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Watershed

Big Fork River Watershed Restoration and Protection Strategy Report Update 2025

MINNESOTA POLLUTION CONTROL AGENCY

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Key terms and abbreviations

1W1P	One Watershed, One Plan
BMP	Best management practice
Chl-*a*	Chlorophyll-a
CLMP	Citizen Lake Monitoring Program
CWMP	Comprehensive Watershed Management Plan
DO	Dissolved Oxygen
DNR	Minnesota Department of Natural Resources
EPA	U.S. Environmental Protection Agency
FIBI	fish community-based Index of Biological Integrity
GRAPS	Groundwater Restoration and Protection Strategies
HSPF	Hydrologic Simulation Program–Fortran
HUC	Hydrologic Unit Code
IBI	index of biological integrity
IWL	Impaired waters list
IWM	Intensive watershed monitoring
LA	Load allocation
LTBM	long term biomonitoring
mg/L	Milligrams per liter
ug/L	Micrograms per liter
µS/cm	Microsiemens per centimeter
MIBI	Macroinvertebrate community-based index of biological integrity
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer System
SONAR	Statement of Need and Reasonableness
SWCD	Soil and Water Conservation District
TDO3	Temperature where dissolved oxygen concentration equals 3 mg/L
TP	Total phosphorus
10X	Ten times (chemistry samples collected on 10 dates)
TMDL	Total maximum daily load
TSS	Total suspended solids

U of M	University of Minnesota
WID	water unit identifications
WPLMN	Watershed Pollutant Load Monitoring Network
WRAPS	watershed restoration and protection strategy
WHAF	Watershed Health Assessment Framework
WWTP	Wastewater Treatment Plant

Executive summary

The Big Fork River Watershed (BFRW) is a pristine watershed located in Northern Minnesota. The watershed is sparsely populated and contains mostly forested lands and many healthy lakes, streams, and wetlands. The BFRW spans through two counties, Itasca and Koochiching, and two tribal reservations of the Leech Lake Band of Ojibwe (LLBO) and Bois Forte Band of Chippewa. Water quality monitoring shows very few impairments and many exceptional water bodies, including 122 miles of exceptional biological assemblages found in the Big Fork River.

The BFRW WRAPS Report Update 2025 is an update of the 2017 BFRW WRAPS Report. The intent of this report is to summarize the water quality data that was collected from 2020 through 2022, explain priority focus areas decided by the BFRW core team, and deliver restoration and protection strategies developed for priority lakes and streams. The BFRW core team includes the Minnesota Pollution Control Agency (MPCA), Koochiching Soil and Water Conservation District (SWCD), Itasca SWCD, LLBO, and Minnesota Department of Natural Resources (DNR). Select Hydrologic Unit Code (HUC) 12 subwatersheds are the focus in this report rather than focusing on the entire HUC-8; however, there are additional select water bodies that are priority throughout the HUC-8 that are also emphasized for protection. These HUC-12 subwatersheds were chosen by the BFRW core team, which are the same partners that are developing the upcoming BFRW Comprehensive Watershed Management Plan (CWMP) in 2025-2026. The priority focus areas include water bodies that have been identified as impaired, vulnerable to impairment, exceptional, cold-water designated lakes and cisco refuge lakes. Some of these priority focus water bodies are located wholly within the LLBO reservation and Bois Forte reservation; therefore, they are subject to the LLBO Water Quality Standards Act or Bois Forte Band of Chippewa discretion.

Restoration strategies have been identified for the impaired lakes of Island Lake (31-0913-00), Shallow Pond (*31-0910-00)*, Jessie Lake *(*31-0786-00*)*, and Little Spring *(31-0797-00).* These lakes are not meeting water quality standards for aquatic recreation due to excess nutrients. The potentially impaired lakes of Round Lake (*31-0896-00)*, Dunbar Lake (*31-0904-00)*, and Bowstring Lake *(31-0813-00)* are located within the LLBO reservation, and are subject to LLBO water quality standards; however, these lakes are included in the restoration strategies table because there are lakes and streams outside of the reservation boundary that flow into Bowstring Lake and Round Lake, and vice versa. An impairment has not yet been designated and will be determined by U.S. Environmental Protection Agency (EPA) based on LLBO water quality data at a future date. There are also seven streams and four lakes vulnerable to impairment. A lake comparison analysis was conducted on the impaired lakes and the vulnerable lakes to gain further understanding on why they're impaired. A special focus was prioritized for Island Lake with tributary monitoring occurring in 2022 to gain a better understanding of phosphorus inputs. A special study is planned on Bowstring and Round Lake in the near future in partnership between MPCA and LLBO.

