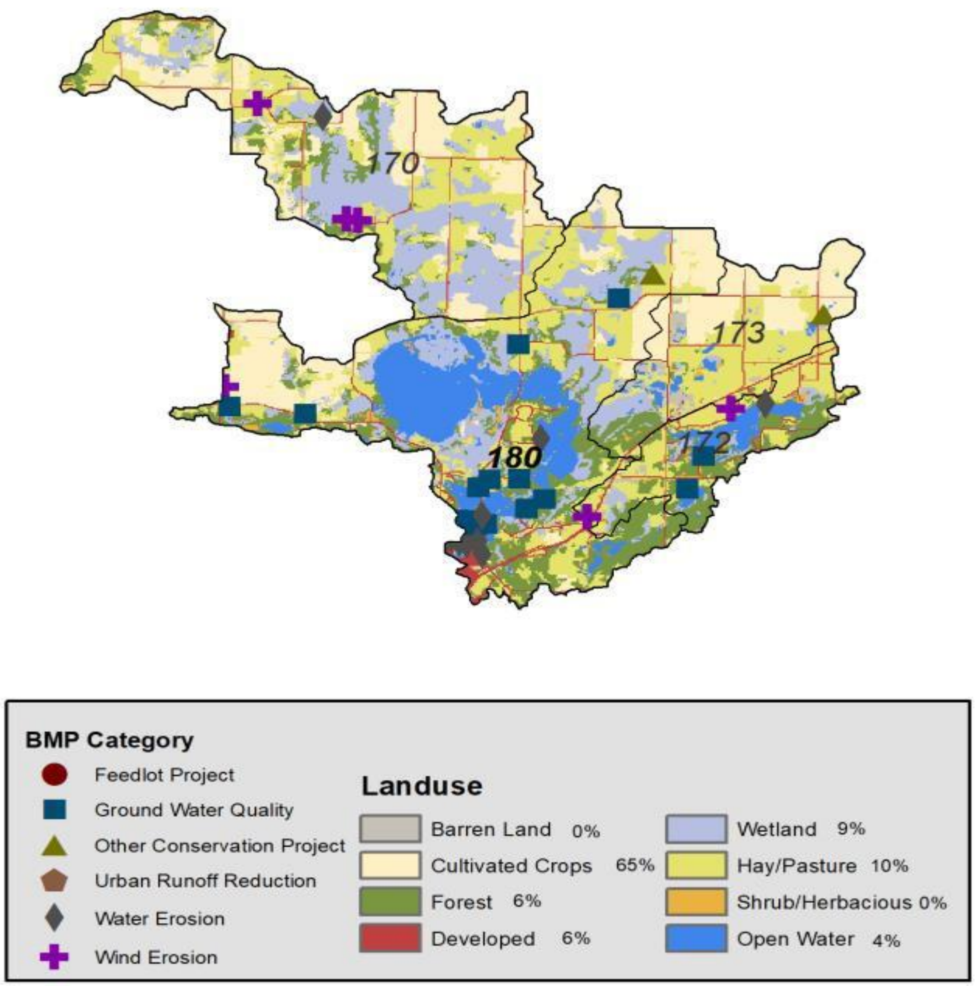


Table 8. Land use in Lake Monongalia (070102040204).

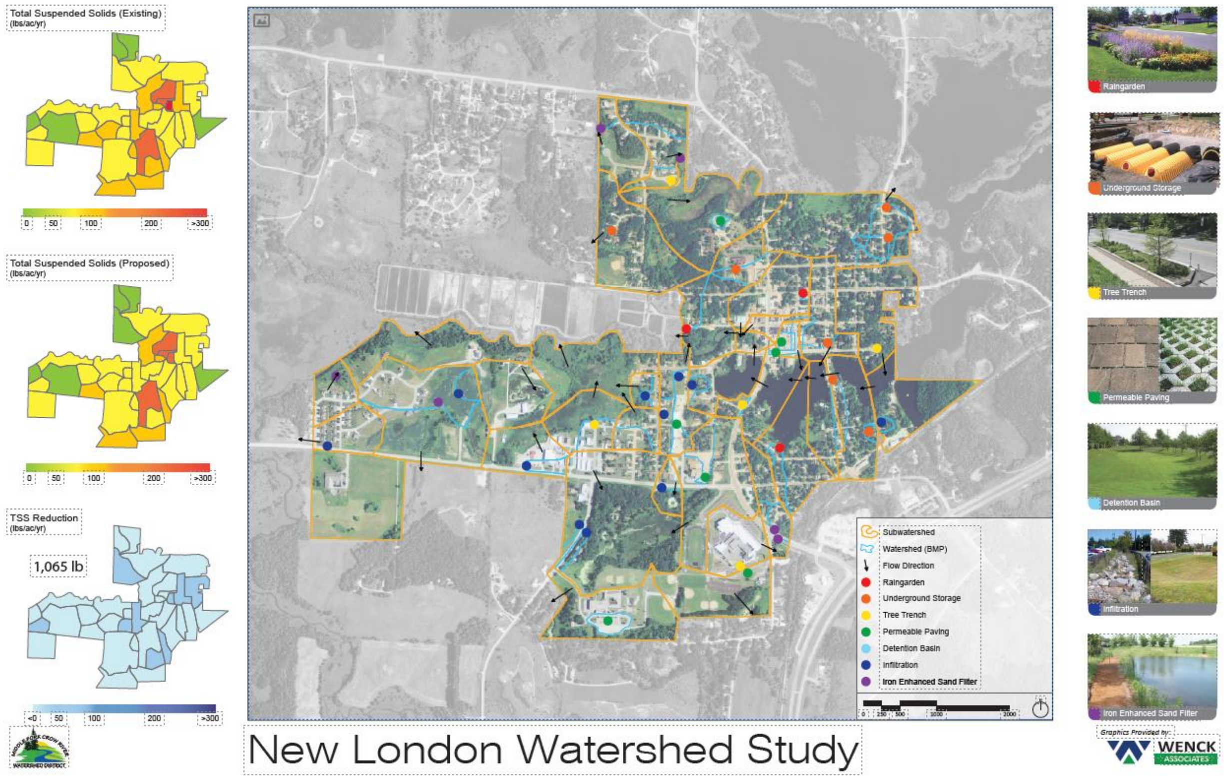
Land Use	Percent	Acres
Open Water	10	2546
Developed	5	1216
Barren Land	1	256
Forest	3	865
Hay/Pasture	28	7044
Cultivated Crops	21	5272
Wetlands	20	5039
Shrub/Herbaceous	1	296

This subwatershed was chosen to represent forested areas with shallow lakes and urbanization in the watershed. There are 4 catchments within the larger subwatershed, with a total of 36 known BMPs implemented within its boundaries. The most commonly implemented practice is streambank and shoreline protection (10).

Water quality in the Middle Fork Crow River Subwatershed is mostly good, with both Lake Monongalia (also known as Mud Lake), and the Middle Fork Crow River meeting standards for Aquatic Life and Aquatic Recreation. The U.S. Environmental Protection Agency (EPA) has assessed Lake Monongalia as not supporting standards for wild rice, although the MPCA currently has insufficient data to make its own assessment.

The City of New London has upgraded their stormwater infrastructure, which is documented in the City on the Pond Study (https://www.mfcrow.org/new-london-spicer-stormwater-study/). An Accelerated Implementation Grant (AIG) was used to study subwatersheds within the city to determine hotspots for nutrient loading. A P8 (Program for Predicting, Polluting Particle Passage through Pits Puddles and Ponds) computer model was used to determine hotspots, and hypothetical projects were added through Hydrocad. The P8 program was rerun taking into account new projects. The city looked for opportunities to combine project installation with street improvements to minimize disturbance/staging/etc. The city then used community partners grant to aid with financing. The city installed four rain gardens, five storm-ceptors, five tree trenches, and an infiltration area along the Middle Fork Crow River. (Monitoring site 03-201) (Stream site (MFC4-S002-295,299)).

Figure 31. New London Watershed.



The MFCRWD has implemented an education and outreach program with the citizens and decision makers within the New London community to develop long term planning for the purpose of protecting water quality in lake. This effort has attained sufficient buy-in from the community to successfully install the aforementioned projects, with anticipation of many more installations. The city has requested that the watershed district levy for funding to pay for many of the improvements, and to this point the partnership has been highly successful. The effects of this effort on water quality are still undetermined, although the study indicates that as much as 300 lbs of TSS per acre can be removed from runoff as a result of this plan.

Table 9. Cost Estimates for stormwater BMPs described in the MFCRWD Water Quality Subwatershed Assessment - Stormwater Modeling Report (https://www.mfcrow.org/wp-content/uploads/2017/07/Final-MFCRWD-Water-Quality-Subwatershed-Assessment.pdf - Wenck Associates, March 10, 2017).

BMP	Estimated Construction Cost Per Unit	Units
Raingarden	\$20 - \$30	SQ FT
Underground infiltration	\$10 - \$20	CU FT
Tree Trench	\$350 - \$450	LIN FT
Permeable Paving	\$30	SQ FT
Detention Basin	\$250 - \$300	CU FT Wetted volume
Iron Enhanced Sand Filter	\$280 - \$380	LIN FT
Bioreactor	\$25 - \$75	CU YD
Infiltration Trench/Ditch	\$35 - \$45	SQ FT
Infiltration Catch Basin	\$10,000 - \$20,000	EACH

Table 10. The top 10 stormwater projects for New London, based on 2017 Wenck Associates Report.

Watershed	BMP Type	Treatment Area (ac)	Load Reduction (lbs/yr)	Low Cost	High Cost	Cost per lb of Pollutant Removed	Ranking (Weighted: Cost, Removal, Treatment Area, Project Implementation)
NL 1	Iron-enhanced filter	6.55	2,152.50	$ 28,000.00	$ 38,000.00	$ 17.65	1
NL 8	Iron-enhanced filter	8.84	1,507.10	$ 37,000.00	$ 50,000.00	$ 33.18	2
NL 28	Rain garden	2.74	121.80	$4,000.00	$6,000.00	$ 49.26	3
NL 9	Infiltration trench	2.60	203.10	$8,750.00	$ 11,250.00	$ 55.39	4
NL 1	Tree trench	3.27	280.30	$16,000.00	$16,000.00	$ 57.08	5
NL 9	Iron-enhanced filter	22.07	4,517.80	$56,000.00	$76,000.00	$ 16.82	6
NL 15	Infiltration trench	3.32	706.80	$29,400.00	$37,800.00	$ 53.48	7
NL 18	Iron-enhanced filter	2.39	1,831.60	$42,000.00	$57,000.00	$ 31.12	8
NL 7	Permeable pavement	2.96	438.80	$14,750.00	$20,650.00	$ 47.06	9
NL 25	Infiltration trench	0.65	168.30	$7,000.00	$9,000.00	$ 53.48	10

The cities of New London and Spicer will have further opportunities to implement stormwater improvements that reduce the loadings reaching the districts water resources. For the City of Spicer, the top projects to focus on are infiltration. In the City of New London, the top projects for improving water quality are iron-enhanced filters and infiltration trenches. See Table 11 below for an aggregated list of the top 10 projects for the City of New London and the City of Spicer. (Wenck Associates 2017)

Table 11. The top 10 stormwater projects for Spicer, based on 2017 Wenck Associates Report.

Watershed	BMP Type	Treatment Area (ac)	Load Reduction (lbs/yr)	Low Cost	High Cost	Cost per lb of Pollutant Removed	Ranking (Weighted: Cost, Removal, Treatment Area, Project Implementation)
S 7	Bioreactor	20.39	404.80	$15,000.00	$20,000.00	$49.41	1
S 12	Infiltration Bench	17.23	3,966.90	$18,900.00	$24,300.00	$6.13	2
S 11	Infiltration Bench	21.60	5,080.90	$21,420.00	$27,540.00	$5.42	3
S 41	Infiltration Bench	29.06	630.80	$31,710.00	$40,770.00	$64.63	4
S 29	Infiltration Bench	3.58	1,302.80	$21,000.00	$27,000.00	$20.72	5
S 18	Raingarden	5.07	319.80	$8,000.00	$12,000.00	$37.52	6

Watershed	BMP Type	Treatment Area (ac)	Load Reduction (lbs/yr)	Low Cost	High Cost	Cost per lb of Pollutant Removed	Ranking (Weighted: Cost, Removal, Treatment Area, Project Implementation)
S 38	Infiltration Bench	16.13	983.50	$42,630.00	$54,810.00	$55.73	7
S 30	Infiltration Bench	7.53	1,222.30	$35,910.00	$46,170.00	$37.77	8
S 6	Infiltration Catchbasin	9.83	262.40	$10,000.00	$20,000.00	$76.22	9
S 40	Infiltration Trench	12.04	3,640.50	$73,500.00	$94,500.00	$25.96	10

To achieve the best water quality outcomes, the top 10 projects should be explored first. The weighted rankings consider several factors; however, the projects applicability is dependent upon cost and if the landowner is willing to be involved in the project. Partnering with landowners and sharing the cost between the district, municipalities, and applying for implementation grant money will distribute the cost burden. The implementation of the projects should be phased as a long-term solution to water quality issues and be suggested during development or redevelopment projects. (Wenck Associates 2017)

Elsewhere in the watershed, the Nature Conservancy recently purchased farmland west of Nest Lake that will be converted into Oak Savannah, which should add to the water quality benefits gained by the stormwater infrastructure that has and will be installed in New London.

Lakeshore owners have also contributed to improvements in water quality by installing rain gardens, rain barrels, and other practices to reduce individual impacts from shore properties. Infiltration projects such as rain gardens are effective if installed properly; however, if installed improperly, either in soils that are too wet or compacted by equipment during installation, it can significantly reduce the effectiveness of the practice.

Lake Monongalia is a good reminder that the best practices that can be provided are maintaining natural systems such as wetlands, grasslands, and forest that help to protect water quality even when human development and climate change can cause water degradation. However, in heavily developed areas with high levels of impervious surface, retrofitted structural practices that mimic natural systems can also be effective for reducing pollutant discharge into surface waters if installed properly and maintained. But, as with all structural practices, they do have a lifespan and cannot be expected to function effectively into perpetuity.

Mill Creek (070102040606) Subwatershed-Catchment IDs 4443 and 4449 (representation of urban environments)

Figure 32. Mill Creek Subwatershed.

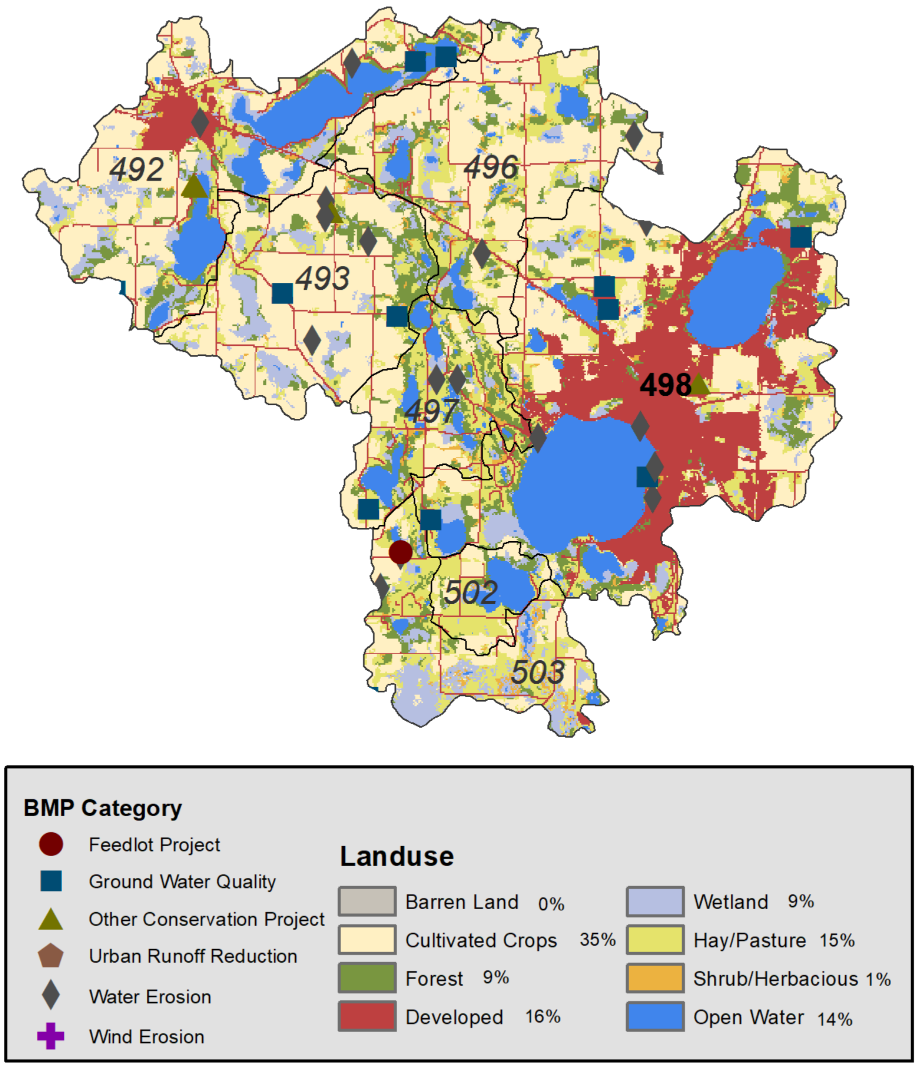


Table 12. Land cover in the Mill Creek Subwatershed.

		Percent	Acres
Open Water	20011500	14	4945
Developed	23411700	16	5785
Barren Land	161100	0.11	40
Forest	13330800	9	3294
Hay/Pasture	20745900	15	5126
Cultivated Crops	50532300	35	12487
Wetlands	12409200	9	3066
Shrub/Herbaceous	2000700	1	494

This subwatershed was chosen to represent urban environments in the watershed. There are 10 catchments within the subwatershed, with a total of 98 BMPs implemented within its boundaries. The most commonly implemented BMPs are conversion of land to perennial vegetation through critical area planting (13), and nutrient management for cropland (11).

In the agricultural part of this area, the Wright County SWCD has worked with a number of landowners to install WASCOBs, which are an effective way of getting water off the agricultural landscape, protecting farmland and reducing erosion. The soil in this area of the watershed has a higher clay content than in the headwaters, and WASCOBs are both effective and require relatively little maintenance once installed. Farmers also appreciate the fact that WASCOBs can be made farmable, and thus do not result in the loss of cropland that other types of practices might. WASCOBs have shown a benefit to surface waters by reducing sediment transport into those waters. However, as is the case with many structural BMPS, they are mitigative practices that help to reduce the impacts of standardized agricultural practices, but do not increase organic content in the soils or provide multiple benefits.

Cover crops have also been implemented in this area. Although initially slow to be adopted, the acreage of cover crop continues to increase, which indicates greater acceptance of the financial and long-term soil health benefits of the practice. Data shows that currently over 100 acres of cover crops have been incentivized by Wright SWCD in this area of the watershed. This number has been increasing annually over the past few years. Additional cover crops may be implemented outside of the Wright SWCD program.

Figure 33. Buffalo Lake, shown in the photo below, is impaired by nutrients and has an unhealthy fish community. The City of Buffalo has developed a plan for improvement of the lake water quality, but has yet to implement it.

Buffalo Lake is the largest lake in the subwatershed. It is a moderately shallow lake (14ft mean depth) surrounded by significant residential and commercial development, including substantial impervious surface, a golf course, and little remaining in the way of wetlands or natural systems in the area adjacent to the lake. The lake suffers from legacy levels of phosphorus from former municipal wastewater discharges, and current additions of phosphorus from stormwater. Buffalo Lake may benefit from an alum treatment at some point in the future if the stormwater contributions from the city and agricultural areas are addressed (see North Fork Crow River Watershed TMDL, Bacteria, Nutrients and Turbidity, December 2014, Page 4 through Page 24 (https://www.pca.state.mn.us/sites/default/files/wq-iw8-42e.pdf), but currently little has been done to stem the flow of stormwater from the city to the lake. Implementation of retrofitted stormwater BMPs here are critical to the health of the lake, which is likely to continue to deteriorate if action isn't taken.

The City of Buffalo has developed a stormwater retrofit analysis to address stormwater runoff into Buffalo Lake that identifies and ranks water quality improvement projects for targeted contributing drainage areas:
(http://www.wrightswcd.org/legislative_reporting/2014Buffalo%20Lake%20SRA%20Report%20v3.pdf)

As of 2021, few of the BMPs in the plan have been implemented, so water quality benefits from the plan have not been realized. The analysis depends heavily on costly structural practices (hydrodynamic devises) that will require engineering and specialized installation, which may be why much of it has not been implemented. Even if they are implemented, structural practices do have limited lifespans for functionality, and maintenance or replacement in the future must be an anticipated cost.

Mud Lake (070102040607) Subwatershed-Catchment IDs 4573, 4587, 4596,4588 (representation of agriculture and impaired wetlands)

Figure 34. Mud Lake Subwatershed.

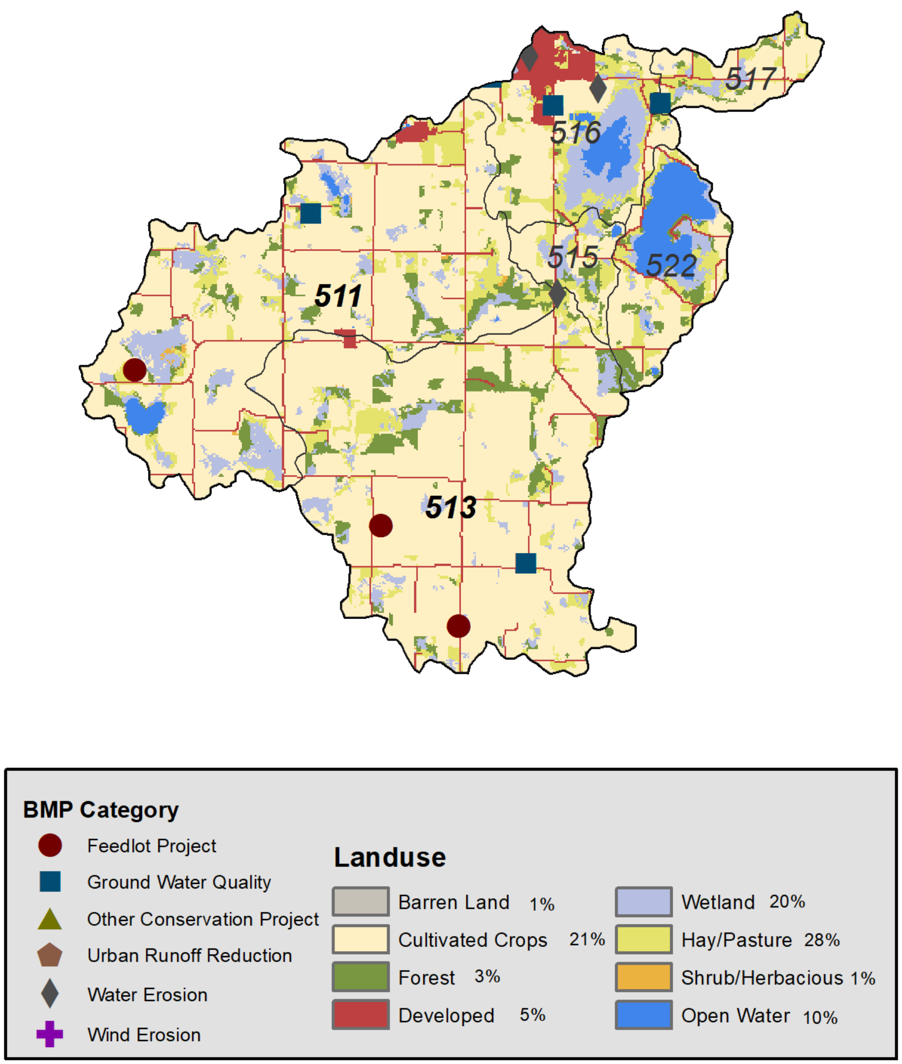


Table 13. Mud Lake Subwatershed land cover.

		Percent	Acres
Open Water	2861100	4	707
Developed	4512600	6	1115
Barren Land	26100	0.03	6
Forest	5077800	6	1255
Hay/Pasture	8106300	10	2003
Cultivated Crops	52173900	65	12892
Wetlands	7053300	9	1743
Shrub/Herbaceous	134100	0.17	33

This subwatershed was chosen to represent areas of agriculture and impaired wetlands. All four catchments in the subwatershed are included in this focus area, and there is a total of 43 known BMPs implemented within its boundaries. The most commonly implemented BMPs are cropland nutrient management and tile inlet improvements.

Mud Lake (Wood Lake WMA) is actually a wetland, and it is listed as having an impaired Aquatic Plant bioassessment. It is located directly south of the city of Montrose and the WWTP where stormwater runoff and effluent it discharges directly into it, as does County Ditch (CD) 21, CD 22, CD 23, and CD 31.

A wetland enhancement, the Woodland WMA (Figure 36), was completed by Ducks Unlimited in partnership with the Minnesota Department of Natural Resources (DNR), Minnesota Outdoor Heritage Council, North American Wetlands Conservation Act, and with philanthropic support from Flint Hills Resources, Unimin Corporation, Caterpillar Foundation, Ziegler CAT, the Van Sloun Foundation, and Ducks unlimited members and sponsors. It is similar in concept to the Prairie Storm project in the headwaters subwatersheds; this project consists of a large dam that holds water back sufficiently to flood a larger area and allow sediment and nutrients to settle out prior to discharging ultimately to the NFCR.

Alternative tile inlets, as discussed in the headwaters subwatershed are generally well accepted by farmers, in the right soil conditions, because of the low cost, effectiveness, and the ability to plant into and over them.

Because this area is so heavily ditched, ditch cleanouts frequently are implemented in this area. Ditch cleanouts are seen as beneficial to agricultural lands because they (ditches) facilitate the removal of excess water from the landscape, thus improving conditions for crop production. However, ditch cleanouts can have negative impacts to water quality. Under certain conditions, such as when ditches have a base of heavy mineral soils or bedrock, the cleanout may result in several years of increased P, nitrogen, and pesticide transport before eventually reducing the quantities of each to pre-cleanout levels. In addition, if the soils are mucky, clay, organic, or low mineral soils, or if the ditch cleanout is dug excessively deep or excessively steep, or if BMPs are not properly installed, it will carry eroded sediment and attached contaminants downstream to surface waters for years after the cleanout is done, which often never return to pre-cleanout levels. Further, ditch cleanouts remove vegetation that slow water transport and improve the processing of nutrients prior to reaching downstream receiving waters (Figure 35). Without vegetation, there is nothing to slow the transport of sediment and other contaminants. Ditch cleanouts are also costly depending on a number of variables, and may outweigh the cost of cover crops, reduced tillage, increased residue, or other soil health improving practices that could help prevent ditches from filling up in the first place, or reduce the need for ditches altogether by improving water holding capacity on the landscape and the availability of water to plants on the landscape. Increased water holding capacity in the farm fields can also reduce the need for irrigation, and reduce nitrate leaching into groundwater.