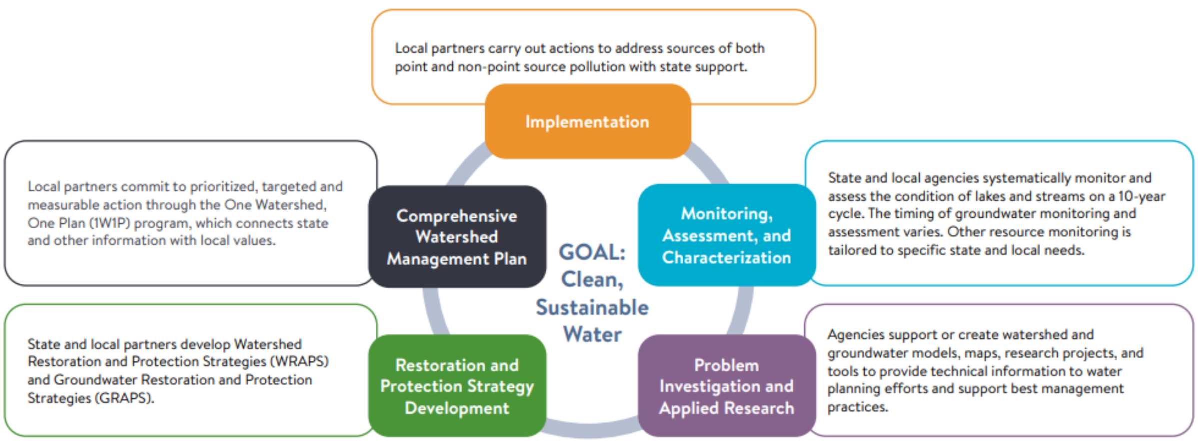
The BFRW has many exceptional and high-quality water resources, and it is important to protect these water bodies. There are 6 exceptional stream reaches (totaling over 100 miles), 8 exceptional lakes, and a high number of cold-water lakes that inhabit cold-water fish species, (i.e. cisco, whitefish, and lake trout), and 13 cisco refuge lakes, all worthy of protection. It's important to protect these lakes from excess nutrients because increasing eutrophication will negatively impact deep, well-oxygenated water needed for cold-water species to survive. The MPCA, Koochiching SWCD, and Itasca SWCD partnered on a few special focus projects conducted between 2020 and 2025. Projects to assess streambank erosion on the mainstem of the Big Fork River, survey spring locations, and assess culverts were conducted to help identify focus areas for restoration and protection within the watershed. Public participation and outreach for the BFRW WRAPS was extensive and included a traveling exhibit showcased at several different venues from 2020 through 2025 to reach as many people as possible in a large, sparsely populated watershed.

1. Watershed approach

Minnesota has adopted a watershed approach to address the state's 80 major watersheds. The Minnesota watershed approach incorporates **water quality assessment, watershed analysis, public participation, planning, implementation, and measurement of results** into a 10-year cycle that addresses both restoration and protection.

As part of the watershed approach, the MPCA developed a process to identify and address threats to water quality in each of these major watersheds.

Figure 1. Minnesota's watershed approach.