Figure 35. A ditch cleanout in the Mud Lake Subwatershed. In many cases, subsequent bank slumping, erosion, and lack of vegetation to slow runoff are all contributors to increased soil and chemical transport to surface waters.

Figure 36. The Woodland WMA is a wetland enhancement project implemented by Ducks Unlimited in partnership with the DNR and many other entities. It has increased habitat and storage capacity of an impaired wetland in the southern part of the NFCRW.

The Mud Lake Subwatershed land area has been primarily altered for agriculture and dominated by this land use for a century or more. Although some simple BMPs have been installed in some areas, the area relies upon ditch systems and drain tile to more rapidly remove water from the landscape, which is contrary to the soil health principles that suggest increasing the water holding capacity of the soil with cover crops and reduced tillage increases the organic content of the soil. The wetland restoration featured in this section may help downstream waters by reducing flashiness of the water levels, but the wetland itself would benefit significantly from any practices installed around the city of Montrose or elsewhere upstream. Montrose's WWTP discharges directly to the wetland, as does much of the surface area within the city itself. Retrofitted stormwater practices in Montrose and soil health improvement practices upstream would do more than large scale structural practices such as dams or weirs, and cost less for the area treated.

Additional photos from field tours

Some of the practices observed (including some practices not specifically described above) are shown below.

Figure 37. This basin at Green Lake Lutheran Ministries settles out larger sediment particle before discharging to double filtration system. These systems can be effective for removing pollutants, but must be maintained to prevent plugging, and inspected regularly to ensure proper functionality.

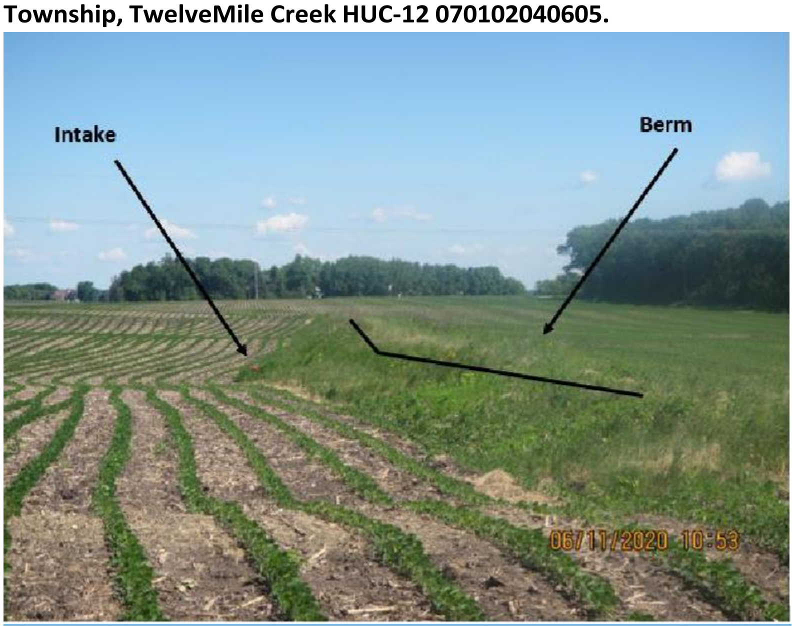
Figure 38. Single and J-hook vanes protect the streambank by redirecting the thalweg away from the streambank and toward the center of the channel. They can also improve in-stream habitat by creating scour pools and providing oxygen and cover. But they must be precisely engineered to be effective, and failure to properly install them can cause more damage and be challenging to fix. Photo taken in the Green Lake Township Rice Lake-NFCR, HUC-12 070102040107.

Figure 39. Rock infiltration trenches, grass waterways, or rain gardens like these filter out larger sediment particles and allow infiltration of runoff into groundwater, but can also allow infiltration of contaminants into groundwater or surface water if not buffered by vegetation prior to discharge. The project shown on the above right has installed large storage basins under the parking lot that hold and treat thousands of gallons of stormwater. Photo of the rock infiltration and parking lot storage taken in the Harrison Township, Diamond Lake HUC-12. 070102040208. Rock infiltration and grass waterway photo taken in the Union Grove Township, MFCR HUC-12. 070102040210.

Figure 40. Infiltration basins are effective stormwater treatment if properly constructed, without compaction and with at least three feet of separation between the bottom of the basin and the seasonally high groundwater table. Photo taken in the Roseville Township, Green Lake HUC-12 070102040206.

Figure 41. Rock tile inlets like this one are popular with farmers because of low installation costs, and because they can farm directly over the top of them. They are reasonably effective at removing sediment from surface runoff before entering drain tiles. This photo was taken in the NFCR Headwaters HUC-12.

Figure 42. WASCOBs are most effective in soils that have enough clay content to allow for compaction that holds through heavy rain events. They are popular with farmers in this area because they help keep topsoil on the land, and can be farmed around, thus minimizing the loss of usable land for crops. Photo taken in the Marysville Township, TwelveMile Creek HUC-12 070102040605.



4.3 Protection considerations and approaches

Protection of waters that are not yet impaired is a critical strategy to maintaining watershed health. It costs many times more from both a financial and time perspective to attempt to restore a lake or stream that has become impaired than it does to protect a water before it becomes impaired, and the success of restoration efforts are never guaranteed. For example, when the Pine River WRAPS was completed in 2017, it was estimated by a consultant that it would cost $64,305,498 to fully protect all of the 435 lakes in the watershed, or $147,828 per lake, while at the same time, a consultant working on the SFCR Watershed TMDL estimated $1.89 billion to restore the 23 lakes identified as impaired in that WRAPS cycle, or $78,260,869 per lake; over 500 times the cost of merely protecting the lakes in the Pine River Watershed.

Deciding which lakes or streams to protect, however, can be complicated. There are generally three high-level categories of waters that fall under the protection umbrella: waters that are relatively pristine and undeveloped and are protected to be kept that way, waters that have been hovering around the standard for impairment for a substantial time and need to be improved enough to be taken out of danger of impairment, and waters that have been trending downward toward the impairment threshold and will become impaired if action is not taken. Addressing all three categories have their own benefits and challenges.

Pristine waters, for example, are often located in relatively undeveloped areas, and typically the conditions in the drainage area of such lakes and streams are difficult to improve on. Most BMPs are designed to mimic natural conditions, and do not improve on them. Thus, the best strategy in these areas is often to leave them undeveloped, which is not always a preferred approach by local entities looking to increase tax base.

Waters that have hovered near the impairment threshold are often a result of land use from which impacts have stabilized. They will have periods of higher parameter levels, and periods where the levels are lower. These are often fairly cost effective to address, as some basic land use improvements or BMPs can potentially bring contaminant levels down. There is also a risk, however, of spending money to protect a water that ultimately becomes impaired anyway, and it can be difficult to justify spending money to improve a water that has shown no indication of deteriorating enough to become impaired.

Waters trending down over a period of time are complicated, because assessing baseline levels of contamination at the time of implementation of a practice is often done without consideration of how much worse water quality will get before the implementation efforts can begin to show a positive effect. Thus, even if implementation efforts have a positive result, a trend line that wasn't projected sufficiently into the future (to show where water quality would have been had action not been taken) may actually be perceived as having no effect, or even as having a negative one.

During the recent WRAPS process, a group of local and state staff with water quality expertise met to discuss water bodies that had been assessed in the NFCRW during the most recent cycle. This "Professional Judgement Group" identified 219 total water bodies that had been assessed, including 110 streams and 109 lakes. Of these water bodies, 64 streams and 33 lakes had sufficient data to classify them as "unimpaired" by the group. Eight of these water bodies were identified as "vulnerable" to future impairment, and are listed below in Table 14.

Table 14. Water bodies identified as vulnerable to impairment.

WID	WATERBODY_NAME	LOC_DESC	VULNERABLE_STATUS
07010204-509	Eagle Creek	Unnamed cr to N Fk Crow R	AQL
07010204-581	County Ditch 7 (County Ditch 37)	Unnamed ditch to N Fk Crow R	AQL, AQR
07010204-700	County Ditch 36	CD 38 to Sedan Bk	AQL
27-0200-00	Rattail	1 MI S OF ROCKFORD	AQR
47-0014-00	Spencer		AQR
47-0050-00	Manuella	2 MI SW OF DARWIN	AQL
86-0017-00	Uhl		AQR
86-0119-00	Sullivan	BUFFALO	AQR

Protection lakes

To take the process a step further, the WRAPS team opted to select five lakes for lake protection studies. These lakes are not technically impaired or, in the case of Lake Koronis, not ready for a TMDL because a stressor has not yet been identified for an impairment. For these lakes, a nutrient reduction target was set, and possible BMPs were chosen specific to each lakeshed to achieve those reductions.

The NFCRW Lake Protection Report (https://www.pca.state.mn.us/sites/default/files/wq-ws4-92p.pdf) was developed by the MPCA staff and a summary is included below, including 2-page summaries for each lake. These lakes are a high priority for local partners to protect in order to maintain the high-water quality conditions. These five lakes are referred to as "protection lakes" in this report and were selected based on a variety of factors: high recreational use, recent trends of declining transparency, water quality that is close to the state standards, and/or development pressures (Table 15).

Table 15. List of high priority protection lakes in NFCRW.

Lake name	Lake ID	County	Designated use class	Reason for high protection priority
Grove	61-0023-00	Pope	2B, 3C	Trend of declining transparency Headwaters of the NFCR
Koronis	73-0200-02	Stearns	2B, 3C	Fluctuating water quality Fish assemblage impairment Significant community and economic importance in the area; high recreational use
Calhoun [a]	34-0062-00	Kandiyohi	2B, 3C	Fluctuating water quality Planned housing development
Minnie-Belle	47-0119-00	Meeker	2B, 3C	Vulnerable fish communities [b] Headwaters of Lake Washington, another protection lake
Washington	47-0046-00	Meeker	2B, 3C	Significant community and economic importance to the cities of Darwin and Dassel

a. Lake Calhoun has an aquatic consumption impairment due to high levels of mercury in fish tissue. The mercury TMDL for Lake Calhoun was approved as part of the *Minnesota Statewide Mercury TMDL* (MPCA 2007).

b. Reference: North Fork Crow River Watershed Water Assessment and Trends Update (MPCA 2020)

The ultimate goal is to maintain or improve water quality in the protection lakes. To achieve this, individual water quality goals for each lake are presented. The water quality goal for each lake (except for Lake Koronis) is a 5% reduction in TP concentration in the lake; the Lake Koronis goal is a 9% reduction in P concentration

(Table 16, Table 17). These concentration goals are translated into P load reduction goals, which range from 8% to 12%. The MPCA and local partner staff selected these modest P reduction goals to help protect the lakes from degradation. The watershed P load reductions needed to meet the lake P concentration goals and the expected corresponding lake chl-*a* concentrations and Secchi depth transparencies were estimated with a lake model (Table 16). The primary P loads to the protection lakes are from nonpoint source watershed runoff (mostly from agricultural lands), septic systems, internal loading, and atmospheric deposition.

Table 16. Water quality summary and targets.

	TP (µg/L)		Chl-*a* (µg/L)		Secchi (m)	
Lake	**Observed**	**Target**	**Observed**	**Target**	**Observed**	**Target**
Grove	31	30	10	9	2.0	2.1
Koronis	33	30	17	16	2.1	2.2
Calhoun	27	26	10	9	1.5	1.5
Minnie-Belle	17	16	4	4	4.5	4.5
Washington	29	27	13	12	1.2	1.3

Table 17. Summary of existing and target loads.

Lake	Existing load (lb/yr)	Target load (lb/yr)	Target P load reduction (lb/yr)	Target P load reduction (%)
Grove	1,248	1,136	112	9
Koronis	16,834	14,749	2,085	12
Calhoun	678	619	59	9
Minnie-Belle	1,520	1,380	140	9
Washington	5,135	4,699	436	8

For each lake, an implementation scenario (Table 18) was developed to illustrate an example combination of BMPs that collectively could achieve the P load reduction targets (Table 17). For each protection lake, local partner staff provided a set of BMPs that are most applicable to the lake watershed. The example implementation scenarios include an annual estimate of cost-share dollars needed to incentivize adoption of the practice. The costs do not take into account design and construction oversight or operation and maintenance costs. The implementation scenario illustrates the approximate level of effort needed to achieve the P reduction targets, but other combinations of BMPs may achieve the same goals. The scenarios should be adapted based on factors such as local knowledge about sources, interested landowners, available funding, etc. Information is provided for each protection lake for local partner staff to develop alternative implementation scenarios. As BMP implementation progresses and new implementation options arise, alternative implementation scenarios will allow local partner staff to evaluate progress made towards achieving the load reduction goals.

Table 18. Example implementation scenario summaries.

Lake name	BMP name	Cropland area treated by BMP (ac)	TP load reduction (lb/yr)	Cost to incentivize ($/yr)
Grove	Alternative tile intakes	537	75	1,252
	Restore tiled wetlands	171	19	5,249
	Total	*708*	*94*	*6,501*
Koronis	Alternative tile intakes	661	198	1,541
	Restore tiled wetlands	108	25	3,311
	WASCOBs [a]	62	25	3,058
	Total	*831*	*248*	*7,910*
Calhoun	Alternative tile intakes	356	32	828
	Restore tiled wetlands	57	4	1,755
	WASCOBs	33	4	1,644
	Total	*446*	*40*	*4,227*
Minnie-Belle	Restore tiled wetlands	22	14	661
	Corn and soybeans with cover crop	114	42	4,311
	Conservation cover perennials	13	14	1,275
	Total	*148*	*70*	*6,247*
Washington	Alternative tile intakes	262	171	611
	Restore tiled wetlands	43	21	1,308
	WASCOBs	24	21	1,208
	Total	*329*	*213*	*3,127*

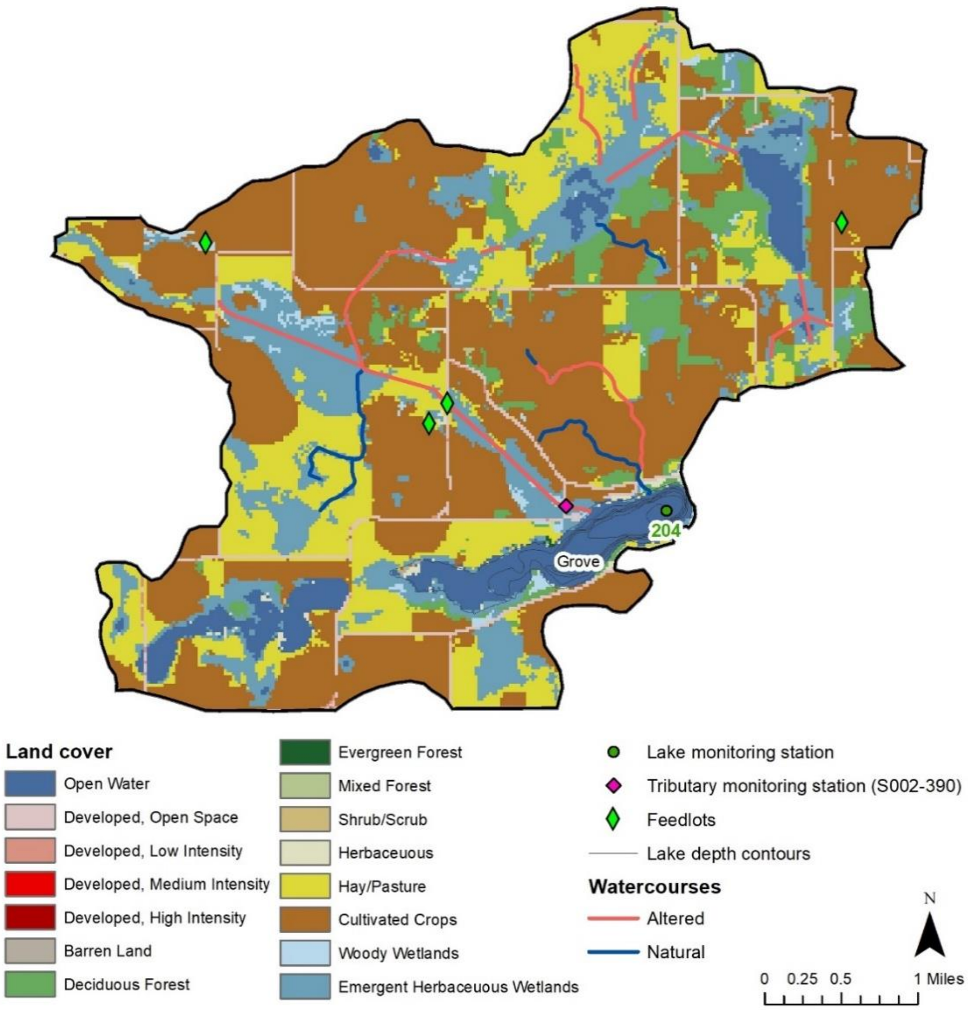
a. WASCOB: water and sediment control basin

Lake protection study summaries

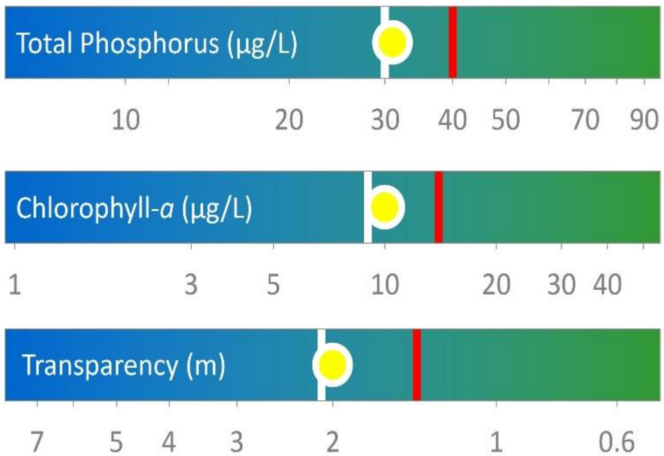
Grove Lake Protection Summary

Grove Lake is at the headwaters of the NFCR and has experienced a decline in transparency over recent years. Land cover in the watershed is approximately 50% cropland, with substantial areas of grassland, pasture, and wetlands. There are no cities in the watershed, and development is heaviest along the lake's shoreline. Many of the watercourses are altered. There are three registered feedlots in the Grove Lake Watershed, with over 150 cattle and over 3,000 swine.

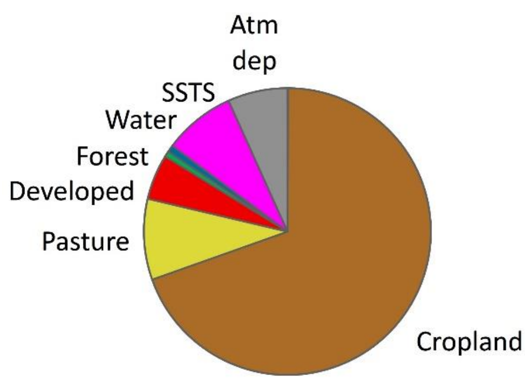
The western half of the lake is shallow and often has nuisance aquatic vegetation, which can compromise summer fishing and recreational boating. The eastern half of the lake is deeper and has greater water clarity. The fishery includes walleye, largemouth bass, and northern pike, with limited panfishing opportunities.



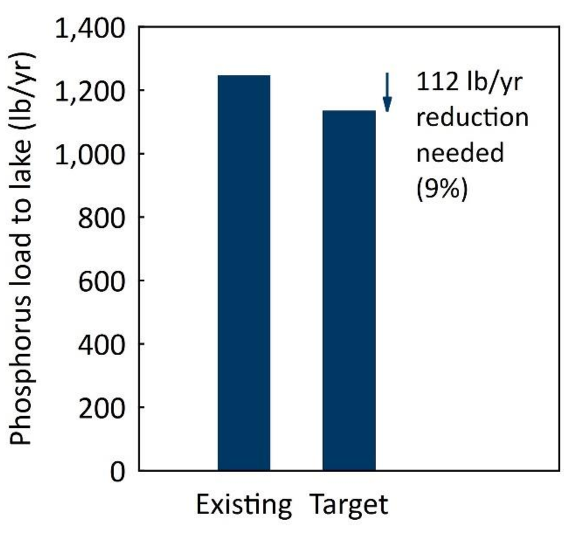
Grove Lake water quality
Existing (yellow circle), state standards (red line), and protection goals (white line)

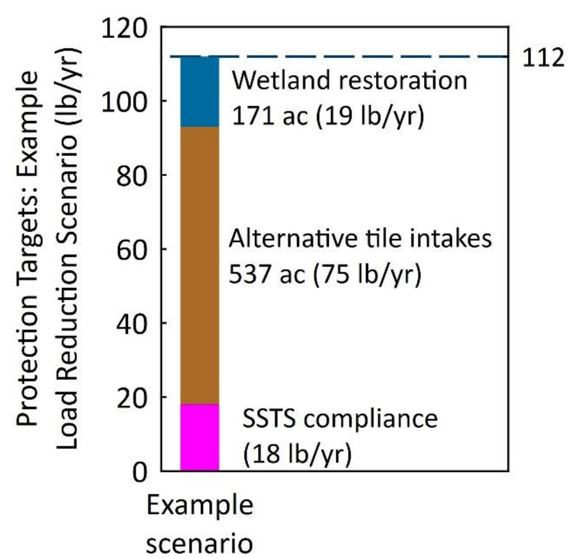


Grove Lake meets state water quality standards and is a high priority for local partners and the state to protect. Water quality protection goals are a 5% reduction in lake phosphorus concentration and the expected changes in chl-*a* (which measures algae growth) and water transparency.



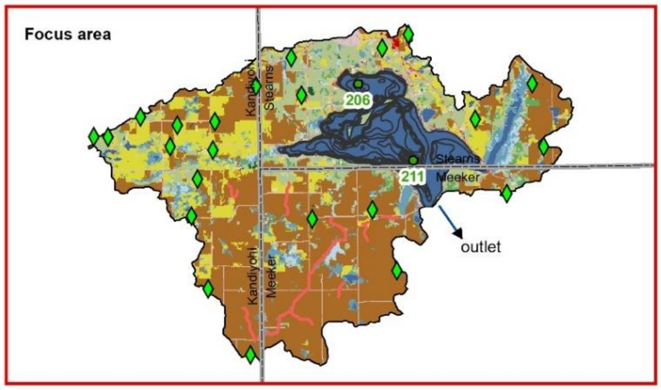
The majority of the phosphorus loading to Grove Lake is from cropland runoff. Other sources of phosphorus include runoff from pasture and developed areas, SSTS, and atmospheric deposition.

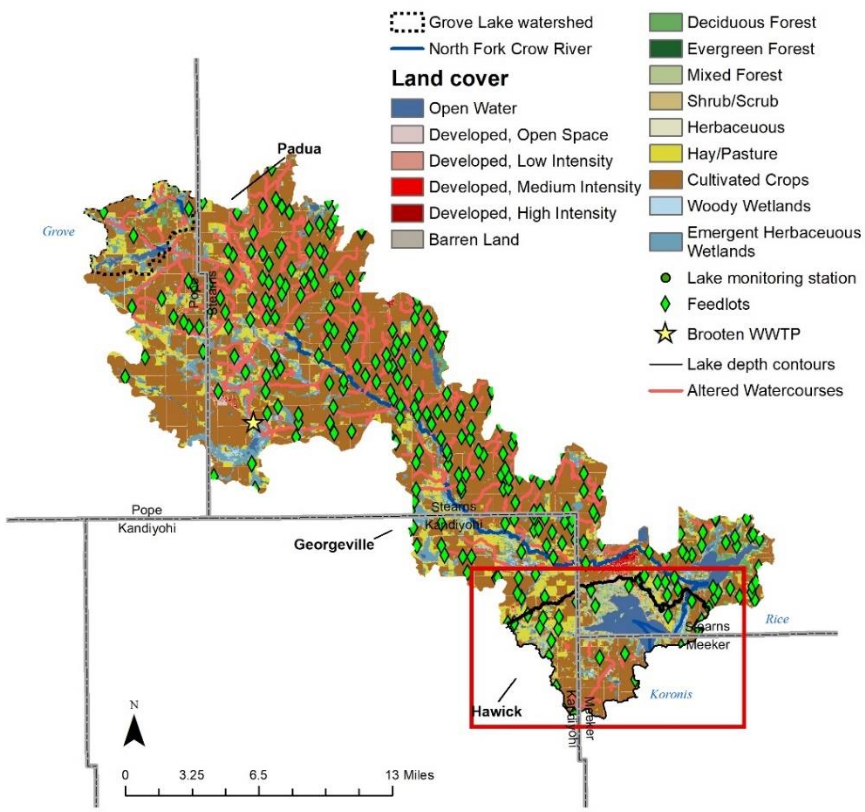




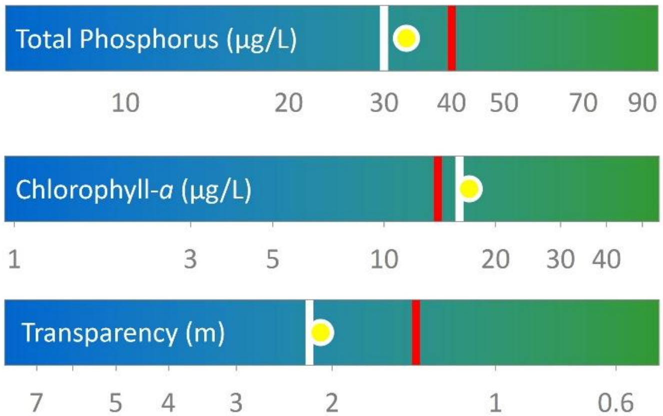
The example implementation scenario includes 100% SSTS compliance and BMPs on 708 acres of cropland, or 16% of the watershed's cropland area. The estimated annual cost to incentivize the cropland BMPs is $6,501.

Lake Koronis is along the flow path of the NFCR, which enters Lake Koronis downstream of Rice Lake. Rice Lake's aquatic recreation use is impaired due to high P, and a P load reduction of 53% is needed for Rice Lake to meet its lake water quality standard. The protection evaluation focuses on the portion of the watershed that is downstream of the Rice Lake outlet, referred to here as the "focus area." Land cover in the entire watershed is approximately 65% cropland, with substantial areas of grassland, pasture, wetlands, and open water. A majority of the lake shoreline is developed. Many of the streams in the watershed have been hydrologically altered. There are 23 registered feedlots in the focus area, with primarily cattle and turkey.

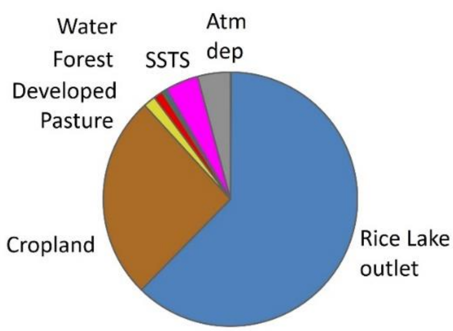




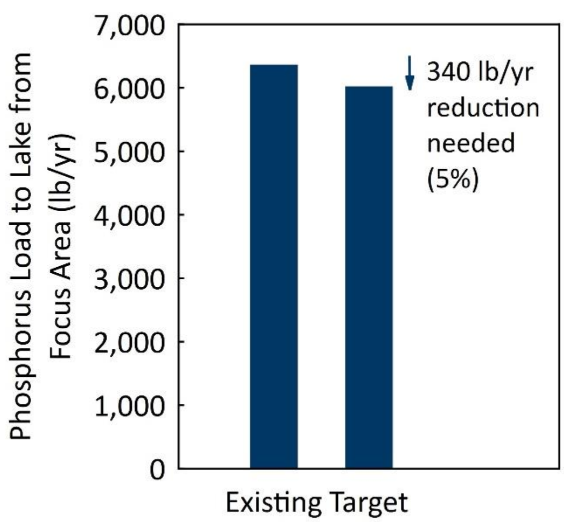
Lake Koronis water quality
Existing (yellow circle), state standards (red line), and protection goals (white line)

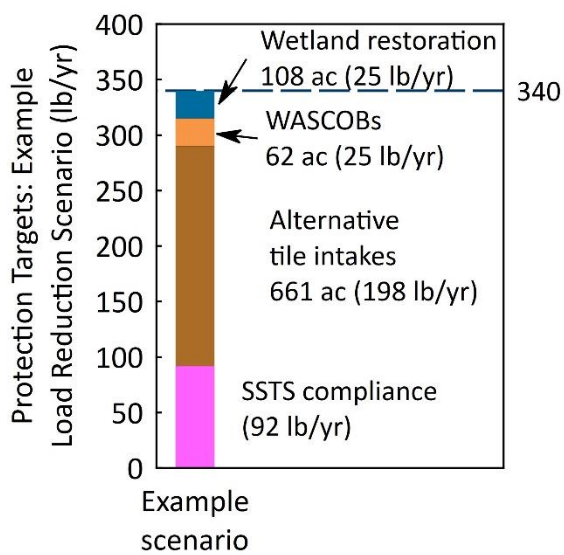


Lake Koronis meets state water quality standards overall, but on average the chl-*a* concentration exceeds the state chl-*a* criteria. The lake is a high priority for local partners and the state to protect. Water quality protection goals are a 9% reduction in lake phosphorus concentration and the expected changes in chl-*a* (which measures algae growth) and water transparency.



The majority of the phosphorus loading to Lake Koronis is from the Rice Lake Watershed, followed by cropland runoff in the Lake Koronis focus area. Other sources of phosphorus include runoff from pasture and developed areas, SSTS, and atmospheric deposition.



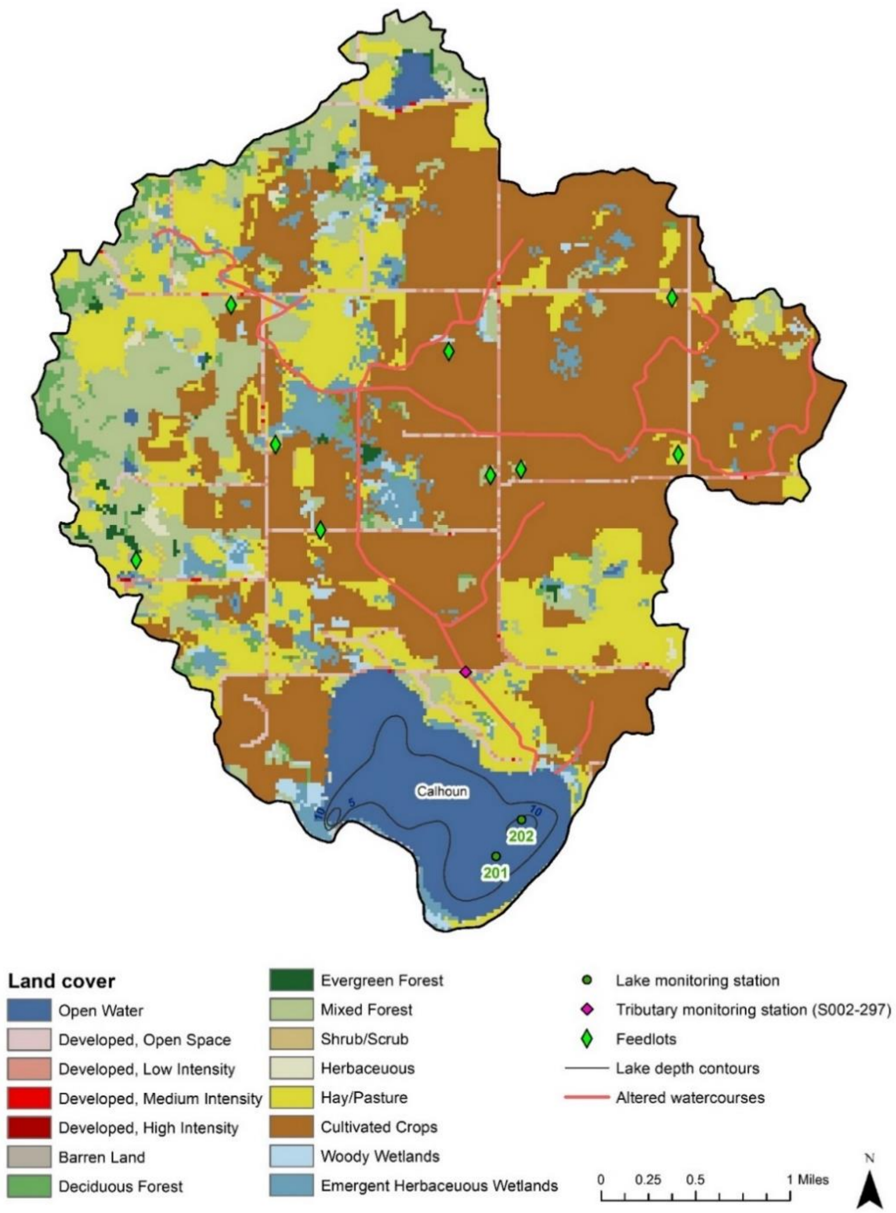


The example implementation scenario includes 100% SSTS compliance and BMPs on 831 acres of cropland in the focus area, or 8% of the focus area's cropland. The estimated annual cost to incentivize the cropland BMPs is $7,910.

Lake Calhoun Protection Summary

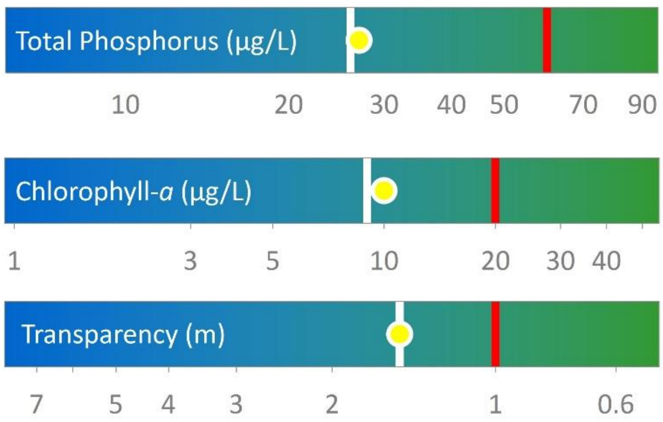
The Lake Calhoun Watershed is located in the central-northwest part of the NFCRW. Land cover in the watershed is approximately 50% cropland, with substantial areas of grassland, pasture, and forest. There are no cities in the watershed, and development is heaviest along the lake's north and east shoreline. Many of the watercourses are altered. There are eight registered feedlots in the Lake Calhoun Watershed, with approximately 460 registered cattle.

Bulrush and cattails are present along the western and southern portions of the lake. Submergent vegetation such as northern milfoil, muskgrass, filamentous algae, water moss, and various pondweed species can be dense. The invasive species Eurasian watermilfoil was first found in Lake Calhoun in 2010, mostly near the Middle Fork Crow River inlet. Zebra mussels, another invasive species, are also present in the lake. Lake Calhoun is a popular bluegill and northern pike fishery.

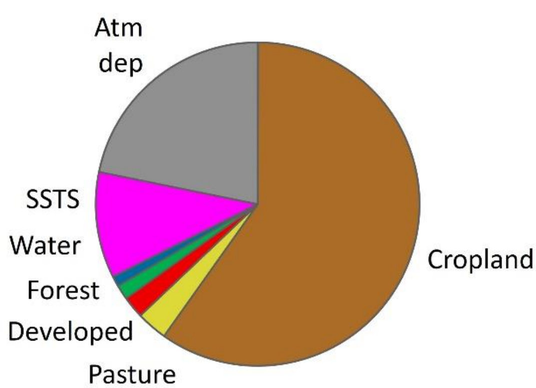


Load Reduction Goals Phosphorus Sources Water Quality

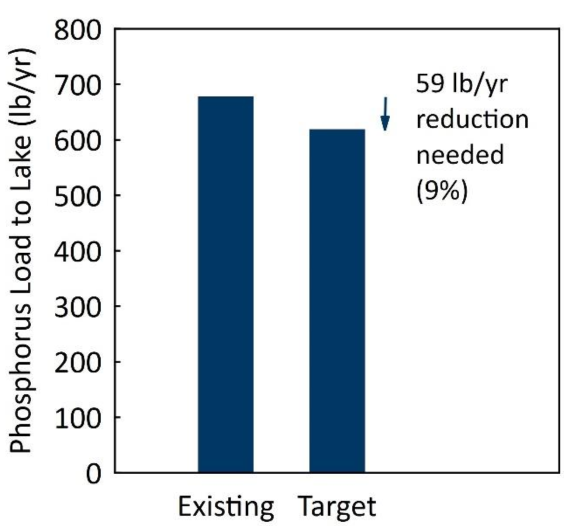
Lake Calhoun water quality
Existing (yellow circle), state standards (red line), and protection goals (white line)

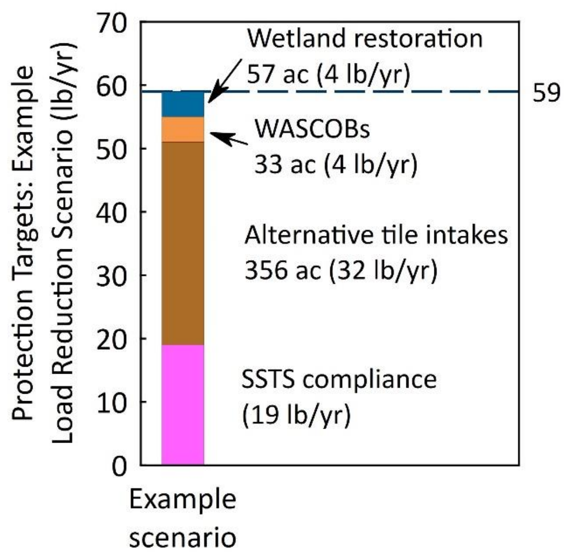


Lake Calhoun meets state water quality standards and is a high priority for local partners and the state to protect. Water quality protection goals are a 5% reduction in lake phosphorus concentration and the expected changes in chl-*a* (which measures algae growth) and water transparency.



The majority of the phosphorus loading to Lake Calhoun is from cropland runoff. Other sources of phosphorus include runoff from pasture and developed areas, SSTS, and atmospheric deposition.



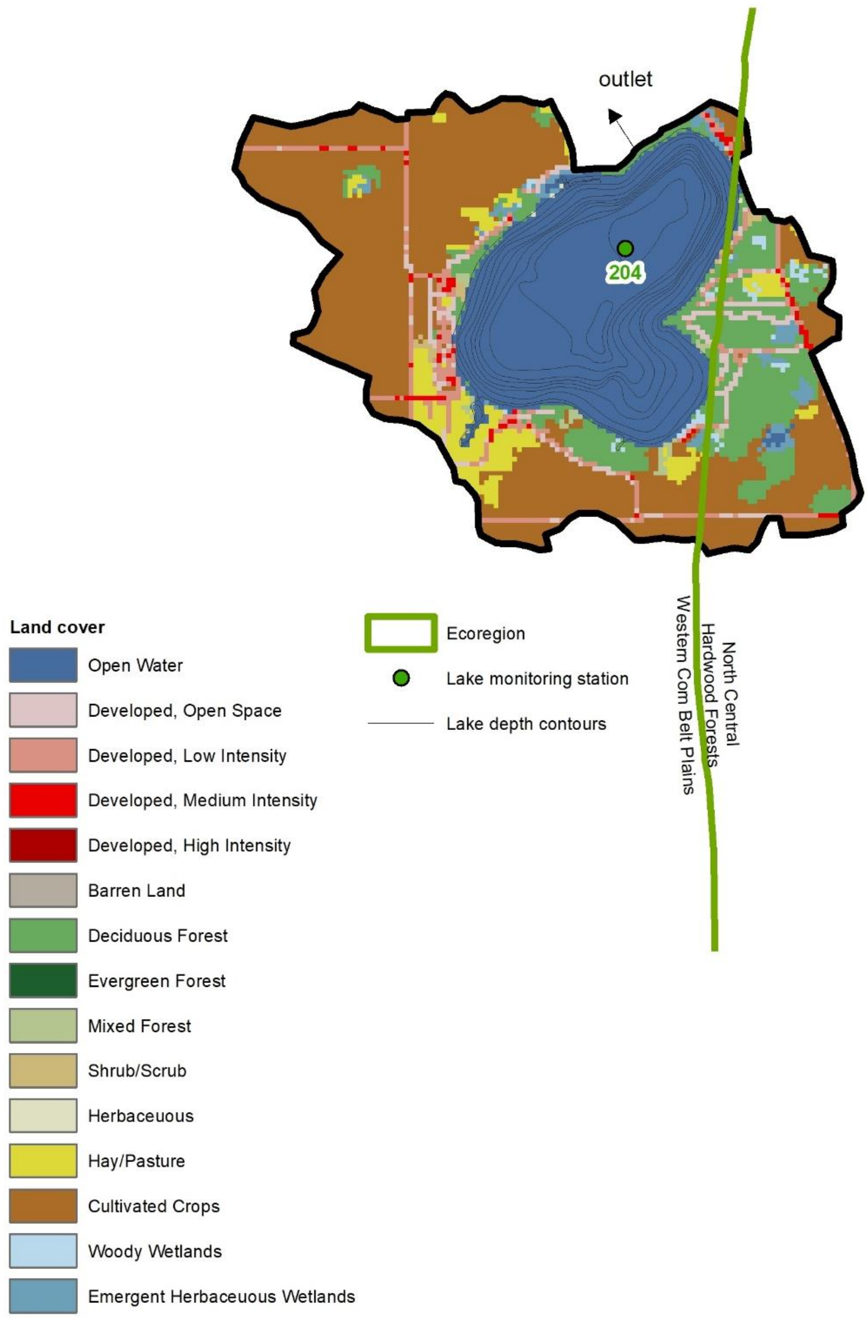


The example implementation scenario includes 100% SSTS compliance and BMPs on 446 acres of cropland, or 13% of the watershed's cropland area. The estimated annual cost to incentivize the cropland BMPs is $4,227.

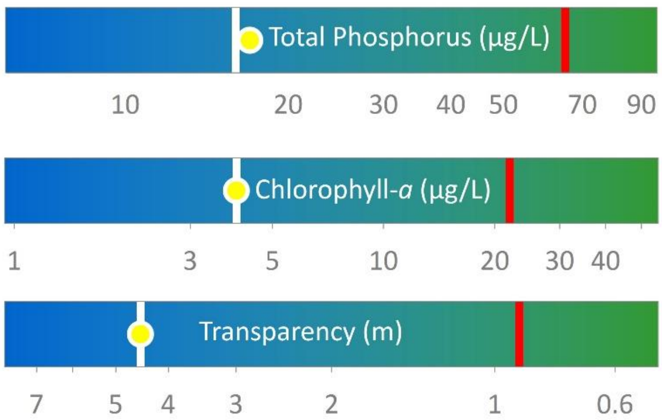
Lake Minnie-Belle Protection Summary

Lake Minnie-Belle is located the south-central portion of the NFCRW and has the highest water quality of the five protection lakes highlighted in the WRAPS. Land cover in the watershed is approximately 58% cropland, with substantial areas of grassland, pasture, developed areas, and forest and shrub. There are no cities in the watershed, and development is heaviest along the lake's shoreline. Many of the watercourses are altered.

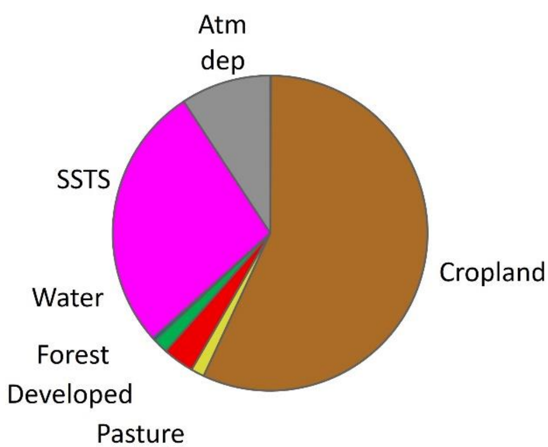
The lake has a high native aquatic plant species diversity relative to other lakes in the region. Although the invasive species curly-leaf pondweed was found in the lake, it did not form single-species beds.



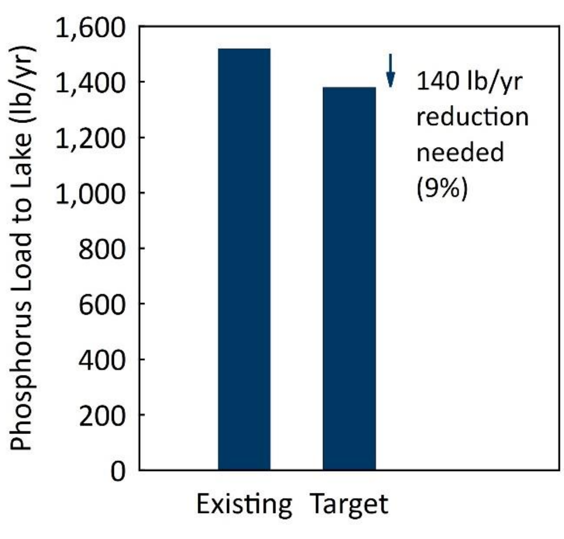
Lake Minnie-Belle water quality
Existing (yellow circle), state standards (red line), and protection goals (white line)

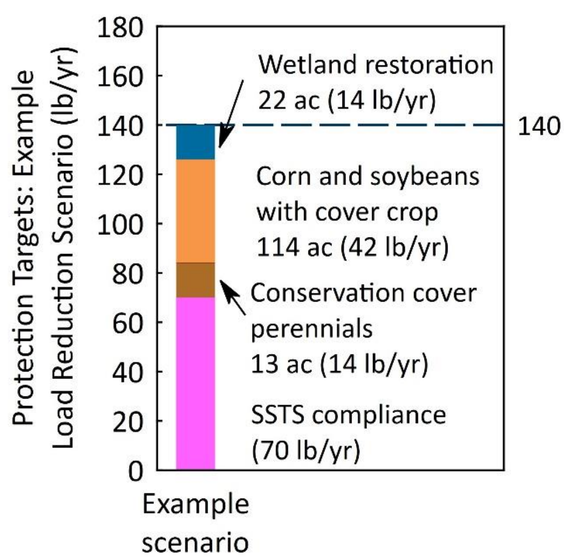


Lake Minnie-Belle meets state water quality standards and is a high priority for local partners and the state to protect. Water quality protection goals are a 5% reduction in lake phosphorus concentration and the expected changes in chl-*a* (which measures algae growth) and water transparency.



The majority of the phosphorus loading to Lake Minnie-Belle is from cropland runoff. Other sources of phosphorus include SSTS and atmospheric deposition.

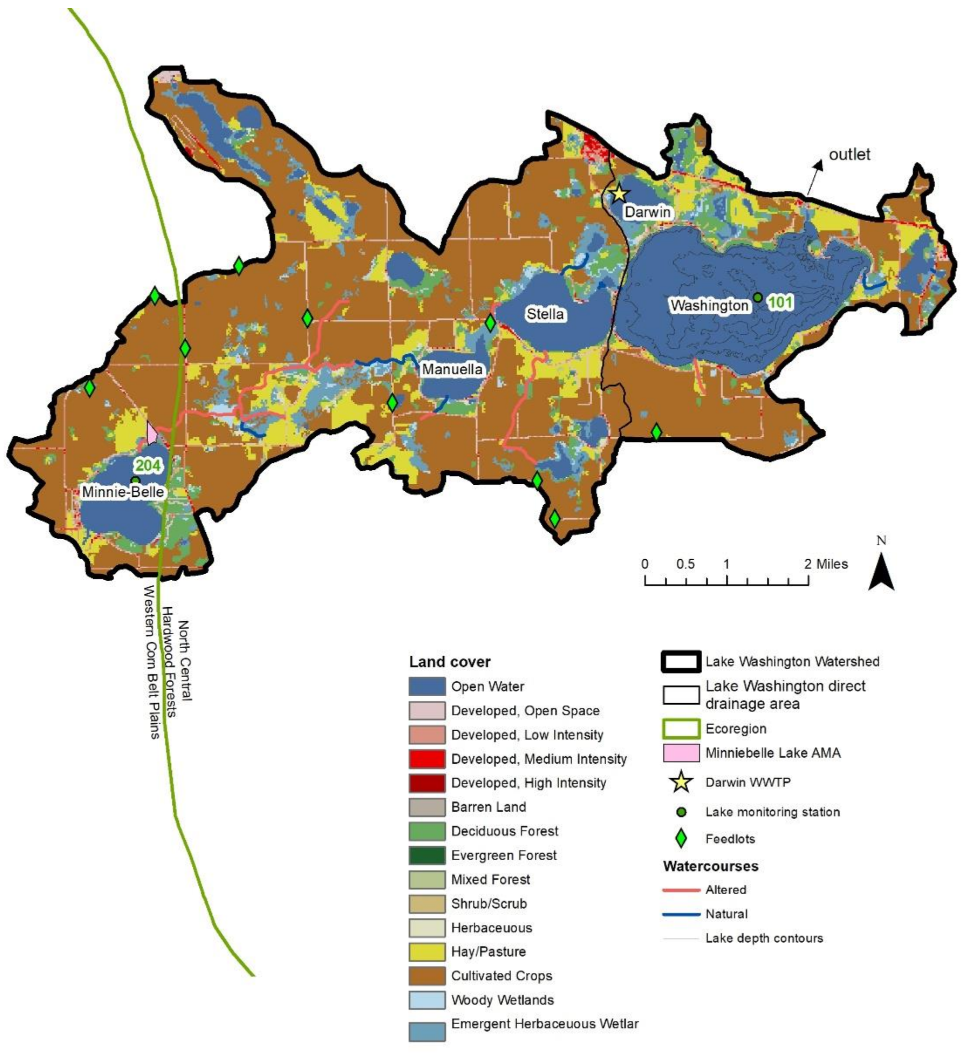




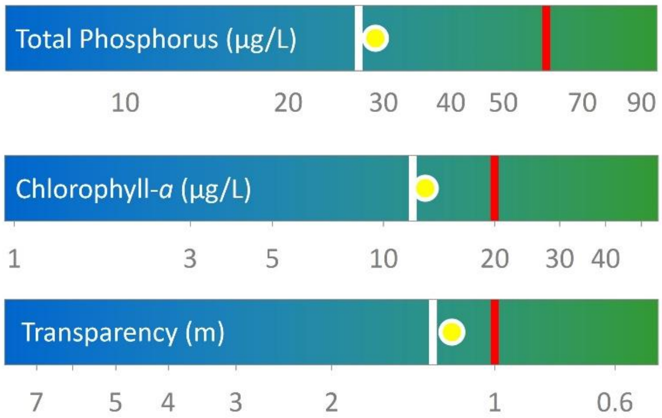
The example implementation scenario includes 100% SSTS compliance and BMPs on 148 acres of cropland in the watershed, or 19% of the watershed's cropland area. The estimated annual cost to incentivize the cropland BMPs is $6,247.

Lake Washington Protection Summary

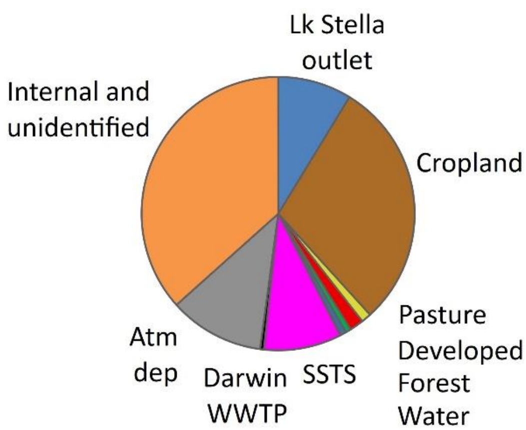
Lake Washington is located in the south-central portion of the NFCRW approximately seven miles downstream of Lake Minnie-Belle. Sucker Creek, the outlet of Lake Minnie-Belle, flows through Manuella Lake and Lake Stella before entering Lake Washington. Because of Lake Stella's high water quality, the protection evaluation focuses on the portion of the watershed that is downstream of the Lake Stella outlet, referred to here as the "direct drainage area." Land cover in the entire watershed is approximately 57% cropland, with substantial areas of grassland, pasture, wetlands, and open water. Portions of the cities of Darwin and Dassel are in the watershed, with additional development along the lake's shoreline. Darwin WWTP discharges to Lake Darwin in the direct drainage area. There are 10 registered feedlots in the watershed, but only one in the direct drainage area.