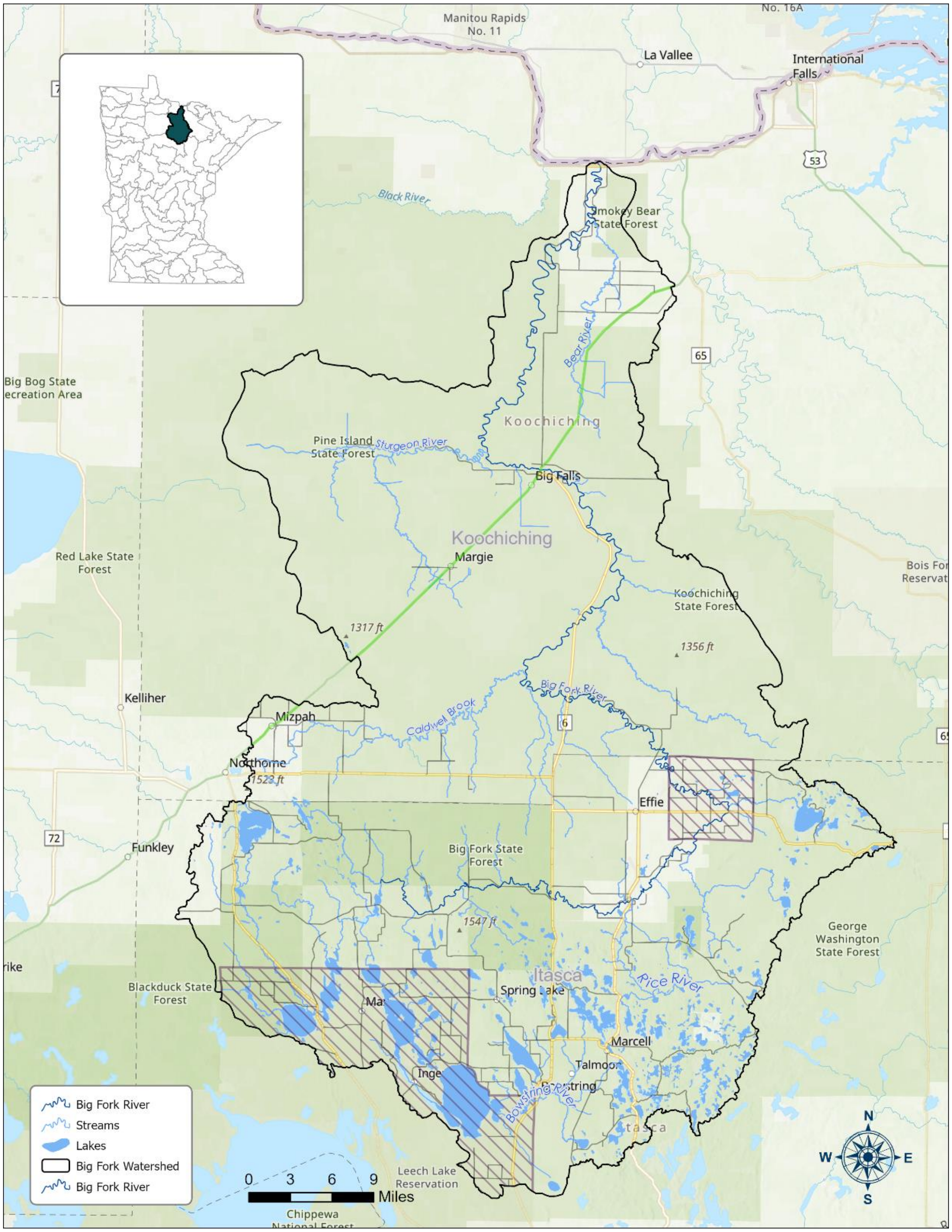
This process is called watershed restoration and protection strategy (WRAPS) development. The WRAPS reports have two parts: impaired waters have strategies for restoration, and waters that are not impaired have strategies for protection.

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. In addition, the watershed approach process facilitates a more cost-effective and comprehensive characterization of multiple water bodies and overall watershed health, including both protection and restoration efforts. A key aspect of this effort is to develop and use watershed-scale models and other tools to identify strategies for addressing point and nonpoint source pollution that will cumulatively achieve water quality targets. 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. More information on the watershed approach can be found on the MPCA website: [Watershed approach to water quality | Minnesota Pollution Control Agency (state.mn.us)]

2. Watershed description

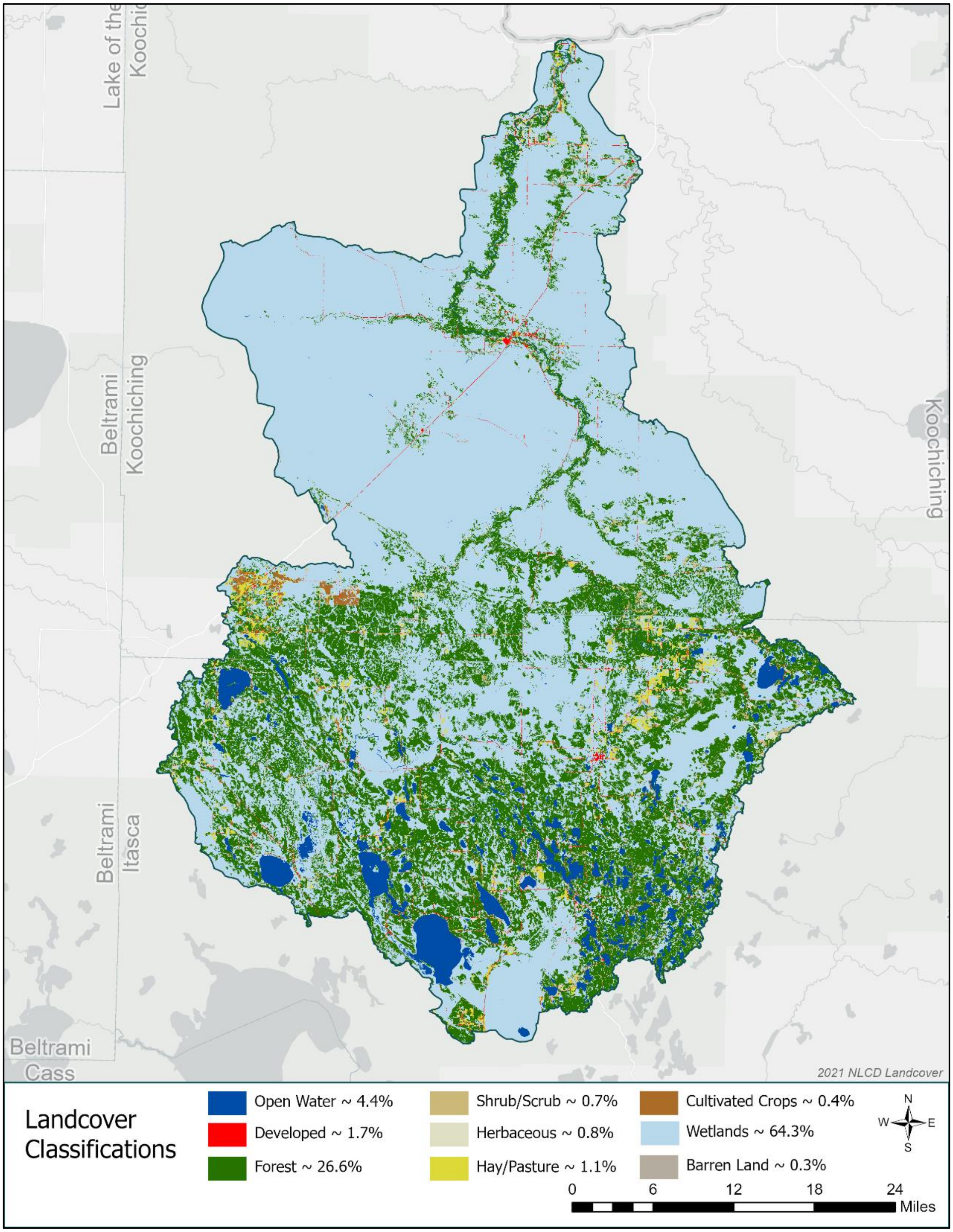
The BFRW is approximately 1.3 million acres and is the 6th largest HUC-8 watershed in Minnesota. The watershed spans across two counties, Itasca County and Koochiching County, and two Anishinaabe (Ojibwe) Reservations of the LLBO and Bois Forte Band of Chippewa. The two largest towns in the watershed are Bigfork and Big Falls, with populations of 446 and 175 people, respectively. Figure 2 is a map of the BFRW.