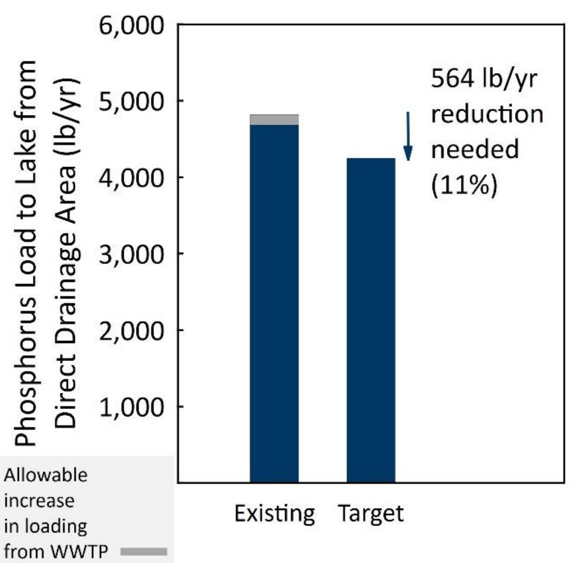
Lake Washington water quality
Existing (yellow circle), state standards (red line), and protection goals (white line)

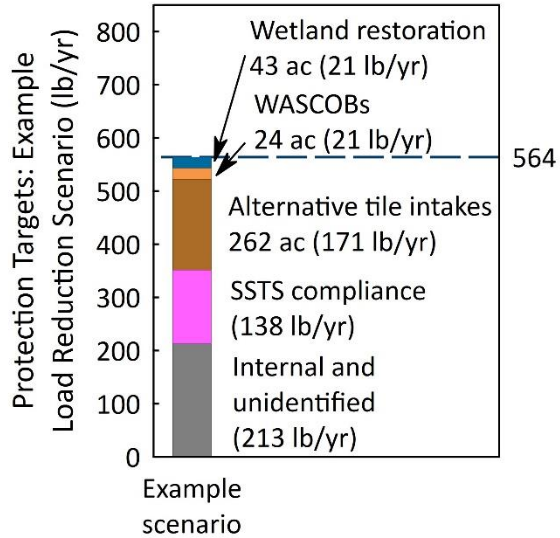


Lake Washington meets state water quality standards and is a high priority for local partners and the state to protect. Water quality protection goals are a 5% reduction in lake phosphorus concentration and the expected changes in chl-*a* (which measures algae growth) and water transparency.



The majority of the phosphorus loading to Lake Washington is from cropland runoff and internal load. Other sources are from the Lake Stella outlet, SSTS, and atmospheric deposition.





The example implementation scenario includes 100% SSTS compliance and BMPs on 329 acres of cropland in the direct drainage area, or 18% of the direct drainage area's cropland. The estimated annual cost to incentivize the cropland BMPs is $3,127.

4.4 NFCR Water Quality Trading Pilot Project

In 2021 the MPCA, BWSR, and the Minnesota Department of Agriculture initiated a pilot project aimed at working with local partners within the NFCRW to support the development of water quality trading projects within the watershed. The purpose of this project was to discuss water quality trading opportunities with NPDES/SDS permittees, local resource managers, and agricultural producers within the watershed, to better understand the challenges in identifying and developing trade proposals, and identify how state agencies and local partners can work together and provide the tools and resources necessary to yield positive results (i.e. make local connections, identify innovative solutions, and partner in water quality trading opportunities). The Water Quality Trading Pilot Project - North Fork Crow River Watershed Final Report (state.mn.us) provides a summary of the project, the feedback received, and recommendations for the tools, processes, and/or resources needed for the state agencies to provide support to water quality trading projects in Minnesota.

4.5 Clean Water Act Section 319 Grants

There are currently three Clean Water Act Section 319 Small Watersheds Focus Program grants active in the NFCRW. The grant program was developed to provide a long-term roadmap at a small watershed scale to support comprehensive implementation to address nonpoint source pollution loading by local government units, supported by EPA funding.

The three subwatersheds that have been accepted into the Section 319 grant program are:

- The NFCRWD for upgrades and storage in the headwaters ditch systems of JD1, CD32, and CD7 to help reduce impairments in the downstream lakes of Rice and Koronis.
- The MFCRWD for city stormwater improvements with the cites of New London and Spicer, and upstream ditch systems of CD 37, JD3, for impairment reductions to the Middle fork Crow River and Nest and Green lakes.
- The Wright County SWCD for restoration and protection measures within the Twelve Mile Creek HUC-12 watershed.

These federally sourced grants require the development and implementation of detailed work plans with associated reductions, which will add to both the understanding of the issues facing this area of the state, and require collaboration of multiple stakeholders to achieve the goals set forth in these work plans. The work plans are developed in part by local partners and in part by the MPCA staff. The goal for each watershed is that after up to 16 years (four grant cycles) of implementation there will be clear positive results shown for water quality in these subwatersheds, which will provide new data and learning that can be applied to other areas of the NFCRW and other watershed of the state in the future.

5. Ongoing water monitoring efforts

MPCA-led monitoring

In addition to LGU monitoring activities, the MPCA's WPLMN has four long term monitoring stations within this watershed, they are: the NFCR near Paynesville (S002-356), the MFCR near Manannah (S004-421), the NFCR near Cokato (S001-517), and the NFCR near Rockford above the confluence with the SFCR (S001-256). The MPCA's WPLMN measures and compares data on pollutant loads from Minnesota's rivers and streams and tracks water quality trends. WPLMN data is used to assist with assessing impaired waters, watershed modeling, determining pollutant source contributions, developing watershed and water quality reports, and measuring the effectiveness of water quality restoration efforts. Data are collected along major river main stems, at major watershed (i.e., HUC-8) outlets to major rivers, and in several subwatersheds. This long-term monitoring program began in 2007.

The MPCA IWM, including biological and water chemistry monitoring, occurs every 10 years, having been performed in 2007-2008, 20017-2018. The next round of IWM is slated for 2028-2029.

LGU-led monitoring

Monitoring efforts of water bodies in the NFCRW varies among LGUs (see table below). The majority of lake monitoring in the NFCRW are sampled by volunteers from lake associations; rivers and streams are primarily monitored by the local watershed districts.

LGU partners look at annual average and long-term trends, as well as Minnesota's Impaired Waters List, to determine any changing conditions to help focus future data needs or gauge BMP effectiveness. The main criteria for determining pollutant reduction and restoration needs are based off the state standards and from Minnesota's Impaired Waters List. The effectiveness of monitoring is crucial for planning as you cannot accurately manage what you do not measure.

It is the intent of the implementing organizations in this watershed to make steady progress in terms of pollutant reduction. However, it is also understood that in situations where water quality has trended rapidly downward and/or for a significant period of time, it is likely unrealistic to expect to see immediate improvement in water quality. In such cases, a flattening or slowing of the downward trend may be considered a success for the first 7 to 10 years after implementation work begins in that area. This is a general guideline. Factors that may mean slower progress include limits in funding or landowner acceptance, challenging fixes (e.g., unstable bluffs and ravines, invasive species), and unfavorable climatic factors. Conversely, there may be faster progress for some impaired waters, especially where high-impact fixes are slated to occur.

LGU partners that make up the Technical Advisory Committee of the NFCRW's 1W1P efforts will use monitoring data for future strategies, project scenarios, and modeling efforts for protection and restoration efforts. LGUs have a goal to increase the volunteer monitoring support base to increase water data collected and to improve watershed connections and education among volunteers. LGUs also will look for opportunities to be more involved with IWM and other monitoring efforts with the DNR and MPCA).

Table 19. Lists the NFCRW water bodies being monitored from 1W1P members or with assistance of volunteers, with sample ID location and parameters. All specific parameters data for each monitoring station ID can be seen by vising the MPCAs Surface Water Data webpage https://webapp.pca.state.mn.us/surface-water/search.

Water body	Water body Type	County	ID#	Monitor	Secchi	TP	Chl-*a*	TSS	DO	Temp	TKN	*E. coli*	PH
Grove Lk outlet	Stream	Pope	S002-391	NFCRWD	Y	Y		Y	Y				Y
JD1 Br 12	Ditch	Stearns	S008-972	NFCRWD	y	y		y	y	y	y	y	y
NFCR/ Hwy 27	River	Stearns	S002-383	NFCRWD	y	y		y	y	y	Y	y	y
NFCR/ Hwy 19	River	Stearns	S002-027	NFCRWD	y	y		y	y	y	y	y	y
NFCR/Paynesville	River	Stearns	S002-356	NFCRWD/ WPLMN	y	y		y	y	y	y		y
NFCR/365th	River	Meeker	S005-564	NFCRWD	y	y		y	y	y	y		y
CD 32	Ditch	Stearns	S002-381	NFCRWD	y				y			y	y
CD 7	Ditch	Stearns	S002-386	NFCRWD	y				y	y		y	y
CD 5	Ditch	Stearns	S001-943	NFCRWD	y				y	y		y	y
Pirz Lake	Lake	Stearns	73-0144-00-203	NFCRWD, Volunteer	y	y	y						
Rice Lake	Lake	Stearns	73-0196-00-203, 73-0196-00-209	NFCRWD, Volunteer	y	y	y						
Lake Koronis	Lake	Stearns/ Meeker	73-0200-02-211, 73-0200-02-206	NFCRWD, Volunteer	y	y	y						
Grove Lake	Lake	Pope	61-0023-00-204	NFCRWD, Volunteer	y	y	y						
Arville	Lake	Meeker	47-0023-00-201	Volunteer	y	y	y				y		
Collinwood	Lake	Meeker/ Wright	86-0293-00-101, 86-0293-00-201	Volunteer	Y	y	y						
Round Lake	Lake	Meeker	47-0102-00-101	Volunteer	Y 2017, 2011, 2010 only	Y 2017, 2011, 2010 only	Y 2017, 2011, 2010 only		Y 2017, 2011, 2010 only				
Spring Lake	Lake	Meeker	47-0032-00-201, 47-0032-00-202	Volunteer	Y				2017 only				2017 only
Stella	Lake	Meeker	47-0068-00-202, 47-0068-00-206	Volunteer	y	2017 only	2017 only						
Washington	Lake	Meeker	47-0046-00-209, 47-0046-00-101, 47-0046-00-207, 47-0046-00-208, 47-0046-00-205	Volunteer	Y	y	y						
Wolf	Lake	Meeker	47-0016-00-201	Volunteer	Y	Y	Y	Not since 2018 CROW					

Water body	Water body Type	County	ID#	Monitor	Secchi	TP	Chl-*a*	TSS	DO	Temp	TKN	*E. coli*	PH
Big Swan	Lake	Meeker	47-0038-00-202, 47-0038-00-201, S002-022, S004-558	Volunteer	Y	y	y	y					
Dunns	Lake	Meeker	47-0082-00-201	Volunteer	N	2000 only			2018 only				2018 only
Richardson	Lake	Meeker	47-0088-00-201	Volunteer	Y	2000 only			2018 only				
Lake Francis	Lake	Meeker/ Wright	47-0002-00-202	Volunteer	Y	Y	Y						
Lake Jennie	Lake	Meeker	47-0015-00-201	Volunteer	y	y	y						
Long Lake-Dassel	Lake	Meeker	47-0026-00-203	Volunteer	Not since 2011	Not since 2011	Not since 2011		2017 only				2017 only
Long lake-Grove City	Lake	Meeker	47-0177-00-202	Volunteer	y				2018 only				2018 only
Manuella	Lake	Meeker	47-0050-00-201	Volunteer	y	2018 only	2018 only		2018/17 only				2018/17 only
Minnie Belle	Lake	Meeker	47-0119-00-204	Volunteer	y	y	y						
Ripley	Lake	Meeker	47-0134-02-203	Volunteer	y	y	y						
West Lake Sylvia	Lake	Wright	86-0279-00-101, 86-0279-00-204, 86-0279-00-206, 86-0279-00-211	Volunteer	y	y	y						
East Lake Sylvia	Lake	Wright	86-0289-00-101, 86-0289-00-204, 86-0289-00-205, 86-0289-00-201, 86-0289-00-205	Volunteer	y	y	y						
Moose	Lake	Wright	86-0271-00-201	Volunteer	y	y	y						
Charlotte	Lake	Wright	86-0011-00-101	Volunteer	y	y	y						
Pulaski	Lake	Wright	86-0053-02-204, 86-0053-02-102	Volunteer	Y	Not since 2013	Not since 2013		2017 only				2017 only
Maple	Lake	Wright	86-0134-03-201, 86-0134-01-203, 86-0134-01-206	Volunteer	y	y	y						
John	Lake	Wright	86-0288-00-201	Volunteer	y	y	y						
Mary	Lake	Wright	86-0193-00-201	Volunteer/Wright SWCD	y	y	y		2022	2022	2022		2022
French	Lake	Wright	86-0273-00-202	Volunteer	y	y	y						
Waverly	Lake	Wright	86-0114-00-203	Volunteer/Wright SWCD	y	y	y		2022	2022	2022		2022
Little Waverly	Lake	Wright	86-0106-00-201, 86-0106-00-202	Wright SWCD	Has not been sampled since 2011 except for once in 2017	Resume 2022	Resume 2022	Resume 2022	2022	2022	2022		2022
Beebe	Lake	Wright	86-0023-00-204, 86-0023-00-205, 86-0023-00-206	Volunteer	y	y	y						

Water body	Water body Type	County	ID#	Monitor	Secchi	TP	Chl-*a*	TSS	DO	Temp	TKN	*E. coli*	PH
Martha	Lake	Wright	86-0009-00-201	Volunteer	y	y	y						
Brooks	Lake	Wright	86-0264-00-201	Volunteer	y	y	y						
Granite	Lake	Wright	86-0217-00-202	Volunteer	y	y	y						
Ramsey	Lake	Wright	86-0120-00-201	Volunteer	y	y	y		2018 only				2018 only
Dean	Lake	Wright	86-0041-00-101	Volunteer	y	y	y		2017 only				2017 only
Ann	Lake	Wright	86-0190-00-201	Volunteer	y	y	y		2017 & 2016 only				
Wright SWCD does not monitor any of the ditch systems in the county													
Long	Lake	Kandiyohi	34-0066-00-204	MFCRWD/Volunteer	y	y	y	y					
George	Lake	Kandiyohi	34-0142-00-204	MFCRWD/Volunteer	y	y	y	y					
Nest	Lake	Kandiyohi	34-0154-00-205	MFCRWD	y	y	y	y	y	y			y
Elkhorn	Lake	Kandiyohi	34-0019-00-201	MFCRWD/Volunteer	y	y	y	y					
Green	Lake	Kandiyohi	34-0079-00-103	MFCRWD	y	y	y	y	y	y			y
Diamond	Lake	Kandiyohi	34-0044-00-202	MFCRWD	y	y	y	y	y	y			y
Calhoun	Lake	Kandiyohi	34-0062-00-201	MFCRWD/Volunteer	y	y	y	y					
Monongalia	Lake	Kandiyohi	34-0158-03-201	MFCRWD/Volunteer	y	y	y	y					
Wheeler South	Lake	Kandiyohi	34-0051-01-201	MFCRWD	y	y	y	y	y	y			y
Shultz	Lake	Kandiyohi	34-0049-00-203	MFCRWD	y	y	y	y	y	y			y
Wheeler North	Lake	Kandiyohi	34-0051-02-202	MFCRWD	y	y	y	y	y	y			y
CD28	Ditch	Kandiyohi	S009-128	MFCRWD	y	y		y			y		
MFC5	River	Stearns	S005-368	MFCRWD	y	y		y			y		
MFC3	River	Kandiyohi	S002-299	MFCRWD	y	y		y			y		
MFC4	River	Kandiyohi	S002-295	MFCRWD	y	y		y			y		
CL3	River	Kandiyohi	S002-293	MFCRWD	y	y		y			y		
NFCR/Manannah	River	Meeker	S004-421	MFCRWD/WPLMN	y	y		y	y	y	y		y
NFCR/Cokato	River	Wright	S001-517	WPLMN	y	y		y	y	y	y		y
NFCR/Rockford	River	Wright	S001-256	WPLMN	y	y		y	y	y	y		y
West Sarah	Lake	Hennepin	27-0191-01-206	?	y	y			y				y
East Sarah	Lake	Hennepin	27-0191-02-205	?	y								
Buffalo	Lake	Wright	86-0090-00-202	Volunteer	Resume 2022	Resume 2022	Resume 2022						
Wilhelm	Lake	Wright	86-2202-00-201	Volunteer	Resume 2022	Resume 2022	Resume 2022						
Crawford	Lake	Wright	86-0046-00	Volunteer resuming in 2023									
CD 10	Ditch	Wright		Wright SWCD will monitor as part of the Twelve Mile 319 grant									

6. Further information and references

1. North Fork Crow River Watershed Assessment and Trends Update (April 2021) https://www.pca.state.mn.us/sites/default/files/wq-ws3-07010204c.pdf
2. North Fork Crow River Watershed Total Maximum Daily Load (2022…link applied after approval)
3. North Fork Crow River Lake Protection (2022…link applied after approval)
4. Groundwater Report-North Fork Crow River Watershed (April 2016) https://www.pca.state.mn.us/sites/default/files/wq-ws1-08.pdf
5. North Fork Crow River Monitoring and Assessment Report (December 2011) https://www.pca.state.mn.us/sites/default/files/wq-ws1-08.pdf
6. North Fork Crow River Watershed Stressor Identification Report (December 2020) https://www.pca.state.mn.us/sites/default/files/wq-ws5-07010204d.pdf
7. North Fork Crow River Watershed Biotic Stressor Identification Report (March 2014) https://www.pca.state.mn.us/sites/default/files/wq-ws5-07010204b.pdf
8. North Fork Crow River Bacteria, Nutrients, and Turbidity TMDL report (December 2014) https://www.pca.state.mn.us/sites/default/files/wq-iw8-42e.pdf

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1. North Fork Crow River Watershed Assessment and Trends Update (April 2021) https://www.pca.state.mn.us/sites/default/files/wq-ws3-07010204c.pdf
2. North Fork Crow River Watershed Total Maximum Daily Load (March 2023 North Fork Crow River | Minnesota Pollution Control Agency (state.mn.us))
3. North Fork Crow River Lake Protection (March 2023 North Fork Crow River | Minnesota Pollution Control Agency (state.mn.us))
4. Groundwater Report-North Fork Crow River Watershed (April 2016) https://www.pca.state.mn.us/sites/default/files/wq-ws1-08.pdf
5. North Fork Crow River Monitoring and Assessment Report (December 2011) https://www.pca.state.mn.us/sites/default/files/wq-ws1-08.pdf
6. North Fork Crow River Watershed Stressor Identification Report (December 2020) https://www.pca.state.mn.us/sites/default/files/wq-ws5-07010204d.pdf
7. North Fork Crow River Watershed Biotic Stressor Identification Report (March 2014) https://www.pca.state.mn.us/sites/default/files/wq-ws5-07010204b.pdf
8. North Fork Crow River Bacteria, Nutrients, and Turbidity TMDL report (December 2014) https://www.pca.state.mn.us/sites/default/files/wq-iw8-42e.pdf

9. Statewide Mercury TMDL (MPCA 2022) https://www.pca.state.mn.us/business-with-us/statewide-mercury-tmdl
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11. Tiered Aquatic Uses Framework (MPCA2022) https://www.pca.state.mn.us/water/tiered-aquatic-life-uses-talu-framework
12. Western Regional Climate Center Data (Western Regional Climate Center 2022) https://wrcc.dri.edu/summary/mnF.html
13. Climate Summary for Watersheds (DNR June 2019) http://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/climate_summary_major_18.pdf
14. Industrial Stormwater BMPs Handbook (MPCA 2015) https://www.pca.state.mn.us/sites/default/files/wq-strm3-26.pdf)
15. Environmental Justice (MPCA 2022) https://www.pca.state.mn.us/about-mpca/environmental-justice.
16. North Fork Crow River Comprehensive Watershed Management Plan (Houston Engineering April 2018) https://www.nfcrwd.org/vertical/sites/%7B14D03102-88C8-485B-81E2-631AD7572BCC%7D/uploads/NFCR_Watershed_1W1P_05012018-Final(1).pdf
17. Water Quality Trading Pilot Project North Fork Crow River Watershed (MPCA Nov 2021) https://www.pca.state.mn.us/sites/default/files/wq-wwprm1-37.pdf

Appendix A. Fish IBI assessments for lakes in the NFCRW

Below are summaries of conditions, stressors, and recommendations for the lakes in the NFCRW for which FIBI assessments were conducted. These assessments are conducted by the DNR. (images created and provided by Stephanie Simon, DNR)

Summary of Sarah (27-0191-00) Fish Community and Stressors

- **Fish Community:**
    - Fish-based index of biotic integrity (FIBI) scores: 19 (2018), 35 (2017), Impairment threshold = 45
    - Species sampled that negatively affect the FIBI score: Black Bullhead, Bluntnose Minnow, Brown Bullhead, Green Sunfish, Yellow Bullhead
    - Species sampled that positively affect the FIBI score: Black Crappie, Bluegill, Bowfin, Central Mudminnow, Golden Shiner, Iowa Darter, Johnny Darter, Largemouth Bass, Northern Pike, Pumpkinseed, Tadpole Madtom, Walleye, Yellow Perch
    - Other species previously sampled: Spottail Shiner, White Crappie, White Sucker
- **Candidate Stressors:**
    - Physical habitat alteration: Score the Shore score of 63 indicates low shoreline habitat quality. Nonnative plants include Curly-leaf Pondweed (CLP) and Eurasian Water-milfoil (EWM)), over 43% of the littoral acres are being chemically treated for control of CLP and EWM in 2019. A fish barrier present (since 1987) to prevent carp migration into the lake from the Crow River.
    - Eutrophication: 92.6 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 66% watershed disturbance (residential (10.5%), agriculture (55.9%), barren land (0.03%))
- **Inconclusive stressors**
    - Altered interspecific competition: Stocking (gamefish management activities includes private walleye stocking program)
    - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade.
- **Recommendations:**
    - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
    - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent). Lake Sarah has a Lake Vegetation Management Plan (LVMP) for control of non native aquatic plants (EWM and CLP) with unknown impacts to native plant species and the fish community in lake that relies on vegetation.
    - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed (Lake Sarah is near the bottom portion of watershed).
    - Continue to research internal phosphorus loading within the lake and its sources.

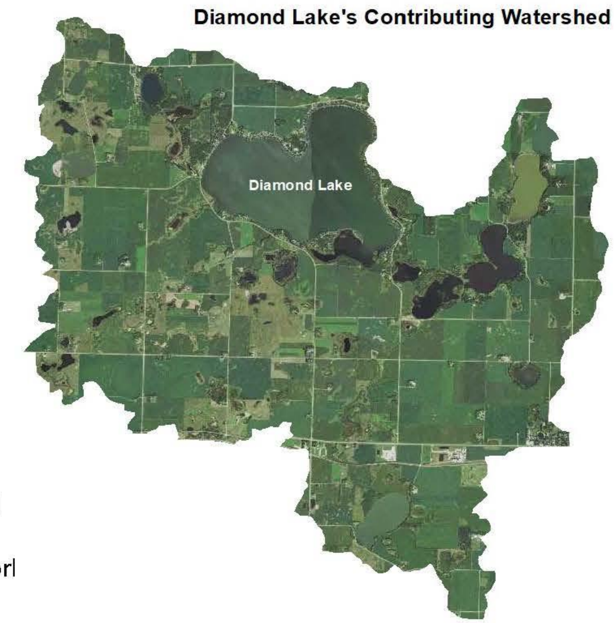
For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

CLEAN WATER LAND & LEGACY AMENDMENT

Summary of Diamond (34-0044-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 15 (2016), 11 (2016), Impairment threshold = 45
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Banded Killifish, Black Crappie, Bluegill, Iowa Darter, Largemouth Bass, Northern Pike, Walleye, Yellow Perch
  - Other species previously sampled: Bigmouth Shiner, White Crappie, Golden Shiner, Mimic Shiner
- **Candidate stressors:**
  - Physical habitat alteration: Score the Shore score of 60 indicates low shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Eutrophication: 65.1 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 75.4% watershed disturbance (residential (4.4%), agriculture (71%))
- **Inconclusive stressors:**
  - Altered interspecific competition: Common Carp, Curly-leaf pondweed, Chinese mystery snail, and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Forl Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper portions of the watershed.



For more information, contact IBI program watershed lead identified at: [MNDNR lake index of biological integrity website]

DEPARTMENT OF NATURAL RESOURCES
CLEAN WATER LAND & LEGACY

Summary of George (34-0142-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 36 (2018), 40 (2017), *24 (2013),* Impairment Threshold = 38 *Italicized information is used as supporting information only*
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Banded Killifish, Bluegill, Bluntnose minnow, Hybrid Sunfish, Largemouth Bass, Iowa Darter, Northern Pike, Walleye, Yellow Bullhead
  - Other species previously sampled: Common Carp
- **Candidate stressors:**
  - Physical habitat alteration: 19 docks/km of shoreline, Score the Shore score of 68 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
- **Inconclusive stressors:**
  - Eutrophication: 15 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 29% watershed disturbance (residential development, agriculture, roads)
  - Altered interspecific competition: Curly-leaf pondweed, Zebra Mussels, and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

For more information, contact IBI program watershed lead identified at: [MNDNR lake index of biological integrity website]

DEPARTMENT OF NATURAL RESOURCES

CLEAN WATER LAND & LEGACY AMENDMENT

Summary of Nest (34-0154-00) Fish Community and Stressors

- **Fish Community:**
    - Fish-based index of biotic integrity (FIBI) scores: 49 (2018), 38 (2017), *23 (2007)*, Impairment Threshold = 45 *Italicized information is used as supporting information only*
    - Species sampled that negatively affect the FIBI score: Black Bullhead, Green Sunfish
    - Species sampled that positively affect the FIBI score: Banded Killifish, Blackchin Shiner, Blacknose Shiner, Bluegill, Bluntnose Minnow, Bowfin, Brook Silverside, Largemouth Bass, Iowa Darter, Logperch, Northern Pike, Pugnose Shiner, Smallmouth Bass, Walleye, White Sucker, Yellow Bullhead, Yellow Perch
    - Other species previously sampled: Common Shiner, Creek Chub, Fathead Minnow, Rock Bass, Sand Shiners
- **Inconclusive stressors:**
    - Eutrophication: 38.2 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 63% watershed disturbance (residential development, agriculture, roads)
    - Physical habitat alteration: 8 docks/km of shoreline, Score the Shore score of 77 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
    - Altered interspecific competition: Zebra Mussels and stocking (gamefish management activities)
    - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
    - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
    - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
    - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

For more information, contact IBI program watershed lead identified at: [MNDNR lake index of biological integrity website]

DEPARTMENT OF NATURAL RESOURCES

CLEAN WATER LAND & LEGACY AMENDMENT

Summary of Jennie (47-0015-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 25 (2014), *20 (2012)*, Impairment Threshold = 36 *Italicized information is used as supporting information only*
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Bluegill, Iowa Darter, Largemouth Bass, Northern Pike, Walleye, Yellow Perch
  - Other species previously sampled: Bluntnose Minnow, Johnny Darter, Tadpole Madtom, White Crappie, Yellow Bullhead
- **Candidate stressors:**
  - Eutrophication: 62 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 70% watershed disturbance (residential development, agriculture, roads)
- **Inconclusive stressors:**
  - Physical habitat alteration: 8 docks/km of shoreline, Score the Shore score of 75 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Altered interspecific competition: Common Carp, Banded mystery snail, Curly-leaved pondweed
  - and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade

Jennie Lake's Contributing Watershed

- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects,
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

Summary of Big Swan (47-0038-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 34 (2017), 31 (2016), Impairment threshold =
  - Species sampled that negatively affect the FIBI score: Bigmouth Buffalo, Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Banded Killifish, Brook Silverside, Bowfir Channel Catfish, Iowa Darter, Logperch, Northern Pike, Smallmouth Bass
  - Other species previously sampled: Smallmouth Buffalo
- **Candidate stressors**
  - Eutrophication: 98.4 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 74.2% watershed disturbance (residential development, agriculture, roads)
- **Inconclusive stressors:**
  - Physical habitat alteration: Score the Shore score of 78 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Altered interspecific competition: Common Carp, Curly-leaved Pondweed, Narrow Leaved Cat and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the Nor Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergen
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Big Swan Lake's Contributing Watershed

DEPARTMENT OF NATURAL RESOURCES

CLEAN WATER LAND & LEGACY

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

Summary of Manuella (47-0050-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 44 (2018), 50 (2014), Impairment Threshold
  - Species sampled that negatively affect the FIBI score: Common Carp, Fathead Minnow, Greei Sunfish
  - Species sampled that positively affect the FIBI score: Bluegill, Bluntnose Minnow, Bowfin, lov Darter, Northern Pike, Walleye, White Sucker, Yellow Perch
  - Other species previously sampled: Bigmouth Shiner, Brown Bullhead, Brown Trout, Bullhead Minnow, Channel Catfish, Mimic Shiner, Rainbow Trout, Shorthead Redhorse, White Crappie
- **Inconclusive stressors:**
  - Eutrophication: 20 µg/l total phosphorus, nutrient impairment listing by MPCA, approximate 73% watershed disturbance (residential development, agriculture, roads)
  - Physical habitat alteration: 14 docks/km of shoreline, Score the Shore score of 72 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetati by lakeshore owners.
  - Altered interspecific competition: Common Carp, Curly-leaf Pondweed, Eurasian Watermilfoi and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the Nc Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

Summary of Erie (47-0064-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 38 (2018), Impairment Threshold = 45
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Green Sunfish
  - Species sampled that positively affect the FIBI score: Banded Killifish, Iowa Darter, Walleye Bluegill, Hybrid Sunfish, Northern Pike
  - Other species previously sampled: Blacknose Shiner, Brook Silverside, Brown Bullhead, Common Carp, Emerald Shiner
- **Inconclusive stressors:**
  - Physical habitat alteration: Score the Shore score of 85 indicates high shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Eutrophication: 21.5 µg/l total phosphorus, approximately 55% watershed disturbance (residential development, agriculture, roads)
  - Altered interspecific competition: Eurasian water-milfoil, Curly-leaved pondweed and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Erie Lake's Contributing Watershed

For more information, contact IBI program watershed lead identified at: [MNDNR lake index of biological integrity website]

DEPARTMENT OF NATURAL RESOURCES

CLEAN WATER LAND & LEGACY AMENDMENT

Summary of Minnie-Belle (47-0119-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 42 (2017), *41 (2008),* Impairment Threshold = 45 *Italicized information is used as supporting information only*
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Banded Killifish, Bluegill, Bluntnose Minnow, Largemouth Bass, Iowa Darter, Least Darter, Northern Pike, Walleye, Yellow Bullhead
  - Other species previously sampled: Bowfin, Smallmouth Bass, White Crappie
- **Candidate stressors:**
  - Physical habitat alteration: 25 docks/km of shoreline, Score the Shore score of 62 indicates low shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
- **Inconclusive stressors:**
  - Eutrophication: 20 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 52% watershed disturbance (residential development, agriculture, roads)
  - Altered interspecific competition: Common Carp, Banded Mystery Snail, Curly-leaf Pondweed, Eurasian Watermilfoil, and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade

- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

Summary of Ripley – West Portion (47-0134-02) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 38 (July 2015), 47 (June 2015), *32 (July 19, 2010), 36 (July 15, 2010)* Impairment Threshold = 36 *Italicized information is used as supporting information only.*
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Banded Killifish, Bluegill, Brook Stickleback, Largemouth Bass, Northern Pike, Walleye, Yellow Bullhead
  - Other species previously sampled: Brown Bullhead, Flathead Catfish, White Crappie, White Sucker
- **Inconclusive stressors:**
  - Eutrophication: 44 µg/l total phosphorus, approximately 67% watershed disturbance (residential development, agriculture, roads)
  - Physical habitat alteration: 7 docks/km of shoreline, Score the Shore score of 58 indicates low shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Altered interspecific competition: Banded Mystery Snail, Common Carp (present in 2010 surveys only) Eurasian Watermilfoil, and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

Summary of Rice (73-0196-00) Fish Community and Stressors

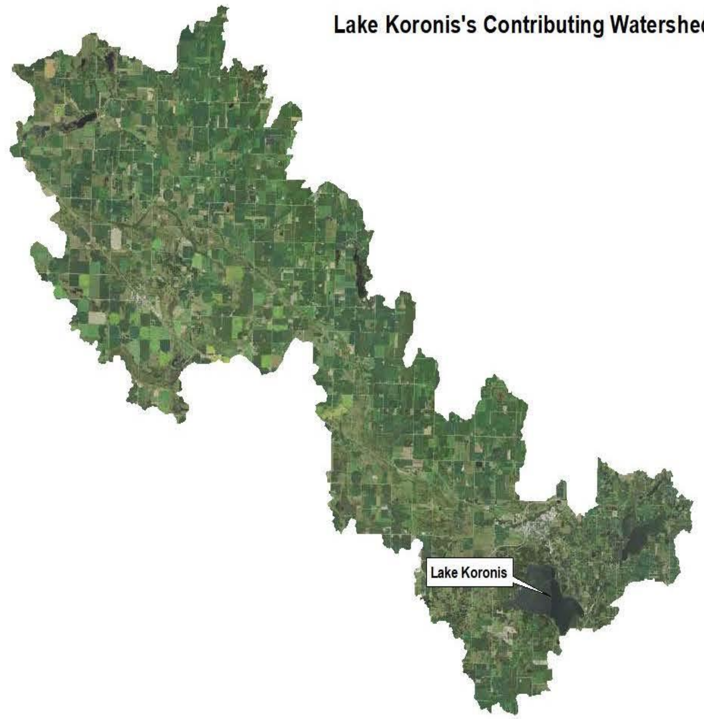
- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 56 (2018), 38 (2016), *53 (2012)*, Impairment Threshold = 45 *Italicized information is used as supporting information only*
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Bigmouth Buffalo, Common Carp, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Bluegill, Bluntnose Minnow, Bowfin, Largemouth Bass, Iowa Darter, Logperch, Northern Pike, Shorthead Redhorse, Walleye, White Sucker, Yellow Perch
  - Other species previously sampled: Creek Chub, Red Shiner, Tullibee (Cisco), White Crappie
- **Candidate stressors:**
  - Eutrophication: 52 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 85% watershed disturbance (residential development, agriculture, roads)
- **Inconclusive stressors:**
  - Physical habitat alteration: 9 docks/km of shoreline, Score the Shore score of 71 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Altered interspecific competition: Common Carp, Curly-leaf Pondweed, Starry Stonewort, and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

Summary of Koronis (73-0200-02) Fish Community and Stressors

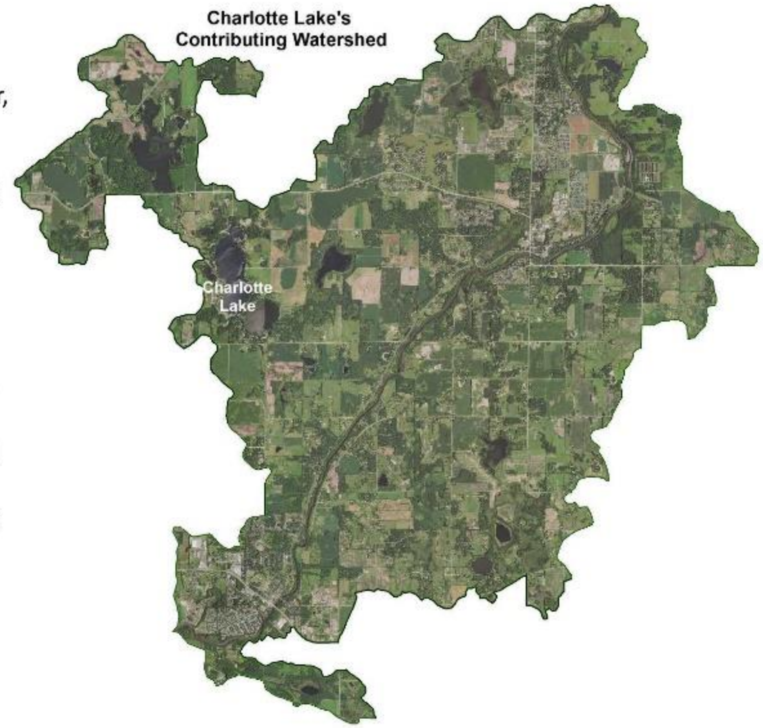
- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 23 (2016/17), *38 (2012),* Impairment threshold = 45 *Italicized information is used as supporting information only*
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Bigmouth Buffalo, Common Ca Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Bluntnose minnow, Cisco, Iowa Darter, Logperch Northern Pike, Rock Bass, Smallmouth Bass, Walleye
  - Other species previously sampled: Banded Killifish, Blacknose Dace, Brown Bullhead, Emerald Shiner, Golden Redhorse, Greater Redhorse, Mimic Shiner, Pugnose Shiner, River Shiner, Sand Shiner, Silver Redhorse, Smallmouth Buffalo, Spotfin Shiner, Trout Perch, White Crappie
- **Candidate stressors:**
  - Eutrophication: 33.5 µg/l total phosphorus, no nutrient impairment but phosphorus at levels where have observed impacts to fish communities in Minnesota lakes, approximately 82.7% watershed disturbance (residential development, agriculture, roads)
  - Physical habitat alteration: 18 docks/km of shoreline, Score the Shore score of 74 indicates moderat shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners, Lake Koronis Dam (recreational dam and outlet) affects aquatic connectivity
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
  - Decreased dissolved oxygen: lack of adequate dissolved oxygen at depths containing suitable temperatures for coldwater species during summer months
- **Inconclusive stressors:**
  - Altered interspecific competition: Common Carp, Starry Stonewort, Curly-leaf pondweed, Purple Loosestrife, and stocking (gamefish management activities)
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent). Lake (LVMP) for control of non native aquatic plants (Starry Stonewort) with unknown impacts to fish community in lake.
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper portions of the watershed.



For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

Summary of Charlotte (86-0011-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 45 (2017), *40 (September 2010), 47 (July 2010)* Impairment threshold = 45 *Italicized information is used as supporting information only*
  - Species sampled that negatively affect the FIBI score: Green Sunfish
  - Species sampled that positively affect the FIBI score: Banded Killifish, Blackchin Shiner, Blacknose Shiner, Bluegill, Bluntnose Minnow, Iowa Darter, Northern Pike, Spotfin Shiner, Yellow Bullhead
  - Other species previously sampled: Black Bullhead, Common Carp, Mimic Shiner, Sand Shiner, Spottail Shiner, White Sucker
- **Inconclusive stressors:**
  - Physical habitat alteration: 12 docks/km of shoreline, Score the Shore score of 70 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Eutrophication: 15 µg/l total phosphorus, approximately 52% watershed disturbance (residential development, agriculture, roads)
  - Altered interspecific competition: Eurasian water-milfoil, curly-leaved pondweed and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.



For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

Summary of Beebe (86-0023-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 28 (2016), Impairment threshold = 45
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Green Sunfish
  - Species sampled that positively affect the FIBI score: Black Crappie, Bluegill, Bluntnose Minnow, Iowa Darter, Northern Pike, Spotfin Shiner, Walleye, Yellow Bullhead.
  - Other species previously sampled: Brown Bullhead, Fathead Minnow, Mimic Shiner, White Crappie
- **Inconclusive stressors:**
  - Physical habitat alteration: 3 docks/km of shoreline, Score the Shore score of 73 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Eutrophication: 44 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 51.3% watershed disturbance (residential development, agriculture, roads)
  - Altered interspecific competition: Common Carp, Eurasian water-milfoil, curly-leaved pondweed, purple loosestrife and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Beebe Lake's Contributing Watershed

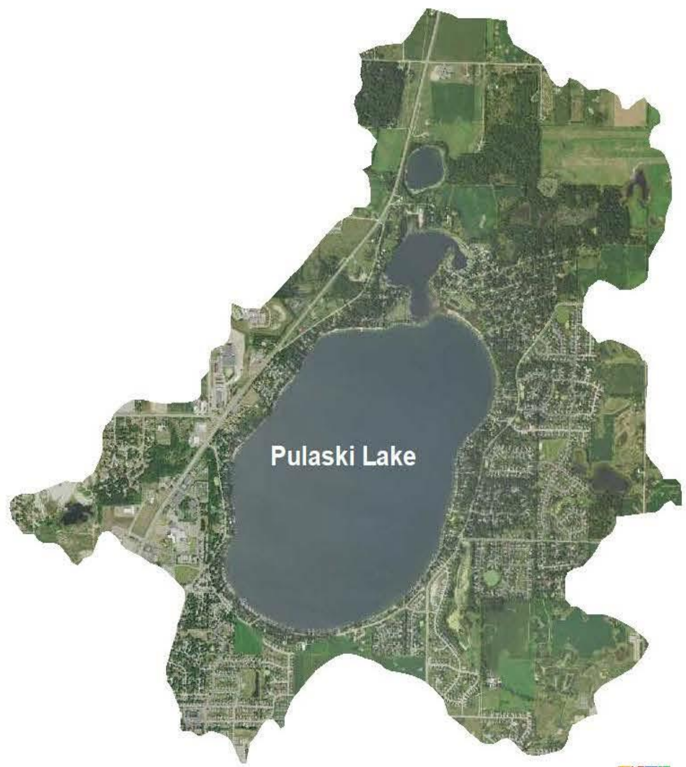
DEPARTMENT OF NATURAL RESOURCES

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

Summary of Pulaski (86-0053-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 40 (2015), 36 *(2010),* Impairment thresho 45 *Italicized information is used as supporting information only*
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Fathead Minnow, Gr Sunfish
  - Species sampled that positively affect the FIBI score: Banded Killifish, Bluegill, Bluntnose Minnow, Iowa Darter, Northern Pike, Rock Bass, Walleye, Yellow Bullhead
  - Other species previously sampled: Emerald Shiner, Mimic Shiner
- **Candidate stressors:**
  - Physical habitat alteration: 18 docks/km of shoreline, Score the Shore score of 53 indicate: shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
- **Inconclusive stressors:**
  - Eutrophication: 21.1 µg/l total phosphorus, no nutrient impairment listing by MPCA, approximately 62.7% watershed disturbance (residential development, agriculture, roads)
  - Altered interspecific competition: Eurasian water-milfoil, curly-leaf pondweed, purple loosestrife and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middl portions of the watershed.

Pulaski Lake's Contributing Watershed



For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

Summary of Buffalo (86-0090-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 12 (2016), 24 (2016), Impairment thresho = 45
  - Species sampled that negatively affect the FIBI score: Bigmouth Buffalo, Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish, Orangespotted Sunfish
  - Species sampled that positively affect the FIBI score: Black Crappie, Blacknose Shiner, Bluegill, Bluntnose Minnow, Bowfin, Brook Silverside, Channel Catfish, Logperch, Largemouth Bass, Northern Pike, Smallmouth Bass, Walleye
  - Other species previously sampled: Hornyhead Chub, Mimic Shiner, Rock Bass, Trout-Perch
- **Candidate stressors:**
  - Eutrophication: 76.3 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 66.9% watershed disturbance (residential development, agriculture, roads)
  - Physical habitat alteration: Score the Shore score of 59 indicates low shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
- **Inconclusive stressors:**
  - Altered interspecific competition: Common Carp, Eurasian water-milfoil, curly-leaved pondweed, purple loosestrife and stocking (gamefish management activities)
  - Temperature regime changes: 0.06℉ increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Buffalo Lake's Contributing Watershed

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

CLEAN WATER LAND & LEGACY AMENDMENT

Summary of Little Waverly (86-0106-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 22 (2014), Impairment threshold = 36
  - Species sampled that negatively affect the FIBI score: Bigmouth Buffalo, Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Bluntnose Minnow, Largemouth Bas Northern Pike, White Sucker
  - Other species previously sampled: Brook Stickleback, White Crappie
- **Candidate stressors:**
  - Eutrophication: 431.3 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 81% watershed disturbance (residential development, agriculture, roads)
- **Inconclusive stressors:**
  - Physical habitat alteration: 1 dock/km of shoreline, Score the Shore score of 79 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vege by lakeshore owners.
  - Altered interspecific competition: Common Carp, Eurasian Water-milfoil, Curly-leaved Pondweed, Purple Loosestrife and stocking (gamefish management activities),
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Little Waverly Lake's Contributing Watershed

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

Summary of Waverly (86-0114-00) Fish Community and Stressors

- **Fish Community:**
    - Fish-based index of biotic integrity (FIBI) scores: 24 (2018), 29 (2014), Impairment threshol
    - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Fathea Minnow, Green Sunfish
    - Species sampled that positively affect the FIBI score: Blugeill, Bowfin, Hybrid Sunfish, Iowa [Largemouth Bass, Northern Pike, Smallmouth Bass, Spottail Shiner, Walleye, White Sucker, ' Perch
    - Other species previously sampled: Bigmouth Shiner, Brassy Minnow, Common Shiner, Sand Shiner, White Crappie
- **Candidate stressors:**
    - Eutrophication: 33.8 µg/l total phosphorus, nutrient impairment listing by MPCA, approxim 62.6% watershed disturbance (residential development, agriculture, roads)
- **Inconclusive stressors:**
    - Physical habitat alteration: 6 docks/km of shoreline, Score the Shore score of 56 indicates lc shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lake owners.
    - Altered interspecific competition: Common Carp, Eurasian Water-milfoil, Curly-leaved Pond Purple Loosestrife and stocking (gamefish management activities)
    - Temperature regime changes: 0.06°F increase in July average air temperatures within the N Fork Crow River Watershed over the last decade
- **Recommendations:**
    - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration pr or rainwater gardens.
    - Limit removal of native aquatic plant communities (submerged, floating leaved, and emerg
    - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Waverly Lake's Contributing Watershed

DEPARTMENT OF NATURAL RESOURCES

CLEAN WATER LAND & LEGACY AMENDMENT

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

Summary of Rock (86-0182-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 19 (2016), Impairment Threshold = 45
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Green Sunfish
  - Species sampled that positively affect the FIBI score: Black Crappie, Bluegill, Bowfin, Iowa Darter, Largemouth Bass, Walleye, Yellow Bullhead
  - Other species previously sampled: Central Mudminnow, Johnny Darter
- **Candidate stressors:**
  - Eutrophication: 49.5 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 55.3% watershed disturbance (residential development, agriculture, roads)
- **Inconclusive stressors:**
  - Physical habitat alteration: 5 docks/km of shoreline, Score the Shore score of 76 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Altered interspecific competition: Common Carp, Eurasian water-milfoil, Curly-leaved Pondweed and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Rock Lake's Contributing Watershed

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

Summary of Dutch (86-0184-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 0 (2016), Impairment Threshold = 38
  - Species sampled that negatively affect the FIBI score: Bigmouth Buffalo, Black Bullhead, Common Carp, Green Sunfish
  - Species sampled that positively affect the FIBI score: Black Crappie, Bluegill, Bowfin, Largemouth Bass, Northern Pike
  - Other species previously sampled: Brown Bullhead, Spottail Shiner, White Crappie
- **Candidate Stressors:**
  - Eutrophication: 157.5 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 71.8% watershed disturbance (residential development, agriculture, roads
- **Inconclusive stressors:**
  - Physical habitat alteration: Score the Shore score of 77 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Altered interspecific competition: Common Carp, Eurasian water-milfoil, Curly-leaved Pondweed and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Dutch Lake's Contributing Watershed

DEPARTMENT OF NATURAL RESOURCES
CLEAN WATER LAND & LEGACY AMENDMENT

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

Summary of Emma (86-0188-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 37 (2018), 36 (2016), impairment threshold = 36
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Black Crappie, Bluegill, Bowfin, Iowa Darter, Largemouth Bass, Northern Pike, Yellow Bullhead, Yellow Perch
  - Other species previously sampled: Bluntnose Minnow, Channel Catfish
- **Inconclusive stressors:**
  - Eutrophication: 144 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 87% watershed disturbance (residential development, agriculture, roads)
  - Physical habitat alteration: 1 docks/km of shoreline, Score the Shore score of 85 indicates high shoreline habitat quality
  - Altered interspecific competition: Common Carp, Curly-leaved Pondweed, Eurasian Watermilfoil and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

Summary of Ann (86-0190-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 5 (2016), *16 (2006),* impairment threshold =
    Italicized information is used as supporting information only
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Fatheac Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Black Crappie, Bluegill, Bowfin, Iowa Darter, Largemouth Bass, Northern Pike, Yellow Bullhead, Yellow Perch
  - Other species previously sampled: Bluntnose Minnow, Channel Catfish
- **Candidate stressors:**
  - Eutrophication: 230.4 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 89.2% watershed disturbance (residential development, agriculture, roads)
- **Inconclusive stressors:**
  - Physical habitat alteration: 4 docks/km of shoreline, Score the Shore score of 75 indicates moderate shoreline habitat quality
  - Altered interspecific competition: Common Carp, Curly-leaved Pondweed and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Ann Lake's Contributing Watershed

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

Summary of Mary (86-0193-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 33 (2017), *25 (2011), 32 (2011), 13 (2001),* Impairment threshold = 45 *Italicized information is used as supporting information only*
  - Species sampled that negatively affect the FIBI score: Common Carp, Green Sunfish
  - Species sampled that positively affect the FIBI score: Black Crappie, Bluegill, Brook Silverside, Hybrid Sunfish, Least Darter, Iowa Darter, Northern Pike, Walleye, Yellow Bullhead
- **Inconclusive stressors:**
  - Physical habitat alteration: 10 docks/km of shoreline, Score the Shore score of 73 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetatio by lakeshore owners.
  - Eutrophication: 22.7 µg/l total phosphorus, no nutrient impairment listing by MPCA, approximately 51.9% watershed disturbance (residential development, agriculture, roads)
  - Altered interspecific competition: Common Carp, Curly-leaved Pondweed, and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the Nor Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Mary Lake's Contributing Watershed

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

Summary of Howard (86-0199-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 9 (2014), *15 (2006)*, Impairment Threshold = 45 *Italicized information is used as supporting information only*
  - Species sampled that negatively affect the FIBI score: Bigmouth Buffalo, Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Black Crappie, Bowfin, Golden Shiner, Iowa Darter, Largemouth Bass, Northern Pike, Walleye, Yellow Bullhead, Yellow Perch
  - Other species previously sampled: Banded Killifish, Common Shiner, Emerald Shiner, Pugnose Shiner, Spotfin Shiner
- **Candidate stressors:**
  - Eutrophication: 72.4 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 75.4% watershed disturbance (residential development, agriculture, roads)
- **Inconclusive stressors:**
  - Physical habitat alteration: 7 docks/km of shoreline, Score the Shore score of 66 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Altered interspecific competition: Common Carp, Curly-leaved Pondweed, Eurasian Watermilfoil and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

Summary of Granite (86-0217-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 12 (2018), 20 (2014), Impairment Threshold = 45
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Bluegill, Bluntnose Minnow, Largemouth Bass, Northern Pike, Walleye, Yellow Bullhead
  - Other species previously sampled: White Crappie
- **Inconclusive stressors:**
  - Physical habitat alteration: 6 docks/km of shoreline, Score the Shore score of 77 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Eutrophication: 49.2 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 62.7% watershed disturbance (residential development, agriculture, roads)
  - Altered interspecific competition: Common Carp, Eurasian Water-Milfoil, Curly-Leaved Pondweed and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Granite Lake's Contributing Watershed

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

CLEAN WATER LAND & LEGACY AMENDMENT

Summary of Collinwood (86-0293-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 3 (2018), 7 (2018), *7 (2012),* Impairment Threshold = 45 *Italicized information is used as supporting information only*
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish, Orange Spotted Sunfish
  - Species sampled that positively affect the FIBI score: Bluegill, Largemouth Bass, Iowa Darter, Least Darter, Northern Pike, Walleye, White Sucker, Yellow Perch
  - Other species previously sampled: Bigmouth Buffalo, White Crappie
- **Candidate stressors:**
  - Eutrophication: 94.1 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 72% watershed disturbance (residential development, agriculture, roads)
- **Inconclusive stressors:**
  - Physical habitat alteration: 7 docks/km of shoreline, Score the Shore score of 82 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Altered interspecific competition: Common Carp, Chinese mystery snail, Banded mystery snail, and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

Collinwood Lake's Contributing Watershed

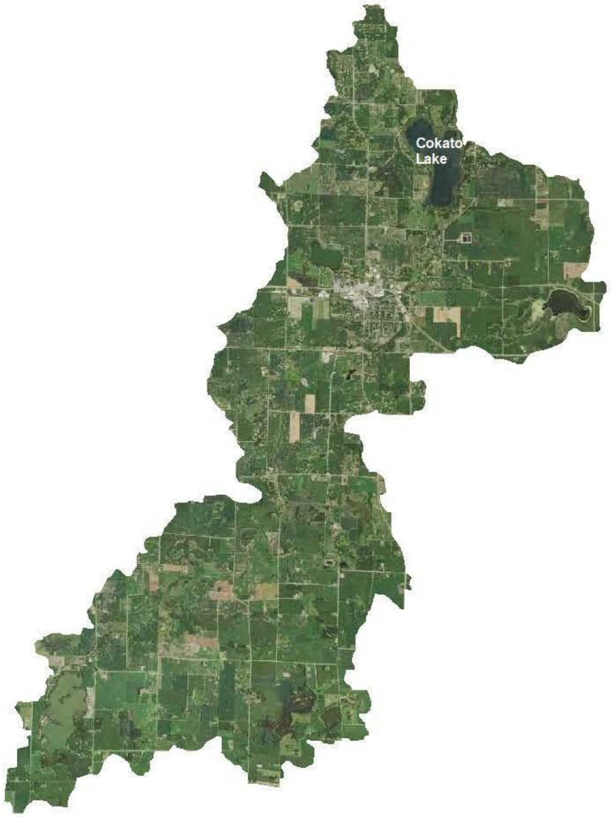
For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

Summary of Cokato (86-0263-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 32 (2014), *17 (2007)*, Impairment Threshold = 45 *It used as supporting information only*
  - Species sampled that negatively affect the FIBI score: Bigmouth Buffalo, Black Bullhead, Common C Green Sunfish
  - Species sampled that positively affect the FIBI score: Bluegill, Black Crappie, Channel Catfish, Johnny Bass, Northern Pike, Silver Redhorse, Smallmouth Bass, Spottail Shiner, Walleye, White Sucker
  - Other species previously sampled: Brassy Minnow, Brook Stickleback, Brown Bullhead, Golden Red Pumpkinseed
- **Candidate stressors:**
  - Eutrophication: 54.1 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 88.4% watershed disturbance (residential development, agriculture, roads)
- **Inconclusive stressors:**
  - Physical habitat alteration: 4 docks/km of shoreline, Score the Shore score of 77 indicates moderate shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Altered interspecific competition: Common Carp, Curly-leaved Pondweed and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

For more information, contact IBI program watershed lead identified at: [MNDNR lake index of biological integrity website]

Cokato Lake's Contributing Watershed



DEPARTMENT OF NATURAL RESOURCES

CLEAN WATER LAND & LEGACY

Summary of French (86-0273-00) Fish Community and Stressors

- **Fish Community:**
  - Fish-based index of biotic integrity (FIBI) scores: 30 (2016), Impairment Threshold = 45
  - Species sampled that negatively affect the FIBI score: Black Bullhead, Common Carp, Fathead Minnow, Green Sunfish
  - Species sampled that positively affect the FIBI score: Black Crappie, Bluegill, Iowa Darter, Largemouth Bass, Northern Pike, Walleye, Yellow Bullhead, Yellow Perch
- **Candidate stressors:**
  - Eutrophication: 37 µg/l total phosphorus, nutrient impairment listing by MPCA, approximately 62% watershed disturbance (residential development, agriculture, roads)
- **Inconclusive stressors:**
  - Physical habitat alteration: Score the Shore score of 65 indicates low shoreline habitat quality, permitted and possibly unpermitted removal of vegetation by lakeshore owners.
  - Altered interspecific competition: Common Carp, Eurasian Water-Milfoil, Curly-Leaved Pondweed and stocking (gamefish management activities)
  - Temperature regime changes: 0.06°F increase in July average air temperatures within the North Fork Crow River Watershed over the last decade
- **Recommendations:**
  - Promote and maintain riparian areas with use of shoreline buffers, shoreline restoration projects, or rainwater gardens.
  - Limit removal of native aquatic plant communities (submerged, floating leaved, and emergent).
  - Continue to implement or promote agricultural BMP's within the North Fork Crow River Watershed to aid with reduction in nutrients and sediment coming from upper and middle portions of the watershed.