Figure 2. Big Fork River Watershed.



The watershed is relatively remote, containing approximately 26.6% forestland and 64.3% wetlands, and only 1.7% developed land (Figure 3 is a land use map of the BFRW). There are expansive wetlands and peatlands due to remnants of Glacial Lake Agassiz. The Big Fork River proper starts at Dora Lake and flows north for 165 miles to the Rainy River. The watershed also contains hundreds of lakes; with 95 of them greater than 100 acres. More details on watershed characteristics can be found in the Big Fork River Watershed Monitoring and Assessment Report (state.mn.us) and the original Big Fork River Watershed Restoration and Protection Strategy Report (state.mn.us).

Figure 3. Land use in the Big Fork River Watershed.

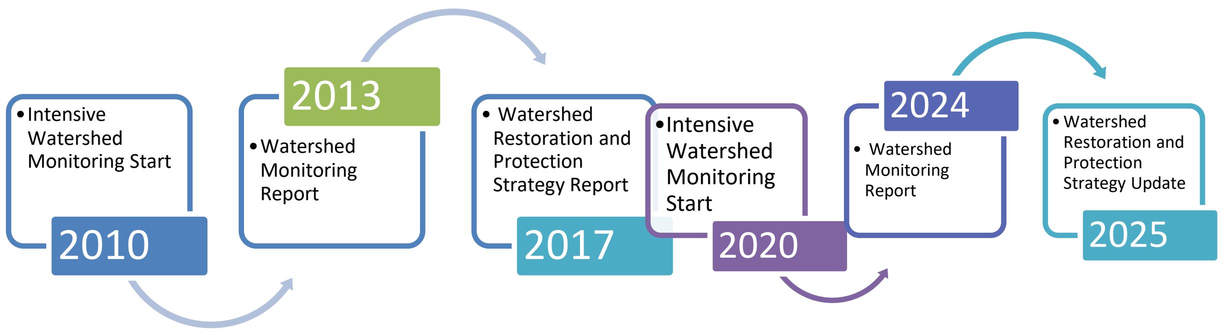


3. Assessing water quality

The first WRAPS report for the BFRW was completed in October 2017. During that cycle (2010 through 2020), intensive watershed monitoring (IWM) started in 2010. This initial WRAPS report included sections on watershed background and description, watershed conditions (condition status, water quality trends, stressors and sources, TMDL summary, protection considerations), prioritizing and implementing restoration and protection, and a monitoring plan.

The second 10-year cycle (2020 through 2030) began in May 2020 with the IWM process. Figure 4 is a depiction of the Big Fork WRAPS process timeline. The intent of the WRAPS Update is to report data that's currently absent from the first round and to incorporate any new findings from the monitoring and assessment process. This updated WRAPS report includes focused data presented in user-friendly maps and narratives, designed to streamline watershed protection and restoration needs. This report will be available to help state agencies, local governments, tribal governments, and other watershed stakeholders determine how to best proceed with protecting and restoring surface waters and groundwater in the BFRW.

Figure 4. Timeline of the Big Fork River Watershed IWM and WRAPS process.



For a complete description of the IWM process, please see the MPCA Water Quality Website: [Water quality | Minnesota Pollution Control Agency (state.mn.us)](). Further information on water quality standards and assessment procedures can be found in the Manual Guidance for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report & 303(d) Impaired Waters List (IWL; [2024 Assessment Guidance Manual (state.mn.us)]()). Below is a except from the manual:

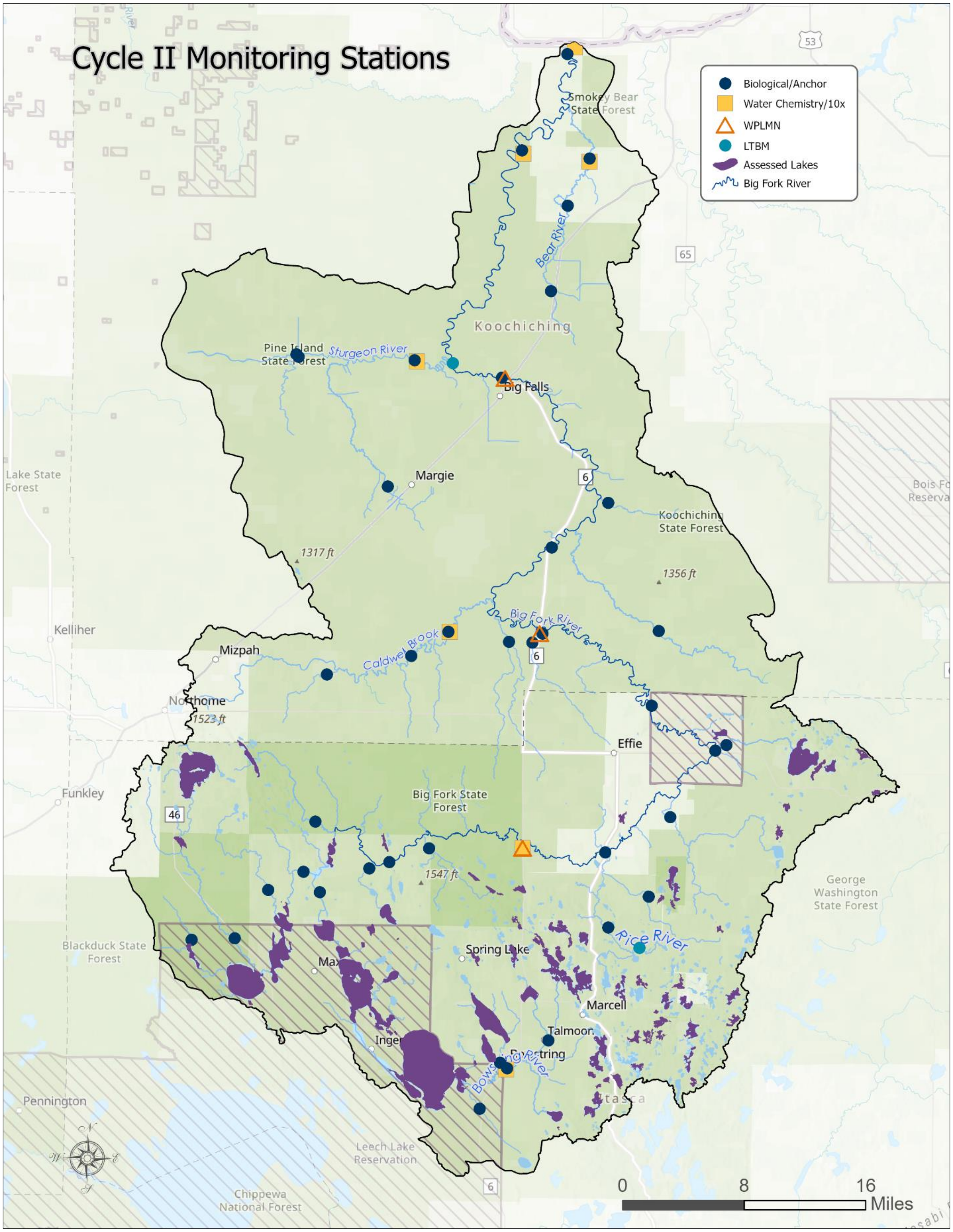
> "This Assessment Manual (also known as the Guidance) explains the methods MPCA utilizes for assessing whether the waters where data has been gathered are meeting the beneficial uses or not. If the waters are not meeting their intended use, they are placed on the IWL for detailed tracking of future improvements…. The scope of this Guidance Manual includes methods for assessing surface waters for the following beneficial uses:
>
> Class 1: Drinking water and aquatic consumption (human health-based standards).
>
> Class 2: Aquatic life (toxicity-based standards, conventional pollutants, biological indicators).
>
> Class 2: Aquatic recreation (Escherichia coli – *E. coli* – bacteria, eutrophication).
>
> Class 2: Aquatic consumption (fish-tissue and wildlife-based standards).
>
> Class 4A: Waters used for production of wild rice.