French Lake's Contributing Watershed

For more information, contact IBI program watershed lead identified at: MNDNR lake index of biological integrity website

DEPARTMENT OF NATURAL RESOURCES

CLEAN WATER LAND & LEGACY AMENDMENT

Additional Lakes assessed include the following:

47-0046-00 Washington Lake

Two FIBI surveys were conducted on Washington Lake in 2008 and 2014 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Washington Lake is 2,438 acres, with maximum depth of 17 feet, and is in Schupp Lake Class 41; these characteristics put it into a group of shallow lakes scored with FIBI Tool 7. The FIBI scores are 49 and 54, which are both above the impairment threshold (36) and are above of the upper limit of the 90% confidence interval (45). The assessment uses the 2014 survey data, and the 2008 survey is used as supporting information. The overall high numbers of small benthic dwelling species and vegetative dwelling species sampled are most positively influencing both FIBI scores, as well as the high proportion of the individuals sampled in the nearshore gear being vegetative dwelling species. The only negative influence on the FIBI scores is the low proportion of biomass in traps nets from insectivore species. The most abundant species by biomass in the gill nets were Black Bullhead, Common Carp, Northern Pike, Smallmouth Bass, and Walleye. Bowfin, Common Carp, and Walleye were the most abundant species by biomass in the trap nets. Bluegill, Bluntnose Minnow, Johnny Darter, and Yellow Perch were the most common species sampled in the nearshore gears. Select stressor information was reviewed for Washington Lake: the contributing watershed is primarily agricultural land and water with approximately 65% watershed disturbance (NLCD 2011). There are approximately 14 docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2016, which resulted in a mean lake-wide habitat score of 74 out of 100, indicating overall moderate quality lakeshore condition. Based on the 2014 FIBI survey information and using the 2008 FIBI survey as supporting information, we recommend classifying Washington Lake as Fully Supporting (FS) for assessment of Aquatic Life Use (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

86-0279-00 West Lake Sylvia

One FIBI survey was conducted on West Lake Sylvia in 2015 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). West Lake Sylvia is 904 acres, with maximum depth of 97 feet, and is in Schupp Lake Class 25; these characteristics put it into a group scored with FIBI Tool 2. The FIBI score is 58, which is above the impairment threshold (45) and outside of the upper limit of the 90% confidence interval (54). The FIBI score was most positively influenced by the overall high number of vegetative dwelling species sampled across all gears, the high proportion of intolerant species sampled in the nearshore gear, and the presence of intolerant species (Rock Bass) in the gill nets. The low proportion of small benthic dwelling species sampled in the nearshore gear as well as the high biomass in the trap nets from omnivore species and tolerant species are most negatively affecting the FIBI score. The most abundant species by biomass in the gill nets were Largemouth Bass, Northern Pike, Walleye, and Yellow Bullhead. Bluegill, Bowfin, Pumpkinseed, and Yellow Bullhead were the most abundant species by biomass in the trap nets. Blackchin Shiner, Blacknose Shiner, Bluegill, Bluntnose Minnow, and Green Sunfish were the most abundant species sampled in the nearshore gear. Select stressor information was reviewed for West Lake Sylvia: the contributing watershed is primarily agricultural land, forested land, and water with approximately 41% watershed disturbance (NLCD 2011). There are approximately 20 docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2015, which resulted in a mean lake-wide habitat score of 68 out of 100, indicating overall moderate quality lakeshore condition. Based on the 2015 FIBI survey information, we recommend classifying West Lake Sylvia as FS for assessment of Aquatic Life Use (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

86-0288-00 John Lake

Two FIBI surveys were conducted on John Lake in 2006 and 2016 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). John Lake is 398 acres, with maximum depth of 28 feet, and is in Schupp Lake Class 38; these characteristics put it into a group of shallow lakes scored with FIBI Tool 7. The 2016 survey will be used for the assessment and the 2006 survey is supporting information. The FIBI scores are 64 and 69, which are both above the impairment threshold (36) and outside the upper limit of the 90% confidence interval (45). The overall high number of vegetative dwelling species sampled across all gears, the high proportion of biomass in trap nets from insectivore species, and the low proportion of biomass in trap nets from tolerant species are most positively influencing the 2016 FIBI score. The overall low number of small benthic dwelling species is most negatively affecting the 2016 FIBI score. The most abundant species by biomass in the gill nets of both surveys included Northern Pike, Walleye, and Yellow Bullhead. Bluegill, Bowfin, Largemouth Bass, Northern Pike, and Yellow Bullhead were the most abundant species by biomass in the trap nets. Blackchin Shiner, Bluegill, Green Sunfish, and Largemouth Bass were the most abundant species sampled in the nearshore gear. Select stressor information was reviewed for John Lake: the contributing watershed is primarily agricultural land, forested land, and water with approximately 59% watershed disturbance (NLCD 2011). There are approximately 10 docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2016, which resulted in a mean lake-wide habitat score of 73 out of 100, indicating overall moderate quality lakeshore condition. Based on the 2016 FIBI survey and the supporting information from the 2006 FIBI survey, we recommend classifying John Lake as FS and for assessment of Aquatic Life Use (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

47-0026-00 Long Lake

One FIBI survey was conducted on Long Lake in 2003 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Long Lake is 164 acres, with a maximum depth of 28 feet, and is in Schupp Lake Class 34; these characteristics put it into a group scored with FIBI Tool 5. Long Lake has a history of winterkill events and therefore should not be assessed with the FIBI tool. We recommend classifying Long Lake as Not Assessable (NA) for assessment of Aquatic Life Use due to recent winterkill (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

86-0041-00 Dean Lake

One FIBI survey was conducted on Dean Lake in 2011 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Dean Lake is 176 acres, with a maximum depth of 20 feet, and is in Schupp Lake Class 30; these characteristics put it into a group scored with FIBI Tool 4. The FIBI score is six, which is well below the impairment threshold (38) and outside of the lower limit of the 90% confidence interval (30). All the metrics of the FIBI scored negatively and the most notable negative influences were the lack of small benthic dwelling species sampled in the nearshore gears and the overall high number of tolerant species sampled and the high proportion of biomass in trap nets from tolerant species (Black Bullhead and Common Carp). The most abundant species by biomass in the gill nets were Black Bullhead, Black Crappie, Bluegill, and Yellow Perch. Black Crappie, Bluegill, and Common Carp were the most abundant species by biomass in the trap nets. Bluegill, Central Mudminnow, Largemouth Bass, and Yellow Perch were the most abundant species sampled with the nearshore gears. Select stressor information was reviewed for Dean Lake: the contributing watershed is primarily agricultural land with approximately 63% watershed disturbance (NLCD 2011). There are approximately four docks/km of shoreline. The 2011 FIBI survey is outside of the recommended window for assessment. We recommend classifying Dean Lake as Insufficient Information (IF) for Aquatic Life Use (January 14, 2019, Jessica Moore-DNR Fisheries Lake IBI Program).

86-0046-00 Crawford Lake

One FIBI survey was conducted on Crawford Lake in 2007 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Crawford Lake is 110 acres, with a maximum depth of 19 feet, and is in Schupp Lake Class 39; these characteristics put it into a group scored with FIBI Tool 5. Crawford Lake has a history of winterkill events and therefore should not be assessed with the FIBI tool. We recommend classifying Crawford Lake as Not Assessable (NA) for Aquatic Life Use due to recent winterkill (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

86-0051-00 Constance Lake

One FIBI survey was conducted on Constance Lake in 2011 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Constance Lake is 175 acres, with a maximum depth of 23 feet, and is in Schupp Lake Class 24; these characteristics put it into a group scored with FIBI Tool 2. The FIBI score is 13, which is well below the impairment threshold (45) and outside of the lower limit of the 90% confidence interval (36). Most of the metrics of the FIBI scored negatively, the most notable negative influences were the low proportion of biomass in gill nets from top carnivore species, and the lack of small benthic species sampled in the nearshore gears. The FIBI score was positively influenced by the overall low number of omnivore species sampled and the low proportion of biomass in trap nets from tolerant species. The most abundant species by biomass in the gill nets were Black Crappie, Bluegill, Brown Bullhead, and Yellow Bullhead. Bluegill and Yellow Bullhead were the most abundant species by biomass in the trap nets. Bluegill and Green Sunfish were the most abundant species sampled with the nearshore gears. Select stressor information was reviewed for Constance Lake: the contributing watershed is primarily agricultural land and water with approximately 58 % watershed disturbance (NLCD 2011). There are approximately five docks/km of shoreline. The 2011 FIBI survey is outside of the recommended window for assessment. We recommend classifying Constance Lake as Insufficient Information (IF) for Aquatic Life Use (January 14, 2019, Jessica Moore-DNR Fisheries Lake IBI Program).

86-0289-00 East Lake Sylvia

One FIBI survey was conducted on East Lake Sylvia in 2015 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). East Lake Sylvia is 669 acres, with maximum depth of 78 feet, and is in Schupp Lake Class 24; these characteristics put it into a group scored with FIBI Tool 2. The FIBI score is 52, which is above the impairment threshold (45) and within the upper limit of the 90% confidence interval (54). The FIBI score was most positively influenced by the overall high number of vegetative species sampled across all gears, the high proportion of intolerant species sampled in the nearshore gear, and the presence of intolerant species captured in gill nets. The overall high number of omnivore species sampled across all gears and the low proportion of small benthic dwelling species sampled in the nearshore gear are most negatively affecting the FIBI score. The most abundant species by biomass in the gill nets were Northern Pike, Walleye, and Yellow Bullhead. Bluegill, Hybrid Sunfish, Pumpkinseed, and Yellow Bullhead were the most abundant species by biomass in the trap nets. Bluegill, Bluntnose Minnow, and Mimic Shiner were the most commonly sampled species in the nearshore gear. Intolerant species sampled included Banded Killifish, Blackchin Shiner, Blacknose Shiner, Iowa Darter, Mimic Shiner, Pugnose Shiner, and Rock Bass. Select stressor information was reviewed for East Lake Sylvia: the contributing watershed is primarily agricultural land, forested land, and water with approximately 50% watershed disturbance (NLCD 2011). There are approximately 21 docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2015, which resulted in a mean lake-wide habitat score of 70 out of 100, indicating overall moderate quality lakeshore condition. Based on the 2015 FIBI survey information, we recommend classifying East Lake Sylvia as FS and for assessment of Aquatic Life Use (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

86-0192-00 Round Lake

Round Lake is not assessable with the FIBI because, at 45 acres, it is much smaller than the minimum acreage for the FIBI tools, 100 acres.

34-0079-00 Green Lake

Two FIBI surveys were conducted on Green Lake in 2012 and 2016 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). The assessment is based off the 2016 survey and the 2012 survey is used as supporting information. Green Lake is 5,569 acres, with maximum depth of 110 feet, and is in Schupp Lake Class 22; these characteristics put it into a group scored with FIBI Tool 2. The FIBI scores are 62 and 50, which are both above the impairment threshold (45) and within or above the upper limit of the 90% confidence interval (54). The FIBI scores were most positively influenced by intolerant species (Cisco, Rock Bass, and Smallmouth Bass) captured in gill nets and the overall high number of small benthic species sampled in the nearshore gears. The high proportion of biomass from a tolerant species (Common Carp) in the trap net gear is most negatively influencing both FIBI scores. The most abundant species by biomass in the gill nets were Northern Pike, Rock Bass, Walleye, and White Suckers. Bluegill, Common Carp, and Northern Pike were the most abundant species by biomass in the trap nets. Bluegill, Bluntnose Minnow, Brook Silverside, and Hybrid Sunfish were the most abundant species in the nearshore surveys. Select stressor information was reviewed for Green Lake: the contributing watershed is primarily agricultural land, forested land, and water with approximately 59 % watershed disturbance (NLCD 2011). There are approximately 29 docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2016, which resulted in a mean lake-wide habitat score of 55 out of 100, indicating overall low-quality lakeshore condition. Based on the 2016 FIBI survey information and the supporting information from the 2012 FIBI survey, we recommend classifying Green Lake as FS for assessment of Aquatic Life Use (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

43-0073-00 Hook Lake

One FIBI survey was conducted on Hook Lake in 2010 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Hook Lake is 330 acres, with a maximum depth of 18 feet, and is in Schupp Lake Class 43; these characteristics put it into a group scored with FIBI Tool 7. Hook Lake has a history of winterkill events and therefore should not be assessed with the FIBI tool. We recommend classifying Hook Lake as Not Assessable (NA) for assessment of Aquatic Life Use due to recent winterkill (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

47-0002-00 Francis Lake

Two FIBI surveys were conducted on Francis Lake in 2010 and 2015 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Francis Lake is 1,053 acres, with maximum depth of 17 feet, and is in Schupp Lake Class 38; these characteristics put it into a group scored with FIBI Tool 7. The FIBI scores are 53 and 64, which are both above the impairment threshold (36) and above of the upper limit of the 90% confidence interval (45). The assessment uses the 2015 FIBI survey information and the 2010 FIBI survey is used as supporting information. A low proportion of biomass in the trap nets being from insectivore species and a high proportion of biomass in trap nets from tolerant species (Common Carp and Green Sunfish) were negatively influencing the 2010 FIBI score. The 2010 FIBI score was positively influenced by the overall high number and high proportion of vegetative dwelling species sampled in nearshore gears as well as an overall high number of small benthic dwelling species sampled in the nearshore gear. The 2015 FIBI score was negatively influenced by the low proportion of biomass in trap nets from insectivore species. The positive influences on the 2015 FIBI score were the overall high number and proportion of vegetative dwelling species sampled in the nearshore gear as well as there being no tolerant species sampled in the trap nets. The most abundant species by biomass in the gill nets are Bowfin, Northern Pike, and Yellow Bullhead. Bluegill, Bowfin, Common Carp, and Northern Pike were the most abundant species by biomass in the trap nets. Bluegill, Bluntnose Minnow, Largemouth Bass, and Yellow Perch were the most abundant species sampled in the nearshore gears. Select stressor information was reviewed for Francis Lake: the contributing watershed is primarily agricultural land, forested land, and water with approximately 35% watershed disturbance (NLCD 2011). There are approximately 15 docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2015, which resulted in a mean lake-wide habitat score of 66 out of 100, indicating overall low-quality lakeshore condition. Based on the 2015 FIBI survey information and using the 2010 FIBI data as supporting information, we recommend classifying Francis Lake as FS for assessment of Aquatic Life Use (January 10, 2019, Jessica Moore-DNR Fisheries Lake IBI Program).

86-0134-01 Upper Maple Lake

One FIBI survey was conducted on Upper Maple Lake in 2015 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Upper Maple Lake is 739 acres, with maximum depth of 76 feet, and is in Schupp Lake Class 24; these characteristics put it into a group scored with FIBI Tool 2. The FIBI score is 59, which is well above the impairment threshold (45) and above the upper limit of the 90% confidence interval (54). The overall high numbers of insectivore, cyprinid, and vegetative dwelling species sampled across all gears positively influenced the FIBI score. The lack of intolerant species sampled in the gill nets and the low proportion of small benthic dwelling species sampled in the nearshore gear are most negatively affecting the FIBI score. The most abundant species by biomass in the gill nets were Northern Pike, Walleye, and Yellow Bullhead. Bluegill, Bowfin, and Yellow Bullhead were the most abundant species by biomass in the trap nets. Bluegill, Bluntnose Minnow, Green Sunfish, and Largemouth Bass were the most abundant species sampled in the nearshore gear. Intolerant species sampled included Banded Killifish, Blackchin Shiner, Blacknose Shiner, Iowa Darter, Least Darter, and Pugnose Shiner. Select stressor information was reviewed for Upper Maple Lake: the contributing watershed is primarily agricultural land, urban area, and water with approximately 59% watershed disturbance (NLCD 2011). There are approximately 11 docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2015, which resulted in a mean lake-wide habitat score of 58 out of 100, indicating overall low-quality lakeshore condition. Based on the 2015 FIBI survey information, we recommend classifying Upper Maple Lake as FS for assessment of Aquatic Life Use (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

34-0066-00 Long Lake

Two FIBI surveys were conducted on Long Lake in 2013-2014 and 2017-2018 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Long Lake is 325 acres, with maximum depth of 46 feet, and is in Schupp Lake Class 25; these characteristics put it into a group scored with FIBI Tool 2. The FIBI scores are 57 and 54, which are both above the impairment threshold (45) and at or above the upper limit of the 90% confidence interval (54). The positive influences on the FIBI score in 2014 were the overall high numbers of insectivore species, cyprinid species, and small benthic dwelling species sampled across all gears. The metric most negatively influencing the 2014 FIBI score was a high biomass of omnivore species sampled in trap net gear. The 2017 FIBI score had positive influences from the overall high numbers of cyprinid species, small benthic dwelling species, and vegetative dwelling species sampled in the nearshore area. The negative influences on the 2017 FIBI score were the high number and high proportion of biomass in the trap nets from omnivore species as well as the low proportion of biomass in the trap nets from insectivore species. The most abundant species by biomass in the gill nets were Northern Pike and Walleye. Bluegill, Bowfin, and Yellow Bullhead were the most abundant species by biomass in the trap nets. Bluegill, Bluntnose Minnow, and Blackchin Shiners were the most abundant species in the nearshore surveys. Select stressor information was reviewed for Long Lake: the contributing watershed is primarily agricultural land, grassland, and water with approximately 41% watershed disturbance (NLCD 2011). There are approximately nine docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2017, which resulted in a mean lake-wide habitat score of 85 out of 100, indicating overall moderate quality lakeshore condition. Based on FIBI survey information collected from 2013 – 2018, we recommend classifying Long Lake as FS for assessment of Aquatic Life Use (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

86-0120-00 Ramsey Lake

One FIBI survey was conducted on Ramsey Lake in 2017 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Ramsey Lake is 316.52 acres, with maximum depth of 80 feet, and is in Schupp Lake Class 24; these characteristics put it into a group scored with FIBI Tool 2. The FIBI score is 60, which is well above the impairment threshold (45) and above the upper limit of the 90% confidence interval (54). The FIBI score was most positively influenced by the overall high number of insectivores, small benthic dwelling, and vegetative dwelling species sampled across all gears as well as the high proportion of biomass in the trap nets from insectivore species. The overall high number of tolerant species sampled across all gears and the lack of intolerant species sampled in the gill nets are most negatively affecting the FIBI score. The most abundant species by biomass in the gill nets were Northern Pike, Walleye, and Yellow Bullhead. Bluegill, Bowfin, and Yellow Bullhead were the most abundant species by biomass in the trap nets. Bluegill, Green Sunfish, Largemouth Bass, and Yellow Perch were the most commonly sampled species with the nearshore gear. Intolerant species sampled included Banded Killifish, Blackchin Shiner, Blacknose Shiner, Iowa Darter, Least Darter, and Pugnose Shiner. Select stressor information was reviewed for Ramsey Lake: the contributing watershed is primarily agricultural land, forested land, urban area, and water with approximately 62% watershed disturbance (NLCD 2011). A Score the Shore survey was completed to assess shoreline habitat in 2017, which resulted in a mean lake-wide habitat score of 74 out of 100, indicating overall moderate quality lakeshore condition. Based on the 2017 FIBI survey information, we recommend classifying Ramsey Lake as FS for assessment of Aquatic Life Use (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

86-0221-00 Camp Lake

One FIBI survey was conducted on Camp Lake using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). A gill net and trap net survey along with a nearshore survey were completed in 2012. Camp Lake is 123 acres, with maximum depth of 52 feet, and is in Schupp Lake Class 24; these characteristics put it into a group scored with FIBI Tool 2. The FIBI score is 18, which is below the impairment threshold (45) and outside of the lower limit of the 90% confidence interval (36). Nearly all of the metrics of the FIBI scored negatively and this is contributing to a low FIBI score. The most notable negative influences on the FIBI scores are the lack of intolerant species sampled and low proportion of small benthic dwelling species sampled in the nearshore gears. The most abundant species by biomass in the gill nets were Northern Pike and Yellow Bullhead. Bluegill, Largemouth Bass, Northern Pike, and Yellow Bullhead were the most abundant species by biomass in the trap nets. Bluegill, Bluntnose Minnow, and Hybrid Sunfish were the most abundant species sampled in the nearshore gear. Select stressor information was reviewed for Camp Lake: the contributing watershed is primarily agricultural land and water with approximately 72% watershed disturbance (NLCD 2011). There are approximately two docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2017, which resulted in a mean lake-wide habitat score of 79 out of 100, indicating overall moderate quality lakeshore condition. This FIBI survey from 2002 is well outside of the recommended window for assessment. We recommend classifying Camp Lake as Insufficient Information (IF) for assessment of Aquatic Life Use. (January 14, 2019, Jessica Moore-DNR Fisheries Lake IBI Program).

47-0068-00 Stella Lake

One FIBI survey was conducted on Stella Lake in 2014 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Stella Lake is 599 acres, with maximum depth of 75 feet, and is in Schupp Lake Class 24; these characteristics put it into a group scored with FIBI Tool 2. The FIBI score is 52, which is above the impairment threshold (45) and within the upper limit of the 90% confidence interval (54). The FIBI score was most positively influenced by the presence of intolerants species (Smallmouth Bass) in the gill nets and the high proportion of individuals sampled in the nearshore areas being small benthic dwelling species. The overall high number of tolerant species (Black Bullhead, Common Carp, Fathead Minnow, and Green Sunfish) sampled and high proportion of biomass in trap nets from tolerant species were most negatively affecting the FIBI score. The most abundant species by biomass in the gill nets were Northern Pike, Smallmouth Bass, and Walleye. Bluegill, Common Carp, and Northern Pike were the most abundant species by biomass in the trap nets. Bluntnose Minnow, Largemouth Bass, and Yellow Perch were the most commonly sampled species in the nearshore gear. Select stressor information was reviewed for Stella Lake: the contributing watershed is primarily agricultural land and water with approximately 73% watershed disturbance (NLCD 2011). There are approximately 12 docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2016, which resulted in a mean lake-wide habitat score of 77 out of 100, indicating overall moderate quality lakeshore condition. Based on the 2014 FIBI survey information, we recommend classifying Stella Lake as FS for assessment of Aquatic Life Use (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

61-0023-00 Grove Lake

Two FIBI surveys were conducted on Grove Lake in 2012 and 2017 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Grove Lake is 345 acres, with maximum depth of 31 feet, and is in Schupp Lake Class 34; these characteristics put it into a group scored with FIBI Tool 5. The FIBI scores are 53 and 75, which are well above the impairment threshold (24) and outside of the upper limit of the 90% confidence interval (39). The assessment uses the 2017 survey data and the 2012 survey data as supporting information. The 2012 FIBI score was most positively influenced by a large proportion of biomass in gill nets from top carnivore species and the score was most negatively influenced by a large portion of biomass in trap nets from omnivore species. The 2017 FIBI score was positively influenced by an overall high number and high proportion of intolerant species (Banded Killifish, Blackchin Shiner, Blacknose Shiner, Iowa Darter, and Least Darter) sampled in the nearshore gear as well as a large proportion of the gill net biomass from top carnivore species. The low proportion of biomass in trap nets from insectivore species most negatively affected the 2017 FIBI score. The most abundant species by biomass in the gill nets were Northern Pike, Walleye, White Sucker, and Yellow Bullhead. Bluegill, Bowfin, and Yellow Bullhead were the most abundant species by biomass in the trap nets. Banded Killifish, Blackchin Shiner, Largemouth Bass, and White Sucker were the most abundant species sampled with the nearshore gear. Select stressor information was reviewed for Grove Lake: the contributing watershed is primarily agricultural land and wetland with approximately 75% watershed disturbance (NLCD 2011). There are approximately 10 docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2017, which resulted in a mean lake-wide habitat score of 73 out of 100, indicating overall moderate quality lakeshore condition. Based on the 2017 FIBI survey and 2012 FIBI survey as supporting information, we recommend classifying Grove Lake as FS for assessment of Aquatic Life Use (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

34-0062-00 Calhoun

Two FIBI surveys were conducted on Lake Calhoun in 2012-2013 and 2017-2018 using multiple gears (backpack electrofishing, seines, trap nets, and gill nets). Lake Calhoun is 647 acres, with maximum depth of 13 feet, and is in Schupp Lake Class 43; these characteristics put it into a group of shallow lakes scored with FIBI Tool 7. The FIBI scores are 48 and 63, which are both above the impairment threshold (36) and above the upper limit of the 90% confidence interval (45). In both surveys, the overall number of vegetative dwelling species sampled and high proportion of vegetative dwelling species in the nearshore gear positively influenced the FIBI score. The overall high number of insectivores sampled in nearshore gears positively contributed to the score. The only negative impacts to the FIBI scores were the high proportional biomass in trap nets from tolerant species (Bigmouth Buffalo, Black Bullhead, Common Carp, and Green Sunfish) and the relatively low proportional biomass in trap nets from insectivore species (Bluegill, Green Sunfish, Hybrid Sunfish, and Pumpkinseed). The most abundant species by biomass in the gill nets included Largemouth Bass, Northern Pike, and Yellow Bullhead. Bluegill, Common Carp, and Northern Pike were the most abundant species by biomass in the trap net gear. Bluegill and Brook Silversides were the most abundant species sampled with the nearshore gears as well as Blacknose Shiner and Largemouth Bass. Select stressor information was reviewed for Lake Calhoun: the contributing watershed is primarily agricultural and forested land with approximately 69% watershed disturbance (NLCD 2011). There are approximately six docks/km of shoreline and a Score the Shore survey was completed to assess shoreline habitat in 2017, which resulted in a mean lake-wide habitat score of 83 out of 100, indicating overall moderate quality lakeshore condition. Based on FIBI survey information collected from 2012 through 2018, we recommend classifying Lake Calhoun as FS for assessment of Aquatic Life Use (December 28, 2018, Jessica Moore-DNR Fisheries Lake IBI Program).