Class 7: Limited value resource waters (toxicity-based standards, bacteria, conventional pollutants)". (MPCA 2024a)

For a full list of designated use classes for streams in the BFRW, see Beneficial use designations for stream reaches in the Big Fork River Watershed (09030006) (Table created August 9, 2016) (state.mn.us).
IWM is the process of gathering data in surface waters that align with the watershed approach. The water quality data for cycle 2 was collected in partnership with MPCA, DNR, LLBO, Itasca SWCD, Koochiching SWCD, and volunteer water monitors from the Citizen Lake Monitoring Program (CLMP), Volunteer monitoring reports and data | Minnesota Pollution Control Agency. Assessments take place immediately following a watershed's completion of IWM. For the BFRW, assessments took place in 2023. There were 28 stream sections assessed, also known as water unit identifications (WIDs). A stream WID usually extends from one significant tributary to another or from the headwaters to the first significant tributary. There were 56 lakes sampled and assessed. Forty biological monitoring stations were sampled on streams, two of which are long term biomonitoring (LTBM) stations that get sampled semi-annually, Long-term biological monitoring of rivers and streams | Minnesota Pollution Control Agency. There were nine stream water chemistry stations sampled, three of which are watershed pollutant load monitoring network (WPLMN) sites that get sampled regularly, focused during periods of high streamflow and runoff, Watershed pollutant load monitoring | Minnesota Pollution Control Agency. Please see Section 4: Watershed Condition of this report for details on the Cycle 2 assessment results. Figure 6 is a map of all the IWM monitoring locations for cycle 2 in the BFRW.

Figure 5. Mirror Lake, Photo Credit: Itasca SWCD

Figure 6. Cycle 2 IWM monitoring locations.



4. Watershed condition

The overall water quality in the BFRW is in excellent condition. According to the cycle 2 Monitoring and Assessment Report:

> "Over the past decade, scientists observed little change in water quality within the Big Fork River Watershed. Most water bodies continued to exhibit excellent water quality that supports aquatic recreation and aquatic life. In fact, between 2010 and 2021 the condition of macroinvertebrate communities in the watershed improved slightly. Large tracts of forested land, combined with numerous wetlands and little development, have helped maintain these high-quality aquatic resources. Overall, sediment and nutrient levels throughout the watershed remained low; however, excess nutrients (phosphorus) were still an issue in lakes with previous known impairments" (MPCA 2024b).

To find out more information on the results of the cycle 2 IWM please see Big Fork River Watershed Assessment and Trends Update Report. Below are some key findings of the report:

> "Healthy fish and macroinvertebrate (aquatic insect) communities were found throughout the watershed. Most lakes and streams met water quality standards designed to protect aquatic life. Large stretches of the Big Fork River, the headwaters of the Rice River, and eight lakes have been identified as exceptional resources because they support such high-quality aquatic communities. High levels of turbidity and total suspended solids were found on some sections of the Big Fork River; however, healthy fish and macroinvertebrates were still found in these reaches.
>
> Most lakes and streams met water quality standards designed to protect aquatic recreation (i.e., swimming). High amounts of bacteria were found in the Bowstring River and Bear River; additional monitoring will be conducted to determine the source. Six lakes failed to meet regional standards for nutrients, chlorophyll-a (chl-*a*), and/or transparency. Five of these were previously known impairments that were confirmed by recent monitoring data". (MPCA 2024e)

Toxic Pollutants

Some of the water bodies in the BFRW are impaired by mercury; however, MPCA's Watershed Approach and WRAPS processes are not typically intended to address impairments or complete TMDLs for nonconventional pollutants (e.g., mercury, PCBs). For more information on mercury impairments, see the statewide mercury TMDL at Statewide mercury TMDL | Minnesota Pollution Control Agency.

4.1 Streams and Rivers

The streams and rivers monitored and assessed in cycle 2 are shown in Table 1. Listed within the table are the water body names and the water quality parameter results. If a water body is listed as “Sup” it is found to meet the water quality standard (supporting), if it’s listed as “Imp” it does not meet the water quality standard and therefore, is impaired, “IF” means the data collected was insufficient to make a finding, “NA” means not assessed, and “IC” is Inconclusive. Figure 7 is a map of the BFRW cycle 2 assessment results for streams.

Table 1. 2013 to 2023 assessment status of river reaches in the Big Fork River Watershed (09030006), presented (mostly) from north to south.

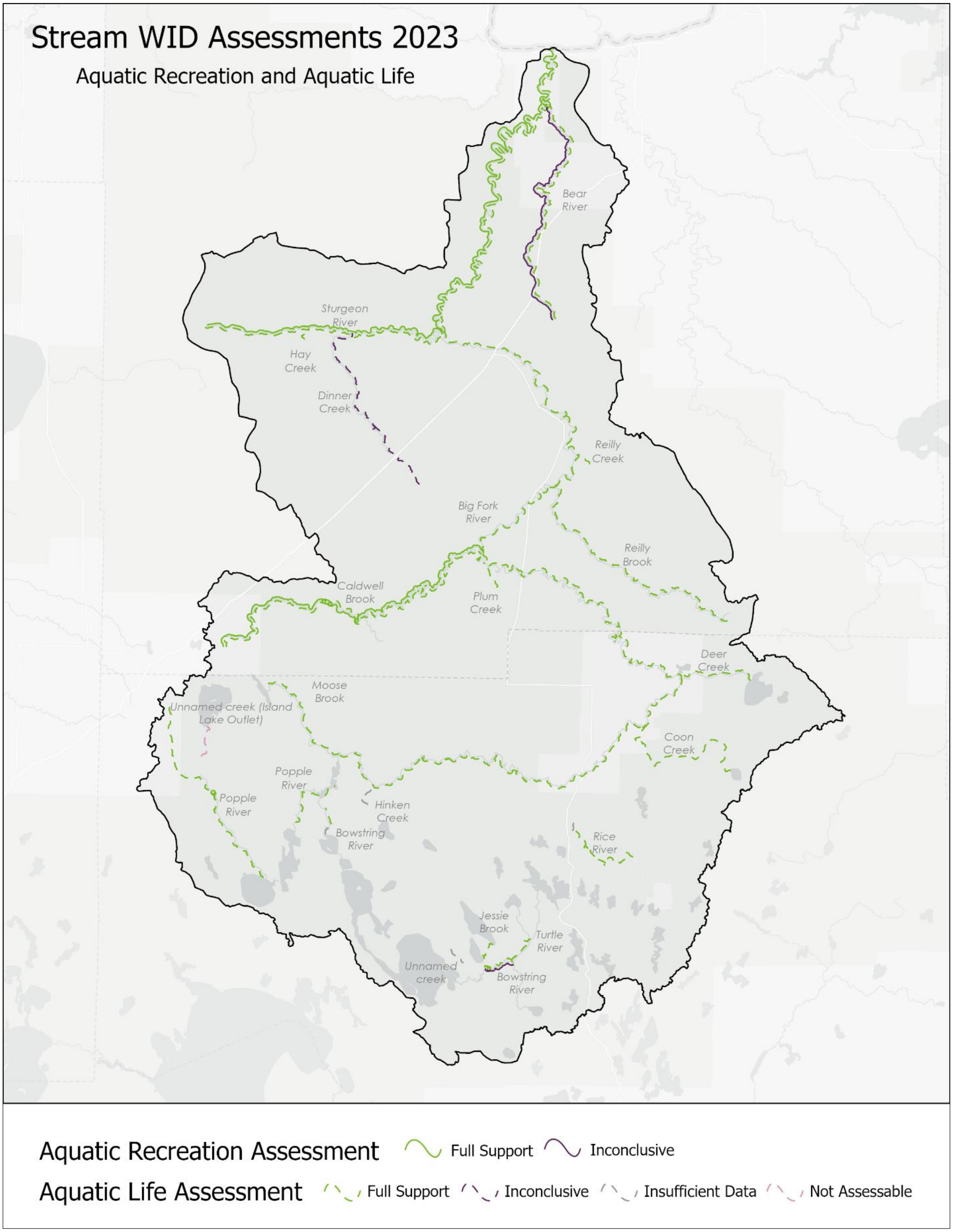
			Aquatic Life											Aquatic Recreation	
AUID (Last 3 digits)	River	Reach description	Overall Assessment	Fish Index of biotic integrity	Macroinvertebrate index of biotic integrity	Dissolved oxygen	Turbidity/TSS	Total Phosphorus	Chlorophyll -a	pH	Secchi-Tube	Chloride	Ammonia	Overall Assessment	Bacteria (*E. coli*)
501	Big Fork River	Bear River to Rainy River	Sup	NA	Sup	Sup	IF	Sup	Sup	Sup	IC	IF	NA	Sup	Sup
502	Big Fork River	Sturgeon River to Bear River	Sup	Sup	Sup	Sup	IF	Sup	NA	Sup	IC	IF	IF	Sup	Sup
503	Big Fork River	Reilly Brook to Sturgeon River	Sup	Sup	Sup	Sup	Imp	Sup	IF	Sup	Imp	NA	Sup	NA	NA
504	Big Fork River	Deer Creek to Caldwell Brook	Sup	Sup	Sup	Sup	Imp	Sup	NA	Sup	Imp	NA	IF	NA	NA
505	Big Fork River	Moose Brook to Coon Creek	Sup	Sup	Sup	IF	Sup	Sup	Sup	Sup	Sup	NA	NA	NA	NA
506	Big Fork River	Coon Creek to Deer Creek	Sup	Sup	Sup	IF	IF	IF	NA	IF	IF	NA	IF	NA	NA
507	Big Fork River	Caldwell Brook to Reilly Brook	Sup	Sup	Sup	IF	IF	IF	NA	IF	IF	NA	IF	NA	NA
509	Sturgeon River	Headwaters to Big Fork River	Sup	Sup	Sup	IF	IF	IF	NA	IF	IC	IF	NA	Sup	Sup