86-0266-00 Mud Lake

Mud Lake is not assessable with the FIBI because, at 56 acres, it is much smaller than the minimum acreage for the FIBI tools, 100 acres.

Appendix B. Impairments added on 2022 Impaired Waters List

The following water bodies have been added to the 2020 impairment list. In addition, Lake Wilhelm (86-0020-00) has been added to the 2022 list due to elevated levels of nutrients, and a TMDL for this lake has been completed as a part of this WRAPS process.

Table 20. Impairments in the NFCRW added in 2020.

Water body name	Water body description	Water body type	AUID	Pollutant or stressor
Ann	Lake or Reservoir	Lake	86-0190-00	Fish bioassessments
Beebe	Lake or Reservoir	Lake	86-0023-00	Fish bioassessments
Big Swan	Lake or Reservoir	Lake	47-0038-00	Fish bioassessments
Buffalo	Lake or Reservoir	Lake	86-0090-00	Fish bioassessments
Cokato	Lake or Reservoir	Lake	86-0263-00	Fish bioassessments
Collinwood	Lake or Reservoir	Lake	86-0293-00	Fish bioassessments
Collinwood Creek	Unnamed cr (Unnamed lk 47-0031-00 outlet) to Big Swan Lk	Stream	07010204-604	Benthic macroinvertebrates bioassessments
Collinwood Creek	Unnamed cr (Unnamed lk 47-0031-00 outlet) to Big Swan Lk	Stream	07010204-604	Dissolved oxygen
Collinwood Creek	Unnamed cr (Unnamed lk 47-0031-00 outlet) to Big Swan Lk	Stream	07010204-604	Fish bioassessments
County Ditch 26	Unnamed lk to Long Lk	Stream	07010204-643	Benthic macroinvertebrates bioassessments
County Ditch 26	Unnamed lk to Long Lk	Stream	07010204-643	Fish bioassessments
County Ditch 26	Unnamed ditch to Unnamed ditch	Stream	07010204-652	Fish bioassessments
County Ditch 32	Unnamed ditch to N Fk Crow R	Stream	07010204-578	Escherichia coli (*E. coli*)
County Ditch 36	Powers Lk outlet to -94.333 45.167	Stream	07010204-755	Benthic macroinvertebrates bioassessments
County Ditch 36	Powers Lk outlet to -94.333 45.167	Stream	07010204-755	Fish bioassessments
County Ditch 37	Unnamed cr to M Fk Crow R	Stream	07010204-536	Fish bioassessments
County Ditch 5	Unnamed cr to N Fk Crow R	Stream	07010204-576	Escherichia coli (*E. coli*)

Water body name	Water body description	Water body type	AUID	Pollutant or stressor
County Ditch 7	Unnamed ditch to N Fk Crow R	Stream	07010204-580	Escherichia coli (*E. coli*)
Crow River, Middle Fork	Green Lk to N Fk Crow R	Stream	07010204-511	Fish bioassessments
Crow River, Middle Fork	Monongalia (Mud) Lk to Nest Lk	Stream	07010204-539	Fish bioassessments
Crow River, North Fork	Lk Koronis to M Fk Crow R	Stream	07010204-504	Fish bioassessments
Crow River, North Fork	Jewitts Cr to Washington Cr	Stream	07010204-506	Escherichia coli (*E. coli*)
Crow River, North Fork	Headwaters (Grove Lk 61-0023-00) to CD 32	Stream	07010204-763	Escherichia coli (*E. coli*)
Crow River, North Fork	CD 32 to Rice Lk	Stream	07010204-764	Escherichia coli (*E. coli*)
Diamond	Lake or Reservoir	Lake	34-0044-00	Fish bioassessments
Dog	Lake or Reservoir	Lake	86-0178-00	Nutrients
Dutch	Lake or Reservoir	Lake	86-0184-00	Fish bioassessments
East Sarah	Lake or Reservoir	Lake	27-0191-02	Fish bioassessments
Erie	Lake or Reservoir	Lake	47-0064-00	Fish bioassessments
French	Lake or Reservoir	Lake	86-0273-00	Fish bioassessments
French Creek	French Lk to T120 R28W S15, west line	Stream	07010204-759	Benthic macroinvertebrates bioassessments
French Creek	French Lk to T120 R28W S15, west line	Stream	07010204-759	Fish bioassessments
Granite	Lake or Reservoir	Lake	86-0217-00	Fish bioassessments
Green Mountain	Lake or Reservoir	Lake	86-0063-00	Nutrients
Grove Creek	Unnamed cr to Unnamed cr	Stream	07010204-642	Benthic macroinvertebrates bioassessments
Grove Creek	Unnamed cr to Unnamed cr	Stream	07010204-642	Fish bioassessments
Howard	Lake or Reservoir	Lake	86-0199-00	Fish bioassessments
Jennie	Lake or Reservoir	Lake	47-0015-00	Fish bioassessments
Jesse	Lake or Reservoir	Lake	34-0060-00	Nutrients
Judicial Ditch 1	Unnamed ditch to N Fk Crow R	Stream	07010204-584	Escherichia coli (*E. coli*)

Water body name	Water body description	Water body type	AUID	Pollutant or stressor
Judicial Ditch 1	Unnamed ditch to Unnamed ditch	Stream	07010204-743	Escherichia coli (*E. coli*)
Judicial Ditch 17	Headwaters to M Fk Crow R	Stream	07010204-532	Fish bioassessments
Koronis (main lake)	Lake or Reservoir	Lake	73-0200-02	Fish bioassessments
Laura	Lake or Reservoir	Lake	27-0123-00	Nutrients
Little Pulaski	Lake or Reservoir	Lake	86-0053-01	Fish bioassessments
Little Waverly	Lake or Reservoir	Lake	86-0106-00	Fish bioassessments
Mary	Lake or Reservoir	Lake	86-0193-00	Fish bioassessments
Mill Creek	Buffalo Lk to N Fk Crow R	Stream	07010204-515	Benthic macroinvertebrates bioassessments
Mill Creek	Ramsey Lk to Buffalo Lk	Stream	07010204-524	Escherichia coli (*E. coli*)
Pulaski (main bay)	Lake or Reservoir	Lake	86-0053-02	Fish bioassessments
Rock	Lake or Reservoir	Lake	86-0182-00	Fish bioassessments
Silver Creek	Unnamed cr to Collinwood Lk	Stream	07010204-557	Benthic macroinvertebrates bioassessments
Sucker Creek	53rd St SW to Cokato Lk	Stream	07010204-762	Benthic macroinvertebrates bioassessments
Sucker Creek	53rd St SW to Cokato Lk	Stream	07010204-762	Fish bioassessments
Twelvemile Creek	Dutch Lk to Little Waverly Lk	Stream	07010204-679	Benthic macroinvertebrates bioassessments
Twelvemile Creek	Dutch Lk to Little Waverly Lk	Stream	07010204-679	Fish bioassessments
Twelvemile Creek	Dutch Lk to Little Waverly Lk	Stream	07010204-679	Escherichia coli (*E. coli*)
Unnamed creek	Woodland WMA wetland (86-0085-00) to N Fk Crow R	Stream	07010204-667	Benthic macroinvertebrates bioassessments
Unnamed creek	Woodland WMA wetland (86-0085-00) to N Fk Crow R	Stream	07010204-667	Fish bioassessments
Unnamed creek	Long Lk to Unnamed cr	Stream	07010204-696	Benthic macroinvertebrates bioassessments
Unnamed creek	Long Lk to Unnamed cr	Stream	07010204-696	Fish bioassessments
Unnamed creek (County Ditch 4)	Unnamed cr to Lk Koronis	Stream	07010204-553	Fish bioassessments

Water body name	Water body description	Water body type	AUID	Pollutant or stressor
Unnamed creek (County Ditch 4)	Unnamed cr to Lk Koronis	Stream	07010204-553	Escherichia coli (*E. coli*)
Unnamed creek (Regal Creek)	Unnamed cr to Crow R	Stream	07010204-542	Benthic macroinvertebrates bioassessments
Unnamed creek (Regal Creek)	Unnamed cr to Crow R	Stream	07010204-542	Fish bioassessments
Unnamed creek (Regal Creek)	Unnamed cr to Crow R	Stream	07010204-542	Nutrients
Washington Creek (County Ditch 9)	-94.342 45.108 to -94.314 45.146	Stream	07010204-751	Benthic macroinvertebrates bioassessments
Washington Creek (County Ditch 9)	CD 36 to T120 R29W S27, east line	Stream	07010204-753	Fish bioassessments
Waverly	Lake or Reservoir	Lake	86-0114-00	Fish bioassessments
West Sarah	Lake or Reservoir	Lake	27-0191-01	Fish bioassessments
Wolf	Lake or Reservoir	Lake	47-0016-00	Nutrients

Appendix C. TMDL tables and information

Table 21. Impaired waters with TMDLs completed prior to this WRAPS Update process in the NFCRW.

Water body name	Water body type		Year added to List	AUID	County	HUC-8	Pollutant or stressor	Year TMDL plan approved	TMDL ID
Albert	Lake		2012	86-0127-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Ann	Lake		1998	86-0190-00	Wright	07010204	Mercury in fish tissue	2007	PRJ07770-001
Ann	Lake		2002	86-0190-00	Wright	07010204	Nutrients	2012	PRJ06384-001
Arvilla	Lake		2008	47-0023-00	Meeker	07010204	Mercury in fish tissue	2008	PRJ07770-001
Beebe	Lake		2002	86-0023-00	Wright	07010204	Mercury in fish tissue	2008	PRJ07770-001
Beebe	Lake		2008	86-0023-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Big Swan	Lake		2006	47-0038-00	Meeker	07010204	Mercury in fish tissue	2008	PRJ07770-001
Big Swan	Lake		2010	47-0038-00	Meeker	07010204	Nutrients	2015	PRJ07722-001
Brooks	Lake		2012	86-0264-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Buffalo	Lake		1998	86-0090-00	Wright	07010204	Mercury in fish tissue	2008	PRJ07770-001
Buffalo	Lake		2008	86-0090-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Calhoun	Lake		2006	34-0062-00	Kandiyohi	07010204	Mercury in fish tissue	2007	PRJ07770-001
Camp	Lake		2008	86-0221-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Cokato	Lake		2008	86-0263-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Collinwood	Lake		1998	86-0293-00	Wright	07010204	Mercury in fish tissue	2008	PRJ07770-001
Collinwood	Lake		2008	86-0293-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Constance	Lake		2012	86-0051-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Cowley	Lake		2010	27-0169-00	Hennepin	07010204	Nutrients	2017	PRJ06872-001
Crow River	Stream		2002	07010204-502	Hennepin	07010204	Turbidity	2013	PRJ05480-001
Crow River	Stream		2004	07010204-502	Hennepin	07010204	Fecal coliform	2013	PRJ05480-001
Crow River, North Fork	Stream		2002	07010204-503	Wright	07010204	Mercury in fish tissue	2007	PRJ07770-001
Crow River, North Fork	Stream		2004	07010204-503	Wright	07010204	Turbidity	2013	PRJ05480-001
Crow River, North Fork	Stream		2002	07010204-504	Meeker	07010204	Mercury in fish tissue	2007	PRJ07770-001

Water body name	Water body type		Year added to List	AUID	County	HUC-8	Pollutant or stressor	Year TMDL plan approved	TMDL ID
Crow River, North Fork	Stream		2002	07010204-506	Meeker	07010204	Mercury in fish tissue	2007	PRJ07770-001
Crow River, North Fork	Stream		2002	07010204-507	Meeker	07010204	Mercury in fish tissue	2007	PRJ07770-001
Crow River, North Fork	Stream		2002	07010204-555	Meeker	07010204	Mercury in fish tissue	2007	PRJ07770-001
Crow River, North Fork	Stream		2002	07010204-556	Wright	07010204	Mercury in fish tissue	2007	PRJ07770-001
Crow River, North Fork	Stream		2006	07010204-687	Stearns	07010204	Mercury in fish tissue	2007	PRJ07770-001
Crow River, North Fork	Stream		2006	07010204-763	Stearns	07010204	Mercury in fish tissue	2007	PRJ07770-001
Crow River, North Fork	Stream		2006	07010204-764	Stearns	07010204	Mercury in fish tissue	2007	PRJ07770-001
Dean	Lake		2012	86-0041-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Deer	Lake		2008	86-0107-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Diamond	Lake		1998	34-0044-00	Kandiyohi	07010204	Mercury in fish tissue	2008	PRJ07770-001
Diamond	Lake		2006	34-0044-00	Kandiyohi	07010204	Nutrients	2011	PRJ06380-001
Dunns	Lake		2002	47-0082-00	Meeker	07010204	Nutrients	2015	PRJ07722-001
Dutch	Lake		2010	86-0184-00	Wright	07010204	Nutrients	2015	PRJ07722-001
East Lake Sylvia	Lake		1998	86-0289-00	Wright	07010204	Mercury in fish tissue	2008	PRJ07770-001
East Sarah	Lake		1998	27-0191-02	Hennepin	07010204	Mercury in fish tissue	2007	PRJ07770-001
East Sarah	Lake		2006	27-0191-02	Hennepin	07010204	Nutrients	2011	PRJ06172-001
Emma	Lake		2012	86-0188-00	Wright	07010204	Nutrients	2012	PRJ06384-001
Erie	Lake		2016	47-0064-00	Meeker	07010204	Mercury in fish tissue	2018	PRJ07770-001
Foster	Lake		2008	86-0001-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Fountain	Lake		2008	86-0086-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Francis	Lake		1998	47-0002-00	Meeker	07010204	Mercury in fish tissue	2007	PRJ07770-001
French	Lake		1998	86-0273-00	Wright	07010204	Mercury in fish tissue	2008	PRJ07770-001
French	Lake		2008	86-0273-00	Wright	07010204	Nutrients	2015	PRJ07722-001

Water body name	Water body type		Year added to List	AUID	County	HUC-8	Pollutant or stressor	Year TMDL plan approved	TMDL ID
George	Lake		2002	34-0142-00	Kandiyohi	07010204	Mercury in fish tissue	2007	PRJ07770-001
Granite	Lake		2002	86-0217-00	Wright	07010204	Mercury in fish tissue	2008	PRJ07770-001
Granite	Lake		2008	86-0217-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Grove	Lake		1998	61-0023-00	Pope	07010204	Mercury in fish tissue	2007	PRJ07770-001
Grove Creek	Stream		2004	07010204-748	Meeker	07010204	Dissolved oxygen	2013	PRJ05480-001
Grove Creek	Stream		2010	07010204-748	Meeker	07010204	Escherichia coli (*E. coli*)	2015	PRJ07722-001
Grove Creek	Stream		2004	07010204-749	Meeker	07010204	Dissolved oxygen	2013	PRJ05480-001
Grove Creek	Stream		2010	07010204-749	Meeker	07010204	Turbidity	2015	PRJ07722-001
Grove Creek	Stream		2010	07010204-749	Meeker	07010204	Escherichia coli (*E. coli*)	2015	PRJ07722-001
Hafften	Lake		2004	27-0199-00	Hennepin	07010204	Nutrients	2015	PRJ07722-001
Hook	Lake		2002	43-0073-00	McLeod	07010204	Mercury in fish tissue	2007	PRJ07770-001
Hook	Lake		2008	43-0073-00	McLeod	07010204	Nutrients	2015	PRJ07722-001
Hope	Lake		2008	47-0183-00	Meeker	07010204	Nutrients	2015	PRJ07722-001
Howard	Lake		1998	86-0199-00	Wright	07010204	Mercury in fish tissue	2008	PRJ07770-001
Howard	Lake		2008	86-0199-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Jennie	Lake		2010	47-0015-00	Meeker	07010204	Nutrients	2015	PRJ07722-001
Jewitts Creek (County Ditch 19, 18, and 17)	Stream		1994	07010204-585	Meeker	07010204	Dissolved oxygen	2013	PRJ05480-001
Jewitts Creek (County Ditch 19, 18, and 17)	Stream		2010	07010204-585	Meeker	07010204	Escherichia coli (*E. coli*)	2015	PRJ07722-001
John	Lake		1998	86-0288-00	Wright	07010204	Mercury in fish tissue	2008	PRJ07770-001
Koronis (main lake)	Lake		1998	73-0200-02	Stearns	07010204	Mercury in fish tissue	2008	PRJ07770-001
Light Foot	Lake		2012	86-0122-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Little Waverly	Lake		2016	86-0106-00	Wright	07010204	Mercury in fish tissue	2018	PRJ07770-001
Little Waverly	Lake		2008	86-0106-00	Wright	07010204	Nutrients	2015	PRJ07722-001

Water body name	Water body type		Year added to List	AUID	County	HUC-8	Pollutant or stressor	Year TMDL plan approved	TMDL ID
Long	Lake		2006	34-0066-00	Kandiyohi	07010204	Mercury in fish tissue	2008	PRJ07770-001
Long	Lake		1998	47-0026-00	Meeker	07010204	Mercury in fish tissue	2008	PRJ07770-001
Long	Lake		2008	47-0177-00	Meeker	07010204	Nutrients	2015	PRJ07722-001
Malardi	Lake		2012	86-0112-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Mary	Lake		2004	86-0193-00	Wright	07010204	Mercury in fish tissue	2007	PRJ07770-001
Mill Creek	Stream		2004	07010204-515	Wright	07010204	Dissolved oxygen	2013	PRJ05480-001
Mill Creek	Stream		2010	07010204-515	Wright	07010204	Turbidity	2015	PRJ07722-001
Minnie-Belle	Lake		1998	47-0119-00	Meeker	07010204	Mercury in fish tissue	2008	PRJ07770-001
Mud	Lake		1998	73-0200-01	Stearns	07010204	Mercury in fish tissue	2008	PRJ07770-001
Nest	Lake		1998	34-0154-00	Kandiyohi	07010204	Mercury in fish tissue	2008	PRJ07770-001
Nest	Lake		2010	34-0154-00	Kandiyohi	07010204	Nutrients	2015	PRJ07722-001
Pelican	Lake		2008	86-0031-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Pulaski (main bay)	Lake		1998	86-0053-02	Wright	07010204	Mercury in fish tissue	2008	PRJ07770-001
Ramsey	Lake		2008	86-0120-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Rice	Lake		1998	73-0196-00	Stearns	07010204	Mercury in fish tissue	2008	PRJ07770-001
Rice	Lake		2008	73-0196-00	Stearns	07010204	Nutrients	2012	PRJ07060-001
Richardson	Lake		1998	47-0088-00	Meeker	07010204	Mercury in fish tissue	2007	PRJ07770-001
Richardson	Lake		2002	47-0088-00	Meeker	07010204	Nutrients	2015	PRJ07722-001
Ripley (west portion)	Lake		2018	47-0134-02	Meeker	07010204	Mercury in fish tissue	2018	PRJ07770-001
Rock	Lake		2012	86-0182-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Sarah Creek	Stream		2012	07010204-628	Hennepin	07010204	Escherichia coli (*E. coli*)	2017	PRJ07695-001
Smith	Lake		2010	86-0250-00	Wright	07010204	Nutrients	2015	PRJ07722-001
Spring	Lake		1998	47-0032-00	Meeker	07010204	Mercury in fish tissue	2007	PRJ07770-001
Spring	Lake		2012	47-0032-00	Meeker	07010204	Nutrients	2015	PRJ07722-001
Sylvan	Lake		2018	27-0171-00	Hennepin	07010204	Nutrients	2017	PRJ06872-001
Twelvemile Creek	Stream		2010	07010204-681	Wright	07010204	Dissolved oxygen	2016	PRJ07722-005

Water body name	Water body type		Year added to List	AUID	County	HUC-8	Pollutant or stressor	Year TMDL plan approved	TMDL ID
Unnamed creek	Stream		2010	07010204-667	Wright	07010204	Escherichia coli (*E. coli*)	2015	PRJ07722-001
Unnamed creek	Stream		2008	07010204-668	Wright	07010204	Turbidity	2015	PRJ07722-001
Unnamed creek (Regal Creek)	Stream		2004	07010204-542	Wright	07010204	Dissolved oxygen	2013	PRJ05480-001
Unnamed creek (Regal Creek)	Stream		2010	07010204-542	Wright	07010204	Escherichia coli (*E. coli*)	2015	PRJ07722-001
Washington	Lake		1998	47-0046-00	Meeker	07010204	Mercury in fish tissue	2008	PRJ07770-001
Waverly	Lake		2008	86-0114-00	Wright	07010204	Mercury in fish tissue	2008	PRJ07770-001
West Lake Sylvia	Lake		1998	86-0279-00	Wright	07010204	Mercury in fish tissue	2008	PRJ07770-001
West Sarah	Lake		1998	27-0191-01	Hennepin	07010204	Mercury in fish tissue	2007	PRJ07770-001
West Sarah	Lake		2006	27-0191-01	Hennepin	07010204	Nutrients	2011	PRJ06172-001

Table 22. Stream reaches with TMDLs completed during the current WRAPS update process.

WID (HUC-08 07010204; last 3 digits)	Water Body	Pollutant /Stressor	TMDL Parameter	Designated Class[1]	Designated Use[1]	Listing Year	Target TMDL Completion
763	Crow River, North Fork, Headwaters (Grove Lk 61-0023-00) to CD32	*E. coli*	*E. coli*	2Bg, 3C	AQR	2020	2021
764	Crow River, North Fork, CD32 to Rice Lk	*E. coli*	*E. coli*	2Bg, 3C	AQR	2020	2021
511	Crow River, Middle Fork, Green Lk to N Fk Crow R	*E. coli*	*E. coli*	2Bg, 3C	AQR	2012	2021
507	Crow River, North Fork, M Fk Crow R to Jewitts Cr	*E. coli*	*E. coli*	2Bg, 3C	AQR	2012	2021
585	Jewitts Creek (County Ditch 19, 18, 17), Headwaters (Lk Ripley 47-0134-00) to N Fork Crow River	Chloride	Chloride	2Bg, 3C	AQL	2010	2021
556		*E. coli*	*E. coli*	2Bg, 3C	AQR	2012	2021

WID (HUC-08 07010204; last 3 digits)	Water Body	Pollutant /Stressor	TMDL Parameter	Designated Class[1]	Designated Use[1]	Listing Year	Target TMDL Completion
	Crow River, North Fork, Meeker/Wright County line to Mill Cr	Turbidity	TSS	2Bg, 3C	AQL	2012	2021
		M-IBI[2]	TSS	2Bg, 3C	AQL	2012	2021
		F-IBI[3]	TSS	2Bg, 3C	AQL	2012	2021
679	Twelvemile Creek (Dutch Lk to Little Waverly Lk)	*E. coli*	*E. coli*	2Bg, 3C	AQR	2020	2021
515	Mill Creek, Buffalo Lk to N Fk Crow R	*E. coli*	*E. coli*	2Bg, 3C	AQR	2012	2021
		Nutrients	Phosphorus	2Bg, 3C	AQL	2016	2021
503	Crow River, North Fork, Mill Cr to S Fk Crow R	*E. coli*	*E. coli*	2Bg, 3C	AQR	2012	2021
		Nutrients	Phosphorus	2Bg, 3C	AQL	2016	2021
542	Unnamed creek (Regal Creek), Unnamed Creek to Crow River	Nutrients	Phosphorus	2Bg, 3C	AQR	2020	2021
502	Crow River, S Fk Crow to Mississippi River	Nutrients	Phosphorus	2Bg, 3C	AQR	2016	2021

Table 23. Lakes for which TMDLs were completed during the current WRAPS Update process

Assessment Unit ID	Water Body	Impairment/Parameter	Designated Class	Beneficial Use[1]	Listing Year/ Target TMDL Completion
47-0016-00	Wolf	Nutrients (phosphorus)	2B	AQR	2020/2021
86-0178-00	Dog	Nutrients (phosphorus)	2B	AQR	2020/2021
86-0063-00	Green Mountain	Nutrients (phosphorus)	2B	AQR	2020/2021
86-0020-00	Wilhelm	Nutrients (phosphorus)	2B	AQR	2022 (draft list)/ 2022

TMDL allocation tables and other information

Note that some of the numbers in the tables show multiple significant digits; they are not intended to imply great precision, but rather this is done primarily to make the arithmetic accurate.

E. coli TMDLs

Each *E. coli* TMDL table below provides a representative existing concentration and percent reduction to provide watershed planners a single percent reduction target. The *E. coli* impairments are based on the monthly geometric mean not to exceed 126 org/100 mL with no less than five samples within any calendar month, or no more than 10% of all samples of any calendar month exceeding 1,260 org/100 mL. The standard applies only between April 1 and October 31.

Table 24. ***E. coli*** **Allocations for the Crow River, North Fork, Headwaters (Grove Lk 61-0023-00) to CD32 (WID 07010204-763).**

Escherichia coli Listing year: 2020 Baseline year: 2012 Numeric WQ standard used: 126 org/100 mL	Flow Condition				
	Very High	High	Mid-Range	Low	Very Low
	[Billions organisms/day]				
Loading Capacity	376.49	131.82	52.02	18.31	5.20
Load Allocation (LA)	338.84	118.64	46.82	16.48	4.68
Margin of Safety (MOS)	37.65	13.18	5.20	1.83	0.52
Overall estimated percent reduction	78%				

Table 25. ***E. coli*** **Allocations for the Crow River, North Fork, CD32 to Rice Lk (WID 07010204-764).**

Escherichia coli Listing year: 2020 Baseline year: 2012 Numeric WQ standard used: 126 org/100 mL		Flow Condition				
		Very High	High	Mid-Range	Low	Very Low
		[Billions organisms/day]				
Loading Capacity		1,453.42	490.89	201.02	78.83	26.21
Wasteload Allocation	Brooten WWTP	5.06	5.06	5.06	5.06	5.06
	Total WLA	5.06	5.06	5.06	5.06	5.06
Load Allocation (LA)		1,303.02	436.74	175.86	65.89	18.53
Margin of Safety (MOS)		145.34	49.09	20.10	7.88	2.62
Average existing monthly geometric mean		318.4 org/100mL				
Overall estimated percent reduction		60%				

Table 26. *E. coli* Allocations for the Crow River, Middle Fork, Green Lk to N Fk Crow R (WID 07010204-511).

Escherichia coli Listing year: 2012 Baseline year: 2012 Numeric WQ standard used: 126 org/100 mL		Flow Condition				
		Very High	High	Mid-Range	Low	Very Low
		[Billions organisms/day]				
Loading Capacity (LC)		1,243.33	538.92	214.36	53.77	9.30
Wasteload Allocation	*Atwater WWTP*	5.83	5.83	5.83	5.83	###[1]
	Belgrade WWTP	7.07	7.07	7.07	7.07	###[1]
	Brooten WWTP	5.06	5.06	5.06	5.06	###[1]
	Glacial Lakes SSWD	4.24	4.24	4.24	4.24	###[1]
	Total WLA	22.20	22.20	22.20	22.20	###[1]
Load Allocation (LA)		1,096.80	462.83	170.72	26.19	###[1]
Margin of Safety (MOS)		124.33	53.89	21.44	5.38	0.93
Average existing monthly geometric mean		313.7 org/100mL				
Overall estimated percent reduction		60%				

Table 27. *E. coli* Allocations for the Crow River, North Fork, M Fk Crow R to Jewitts Cr (WID 07010204-507).

Escherichia coli Listing year: 2012 Baseline year: 2012 Numeric WQ standard used: 126 org/100 mL		Flow Condition				
		Very High	High	Mid-Range	Low	Very Low
		[Billions organisms/day]				
Loading Capacity (LC)		3,246.74	1,447.59	625.16	195.37	38.76
Wasteload Allocation	*Atwater WWTP*	5.83	5.83	5.83	5.83	5.83
	Belgrade WWTP	7.07	7.07	7.07	7.07	7.07
	Brooten WWTP	5.06	5.06	5.06	5.06	5.06
	Glacial Lakes SSWD	4.24	4.24	4.24	4.24	4.24
	Grove City WWTP	4.64	4.64	4.64	4.64	4.64
	Total WLA	26.84	26.84	26.84	26.84	26.84
Load Allocation (LA)		2,895.23	1,275.99	535.80	148.99	8.04
Margin of Safety (MOS)		324.67	144.76	62.52	19.54	3.88
Average existing monthly geometric mean		256.3 org/100mL				
Overall estimated percent reduction		51%				

Table 28. *E. coli* Allocations for TwelveMile Creek, Dutch Lk to Little Waverly (WID 07010204-679).

Escherichia coli Listing year: 2020 Baseline year: 2012 Numeric WQ standard used: 126 org/100 mL	Flow Condition				
	Very High	High	Mid- Range	Low	Very Low
	[Billions organisms/day]				
Loading Capacity (LC)	357.57	114.69	51.82	13.93	3.28
Load Allocation (LA)	321.81	103.22	46.64	12.54	2.95
Margin of Safety (MOS)	35.76	11.47	5.18	1.39	0.33
Average existing monthly geometric mean	775.9 org/100mL				
Overall estimated percent reduction	84%				

Table 29. ***E. coli*** **Allocations for the Crow River, North Fork, Meeker/Wright County line to Mill Cr (WID 07010204-556).**

Escherichia coli Listing year: 2012 Baseline year: 2012 Numeric WQ standard used: 126 org/100 mL		Flow Condition				
		Very High	High	Mid-Range	Low	Very Low
		[Billions organisms/day]				
Loading Capacity (LC)		6,429.02	2,713.79	1,142.17	382.00	106.31
Wasteload Allocation	*Annandale/Maple Lake/Howard Lake WWTP*	5.65	5.65	5.65	5.65	5.65
	Atwater WWTP	5.83	5.83	5.83	5.83	5.83
	Belgrade WWTP	7.07	7.07	7.07	7.07	7.07
	Brooten WWTP	5.06	5.06	5.06	5.06	5.06
	Buffalo WWTP	20.60	20.60	20.60	20.60	20.60
	Cokato WWTP	3.46	3.46	3.46	3.46	3.46
	Darwin WWTP	1.55	1.55	1.55	1.55	1.55
	Dassel WWTP	5.83	5.83	5.83	5.83	5.83
	Glacial Lakes SSWD	4.24	4.24	4.24	4.24	4.24
	Grove City WWTP	4.64	4.64	4.64	4.64	4.64
	Litchfield WWTP	14.78	14.78	14.78	14.78	14.78
	Litchfield City (MS400253)[1]	26.36	11.13	4.68	1.57	0.44
	Total WLA	105.07	89.84	83.39	80.28	79.15
Load Allocation (LA)		5,681.05	2,352.57	944.56	263.52	16.53
Margin of Safety (MOS)		642.90	271.38	114.22	38.20	10.63
Average existing monthly geometric mean		197.1 org/100mL				
Overall estimated percent reduction		36	%			

Table 30. *E. coli* Allocations for the Mill Creek, Buffalo Lk to N Fk Crow R (WID 07010204-515).

Escherichia coli Listing year: 2012 Baseline year: 2013 Numeric WQ standard used: 126 org/100 mL		Flow Condition				
		Very High	High	Mid-Range	Low	Very Low
		[Billions organisms/day]				
Loading Capacity (LC)		**305.87**	**106.33**	**52.48**	**16.91**	**1.58**
Wasteload Allocation	*Buffalo City (MS400238)*[1]	43.81	15.24	7.52	2.43	0.23
	Total WLA	**43.81**	**15.24**	**7.52**	**2.43**	**0.23**
Load Allocation (LA)		**231.47**	**80.46**	**39.71**	**12.79**	**1.19**
Margin of Safety (MOS)		**30.59**	**10.63**	**5.25**	**1.69**	**0.16**
Average existing monthly geometric mean		**129.8 org/100mL**				
Overall estimated percent reduction		**3%**				

Table 31. *E. coli* Allocations for the Crow River, North Fork, Mill Cr to S Fk Crow R (WID 07010204-503).

Escherichia coli **Listing year: 2012** **Baseline year: 2012** **Numeric WQ standard used: 126 org/100 mL**		**Flow Condition**				
		Very High	**High**	**Mid-Range**	**Low**	**Very Low**
		[Billions organisms/day]				
Loading Capacity (LC)		**7,283.12**	**3,082.00**	**1,301.49**	**453.01**	**124.86**
Wasteload Allocation	***Annandale/Maple Lake/Howard Lake WWTP***	**5.65**	**5.65**	**5.65**	**5.65**	**5.65**
	Atwater WWTP	**5.83**	**5.83**	**5.83**	**5.83**	**5.83**
	Belgrade WWTP	**7.07**	**7.07**	**7.07**	**7.07**	**7.07**
	Brooten WWTP	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**
	Buffalo WWTP	**20.60**	**20.60**	**20.60**	**20.60**	**20.60**
	Cokato WWTP	**3.46**	**3.46**	**3.46**	**3.46**	**3.46**
	Darwin WWTP	**1.55**	**1.55**	**1.55**	**1.55**	**1.55**
	Dassel WWTP	**5.83**	**5.83**	**5.83**	**5.83**	**5.83**
	Glacial Lakes SSWD	**4.24**	**4.24**	**4.24**	**4.24**	**4.24**
	Grove City WWTP	**4.64**	**4.64**	**4.64**	**4.64**	**4.64**
	Litchfield WWTP	**14.78**	**14.78**	**14.78**	**14.78**	**14.78**
	Montrose WWTP	**3.72**	**3.72**	**3.72**	**3.72**	**3.72**
	Buffalo City (MS400238)[2]	**48.27**	**20.42**	**8.63**	**3.00**	**0.83**

Escherichia coli Listing year: 2012 Baseline year: 2012 Numeric WQ standard used: 126 org/100 mL		Flow Condition				
		Very High	High	Mid-Range	Low	Very Low
		[Billions organisms/day]				
	Litchfield City (MS400253)[3]	29.13	12.33	5.21	1.81	0.50
	St. Michael City (MS400246)[4]	1.03	0.44	0.18	0.06	0.02
	Total WLA	160.86	115.62	96.45	87.30	83.79
Load Allocation (LA)		6,393.95	2,658.18	1,074.89	320.41	28.58
Margin of Safety (MOS)		728.31	308.20	130.15	45.30	12.49
Average existing monthly geometric mean[1]		150.3 org/100 mL				
Overall estimated percent reduction		16%				

TSS TMDLs

The TMDL table has a representative percent reduction to provide watershed planners a percent reduction target. For TSS, the representative existing condition is taken as the 90th percentile of the observed TSS concentrations. The overall estimated percent reduction is the existing condition relative to the 30 mg/L standard.

Table 32. Current TSS conditions in impaired stream reaches addressed in this TMDL report.

WID	Station	Period	Number of samples	90th Percentile (mg/L)	Number of Exceedances
07010204-556	S001-274	2017	3	86.2	3
	S001-517	2009 - 2018	89	99	52
	S002-019	2009	17	43.4	8
	S005-853	2017	1	24.8	0

Table 33. TSS Allocations for Crow River, North Fork, Meeker/Wright County line to Mill Cr (WID 07010204-556).

Total Suspended Solids Listing year: 2012 Baseline year: 2012 Numeric WQ standard used: 30 mg/L		Flow Condition				
		Very High	High	Mid-Range	Low	Very Low
		[tons/day]				
Loading Capacity		178.659	79.184	35.702	13.525	3.619
Wasteload Allocation	*Annandale/Maple Lake/Howard Lake WWTP*	0.148	0.148	0.148	0.148	0.148
	Atwater WWTP	0.229	0.229	0.229	0.229	0.229
	Belgrade WWTP	0.278	0.278	0.278	0.278	0.278
	Brooten WWTP	0.199	0.199	0.199	0.199	0.199
	Buffalo WWTP	0.451	0.451	0.451	0.451	0.451
	Cokato WWTP	0.136	0.136	0.136	0.136	0.136
	Darwin WWTP	0.061	0.061	0.061	0.061	0.061
	Dassel WWTP	0.229	0.229	0.229	0.229	0.229
	Glacial Lakes SSWD	0.111	0.111	0.111	0.111	0.111
	Grove City WWTP	0.183	0.183	0.183	0.183	0.183
	Litchfield WWTP	0.237	0.237	0.237	0.237	0.237
	Litchfield (MS400253)	0.733	0.325	0.146	0.055	0.015
	Construction/Industrial Stormwater	0.357	0.158	0.071	0.027	0.007
	Total WLA	3.352	2.745	2.479	2.344	2.284
Load Allocation (LA)		157.441	68.521	29.653	9.828	0.973
Margin of Safety (MOS)		17.866	7.918	3.570	1.353	0.362
90th Percentile Concentration		73.0 mg/L				
Overall estimated percent reduction		59%				

Chloride TMDL

The chloride TMDL allocation table below has an overall estimated percent reduction to provide watershed planners with a single percent reduction target. For chloride, the representative existing condition is the average concentration of chloride during very low flows. The overall estimated percent reduction is the reduction of the existing condition to meet the 230 mg/L standard.

Table 34. Allocations for Jewitts Creek (County Ditch 19, 18, 17), Headwaters (Lk Ripley 47-0134-00) to NFCR (07010204-585) Chloride TMDL.

Chloride Listing year: 2010 Baseline year: 2012 Numeric WQ standard used: 230mg/L		Flow Condition				
		Very High	High	Mid-Range	Low	Very Low
		[lbs/day]				
Loading Capacity		96,620	27,138	10,387	5,470	3,496
Wasteload Allocation	Litchfield WWTP	5,950	5,950	5,950	###[1]	###[1]
	Litchfield City (MS400253)[2]	12,271	3,447	1,319	###[1]	###[1]
	Total WLA	18,221	9,397	7,269	###[1]	###[1]
Load Allocation	Total LA	68,737	15,027	2,078	###[3]	###[3]
	Natural Background	7,856	2,206	844	445	284
	Nonpoint Sources	60,881	12,821	1,234	###[3]	###[3]
Margin of Safety (MOS)		9,662	2,714	1,039	547	350
Average Concentration during very low flows		256.7 mg/L[4]				
Overall estimated percent reduction		10.4%				

[1]WLA are flow dependent, see Section 4.2.3.6 in the TMDL report

[2]MS4 WLA set to 12.7% of loading capacity, see Section 4.2.3.4. in the TMDL report

[3]The permitted wastewater design flows exceed the stream flow in the indicated flow zone(s). The allocations are expressed as an equation rather than an absolute number: allocation = (flow contribution from a given source) x (230 mg/L).

[4]Average concentration and overall percent reduction taken as the average concentration during the very low flow conditions (critical condition

Phosphorus TMDLs for rivers

Existing loads are based on the average summer P concentrations from the HSPF model (RESPEC 2012 and 2016) and the summer averaged flows. Model results were used in place of observed values to be consistent with the flow averaging periods.

Table 35. TP Allocations for the Mill Creek, Buffalo Lk to N Fk Crow R (WID 07010204-515).

Phosphorus as P **Listing year: 2016; Baseline year: 2012 Numeric WQ standard used: 100 µg/L**		**Flow Condition- Summer Average** **[lbs /day]**
Wasteload Allocation	**Total WLA**	**1.99**
	Buffalo City (MS400238)	**1.96**
	Construction/Industrial Stormwater	**0.03**
Load Allocation (LA)		**9.98**
Margin of Safety (MOS)		**1.37**
Reserve Capacity (RC)		**0.35**
Loading Capacity (LC/TMDL)		**13.69**
Existing Load		**16.05**
Estimated Load Reduction		**14.7%**

Table 36. TP Allocations for the Crow River, North Fork, Mill Cr to SFCR (WID 07010204-503).

Phosphorus as P **Listing year: 2016; Baseline year: 2012 Numeric WQ standard used: 100 µg/L**		**Flow Condition- Summer Average** **[lbs /day]**
Wasteload Allocation	**Total WLA**	**23.19**
	Annandale/Maple Lake/Howard Lake WWTP	**1.39**
	Atwater WWTP	**0.55**
	Belgrade WWTP	**2.43**
	Buffalo WWTP	**5.05**
	Cokato WWTP	**1.28**
	Dassel WWTP	**1.34**
	Glacial Lakes SSWD	**1.57**
	Great River Energy Dickinson	**0.37**
	Litchfield WWTP	**3.62**

Phosphorus as P Listing year: 2016; Baseline year: 2012 Numeric WQ standard used: 100 µg/L		Flow Condition- Summer Average [lbs /day]
	Montrose WWTP	1.37
	Buffalo City (MS400238)	2.19
	Litchfield City (MS400253)	1.32
	St Michael City (MS400246)	0.05
	Construction/Industrial Stormwater	0.66
Load Allocation (LA)		270.83
Margin of Safety (MOS)		33.04
Reserve Capacity (RC)		3.37
Loading Capacity (LC/TMDL)		330.43
Existing Load		520.33
Estimated Load Reduction		36.5%

Table 37. TP Allocations for Unnamed Creek (Regal Creek), Unnamed Creek to Crow River (WID 07010204-542).

Phosphorus as P Listing year: 2020 Baseline year: 2012 Numeric WQ standard used: 100 µg/L		Flow Condition-Summer Average [lbs /day]
Wasteload Allocation	Total WLA[1]	3.491
	Buffalo City (MS400238)	0.008
	Monticello City (MS400242)	0.021
	Otsego City (MS400243)	0.040
	St Michael City (MS400246)	3.104
	Albertville City (MS400281)	0.297
	MnDOT Metro District (MS400170)	0.004
	Construction/Industrial Stormwater	0.017
Load Allocation (LA)		3.926

Phosphorus as P Listing year: 2020 Baseline year: 2012 Numeric WQ standard used: 100 µg/L	Flow Condition-Summer Average [lbs /day]
Margin of Safety (MOS)	**0.840**
Reserve Capacity (RC)	**0.140**
Loading Capacity (LC/TMDL)	**8.397**
Existing Load	**11.986**
Estimated Load Reduction	**30.0%**

Table 38. TP Allocation for Crow River, S Fork Crow to Mississippi River (WID 07010204-502).

Phosphorus as P Listing year: 2016; Baseline year: 2012 Numeric WQ standard used: 125 µg/L		Flow Condition-Summer Average [lbs /day]
	Total WLA	**46.59**
	Annandale/Maple Lake/Howard Lake WWTP	**1.39**
	Atwater WWTP	**0.55**
	Belgrade WWTP	**2.43**
	Buffalo WWTP	**5.05**
	Cokato WWTP	**1.28**
	Dassel WWTP	**1.34**
	Glacial Lakes SSWD	**1.57**
	Great River Energy Dickinson	**0.37**
	Greenfield WWTP	**0.29**
	Litchfield WWTP	**3.62**

Phosphorus as P Listing year: 2016; Baseline year: 2012 Numeric WQ standard used: 125 µg/L			Flow Condition-Summer Average [lbs /day]
	Otsego City (MS400243)	0.58	
	St Michael City (MS400246)	5.04	
	Litchfield City (MS400253)	0.76	
	Albertville City (MS400281)	0.32	
	Hanover City (MS400286)	0.79	
	Rogers City (MS400282)	2.19	
	MnDOT Metro District (MS400170)	0.06	
	Hennepin County (MS400138)	0.01	
	Construction/Industrial Stormwater	0.78	
Load Allocation (LA)		299.06	
Margin of Safety (MOS)		38.81	
Reserve Capacity		3.63	
Remaining Load (LC-BC; North Fork Crow River)		388.09	
Boundary Condition (South Fork Crow River outlet)		486.35	
Loading Capacity		874.44	
Existing Load		1,564.16	
Estimated Load Reduction		44.1%	
Wasteload Allocation			

Meadows of Whisper Creek WWTP	0.20
Met Council - Rogers WWTP	3.57
Montrose WWTP	1.37
Otsego East WWTP	3.66
Rockford WWTP	1.81
Saint Michael WWTP	5.45
Loretto City (MS400030)	0.02
Corcoran City (MS400081)	0.29
Dayton City (MS400083)	0.19
Independence City (MS400095)	0.23
Medina City (MS400105)	0.10
Buffalo City (MS400238)	1.26
Monticello City (MS400242)	0.02

Table 39. Total phosphorus source summary for impaired stream reaches

Source	Crow River, S Fk Crow to Mississippi River (502)		Crow River, North Fork, Mill Cr to S Fk Crow R (503)		Mill Creek, Buffalo Lk to N Fk Crow R (515)		Unnamed creek (Regal Creek), Unnamed Creek to Crow River (542)	
	TP load (lb/yr)	TP load (%)	TP load (lb/yr)	TP load (%)	TP load (lb/yr)	TP load (%)	TP load (lb/yr)	TP load (%)
South Fork Crow River (boundary condition)	277,011	57%	0	0%	0	0%	0	0%
Cropland	161,998	34%	153,842	82%	1,277	71%	3,145	78%
Pasture and rangeland	5,556	1%	4,773	3%	104	6%	199	5%
Feedlot	724	< 1%	723	< 1%	8	< 1%	16	< 1%
Developed [a]	5,701	1%	3,902	2%	117	7%	406	10%
Forest	2,669	< 1%	2,072	1%	72	4%	65	2%
Wetland	2,796	< 1%	2,463	1%	94	5%	79	2%
Wastewater point sources	23,054	5%	17,161	9%	18	1%	0	0%
Bed and bank erosion	7	< 1%	7	< 1%	1	< 1%	0	< 1%
Septics	1,680	< 1%	1,436	< 1%	68	4%	121	3%
Atmospheric deposition	784	< 1%	645	< 1%	28	2%	18	< 1%

TMDL lakes summary for Phosphorus

Overall, a 23% (Dog Lake) to 82% (Green Mountain Lake) reduction in phosphorus loading to the impaired lakes is needed to meet water quality standards. Loads in the TMDL tables are rounded to two significant digits, except in the case of values greater than 100, which are rounded to the nearest whole number.

Table 40. Wolf Lake (47-0016-00) phosphorus TMDL summary

- Listing year: 2020
- Numeric standard used to calculate TMDL: 60 µg/L TP
- Baseline year: 2013
- TMDL and allocations apply Jun–Sep

TMDL Parameter	TMDL TP Load	
	lb/yr	lb/day
Load allocation	1,848	5.1
WLA for construction stormwater (MNR100001)	2.2	0.0060
WLA for industrial stormwater (MNR050000 and MNG490000)	2.2	0.0060
Margin of safety	206	0.56
Loading capacity	2,058	5.7
Other		
Existing load	5,410	15
Percent load reduction	62%	62%

Table 41. Dog Lake (86-0178-00) phosphorus TMDL summary

- Listing year: 2020
- Numeric standard used to calculate TMDL: 40 µg/L TP
- Baseline year: 2013
- TMDL and allocations apply Jun–Sep

TMDL Parameter	TMDL TP Load	
	lb/yr	lb/day
Load allocation	83	0.23
WLA for construction stormwater (MNR100001)	0.10	0.00027
WLA for industrial stormwater (MNR050000 and MNG490000)	0.10	0.00027
Margin of safety	9.2	0.025
Loading capacity	92	0.26
Other		
Existing load	119	0.33
Percent load reduction	23%	23%

Table 42. Green Mountain Lake (86-0063-00) phosphorus TMDL summary

- Listing year: 2020
- Numeric standard used to calculate TMDL: 60 µg/L TP
- Baseline year: 2013
- TMDL and allocations apply Jun–Sep

TMDL Parameter	TMDL TP Load	
	lb/yr	lb/day
Load allocation	233	0.64
WLA for construction stormwater (MNR100001)	0.28	0.00077
WLA for industrial stormwater (MNR050000 and MNG490000)	0.28	0.00077
Margin of safety	26	0.071
Loading capacity	260	0.71
Other		
Existing load	1,422	3.9
Percent load reduction	82%	82%

Table 43. Lake Wilhelm (86-0020-00) phosphorus TMDL summary

- Listing year (draft): 2022
- Numeric standard used to calculate TMDL: 60 µg/L TP
- Baseline year: 2016
- TMDL and allocations apply Jun–Sep

TMDL Parameter		TMDL TP Load	
		lb/yr	lb/day
Load allocation (internal loading and atmospheric deposition)		94	0.26
WLA for construction stormwater (MNR100001)		0.22	0.00060
WLA for industrial stormwater (MNR050000 and MNG490000)		0.22	0.00060
WLA for MS4 [a]	St. Michael	89	0.24
	Hanover	0.82	0.0022
Margin of safety		21	0.056
Loading capacity		205	0.56
Other			
Existing load		645	1.8
Percent load reduction		68%	

a. The wasteload allocations for MS4s, construction stormwater, and industrial stormwater equate to an aerial phosphorus loading rate of 0.20 lbs/acre/year. MS4 areas at the time of this TMDL report were 446 ac in St. Michael and 4.1 acres in Hanover.

Load reduction targets by source for each of the impaired lakes

These tables are provided for watershed managers to use in watershed planning. The categories in these tables are geared to watershed planning needs and do not directly correspond to the categories in the lake TMDL tables.

Table 44. Wolf Lake (47-0016-00) phosphorus load reductions by source

Source	Existing Load (lb/yr)	Target Load (lb/yr)	Load Reduction Needed (lb/yr)	% Reduction
Watershed runoff	1,509	292	1,217	81%
Lake Jennie outlet	1,275	1,180	95	7%
Internal and unidentified	2,563	523	2,040	80%
Atmospheric deposition	63	63	0	0%
Total	5,410	2,058	3,352	62%

Table 45. Dog Lake (86-0178-00) phosphorus load reductions by source

Source	Existing Load (lb/yr)	Target Load (lb/yr)	Load Reduction Needed (lb/yr)	% Reduction
Watershed runoff	96	69	27	28%
Atmospheric deposition	23	23	0	0%
Total	119	92	27	23%

Table 46. Green Mountain Lake (86-0063-00) phosphorus load reductions by source

Source	Existing Load (lb/yr)	Target Load (lb/yr)	Load Reduction Needed (lb/yr)	% Reduction
Watershed runoff	517	110	407	79%
Internal and unidentified	866	111	755	87%
Atmospheric deposition	39	39	0	0%
Total	1,422	260	1,162	82%

Table 47. Wilhelm Lake (phosphorus load reductions by source

Source	Existing Load (lb/yr)	Target Load (lb/yr)	Load Reduction Needed (lb/yr)	% Reduction
Watershed runoff	205	89	116	57%
Internal and unidentified	415	92	323	78%
Atmospheric deposition	24	24	0	0%
Total	644	205	439	68%

Appendix D. Public participation plan

Appendix E. EPAs nine key elements in the 1W1P and WRAPS processes

Element	Description	WRAPS section and/or 1W1P were addressed
A	An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X numbers of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).	WRAPS Update Appendix C Stressor ID Report WRAPS Update Section 2.1 WRAPS Update Section 2.3 WRAPS Update Section 2.5 WRAPS Update Section 2.6 TMDL reports (various)
B	An estimate of the load reductions expected for the management measures.	WRAPS Appendix C 1W1P Section 4 TMDL reports (various)
C	A description of the nonpoint source management measures that will need to be implemented to achieve the load reductions under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.	1W1P Section 4
D	An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.	1W1P tables ES-2, ES-4, ES-5
E	An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.	Appendix D (Public Participation Plan) WRAPS Section 3
F	A schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.	1W1P Section 4.5
G	A description of interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.	1W1P, Table 4-5
H	A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards.	WRAPS Section 5 Monitoring 1W1P Table 4-5
I	A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.	WRAPS Section 5 Monitoring