AUID (Last 3 digits)	River	Reach description	Aquatic Life											Aquatic Recreation	
			Overall Assessment	Fish Index of biotic integrity	Macroinvertebrate index of biotic integrity	Dissolved oxygen	Turbidity/TSS	Total Phosphorus	Chlorophyll -a	pH	Secchi-Tube	Chloride	Ammonia	Overall Assessment	Bacteria (*E. coli*)
510	Caldwell Brook	Headwaters to Big Fork River	Sup	Sup	Sup	IF	IF	Imp	Sup	Sup	IC	IF	IF	Sup	Sup
511	Moose Brook	Headwaters (Big Calf Lk) to Big Fork R	Sup	NA	Sup	IF	IF	IF	NA	IF	IF	NA	IF	NA	NA
512	Popple River	Natures Lk to Dora Lk	Sup	Sup	NA	NA	IF	IF	NA	IF	IF	NA	IF	NA	NA
513	Coon Creek	Headwaters (Coon Lk) to Big Fork R	Sup	NA	Sup	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
514	Deer Creek	Headwaters (Deer Lk) to Big Fork R	Sup	Sup	Sup	NA	IF	IF	NA	NA	IF	NA	NA	NA	NA
515	Reilly Brook	Headwaters to Big Fork River	Sup	Sup	Sup	NA	IF	IF	NA	NA	IF	NA	NA	NA	NA
516	Bear River	Headwaters to Big Fork River	Sup	IC	Sup	IC	IF	IF	NA	Sup	IC	IF	IF	IC	Imp
517	Popple River	Headwaters to Round Lake	Sup	Sup	NA	IF	IF	IF	NA	IF	IF	NA	NA	NA	NA
539	Rice River	Batson Lk outlet to Pelton Lk outlet	Sup	Sup	NA	IF	IF	IF	NA	IF	IF	NA	NA	NA	NA
541	Rice River	Pelton Lk outlet to Lauchoh Lk outlet	IF	NA	NA	NA	NA	NA	NA	NA	Sup	NA	NA	NA	NA
555	Bowstring River	Unnamed lk (Schoolhouse) to Unnamed cr	Sup	Sup	NA	IF	NA	NA	NA	IF	Sup	NA	NA	NA	NA

AUID (Last 3 digits)	River	Reach description	Aquatic Life											Aquatic Recreation	
			Overall Assessment	Fish Index of biotic integrity	Macroinvertebrate index of biotic integrity	Dissolved oxygen	Turbidity/TSS	Total Phosphorus	Chlorophyll -a	pH	Secchi-Tube	Chloride	Ammonia	Overall Assessment	Bacteria (*E. coli*)
575	Bowstring River	Turtle R to Jessie Bk	Sup	Sup	NA	NA	IF	IF	NA	Sup	Sup	IF	NA	IC	IC
582	Turtle River	Little Turtle Cr to Bowstring R	Sup	Sup	Sup	NA	IF	IF	NA	NA	IF	NA	NA	NA	NA
586	Jessie Brook	Jessie Lk to Bowstring R	Sup	Sup	NA	NA	IF	IF	NA	NA	IF	NA	NA	NA	NA
592	Dinner Creek	Headwaters to Sturgeon R	IC	IC	IC	NA	IF	IF	NA	NA	IF	NA	NA	NA	NA
610	Hay Creek	Unnamed cr to Sturgeon R	Sup	Sup	Sup	NA	IF	IF	NA	NA	IF	NA	NA	NA	NA
612	Plum Creek	Wade Bk to Big Fork R	Sup	Sup	Sup	NA	IF	IF	NA	NA	IF	NA	NA	NA	NA
625	Reilly Creek	Unnamed cr to Big Fork R	Sup	Sup	Sup	NA	IF	IF	NA	NA	IF	NA	NA	NA	NA
644	Rice River	Headwaters (Cameron k) to Batson Lk outlet	Sup	Sup	Sup	IF	IF	IF	NA	IF	IF	NA	Sup	NA	NA

Sup = found to meet the water quality standard (supporting), 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

Figure 7. Big Fork River Watershed IWM assessment results for streams.



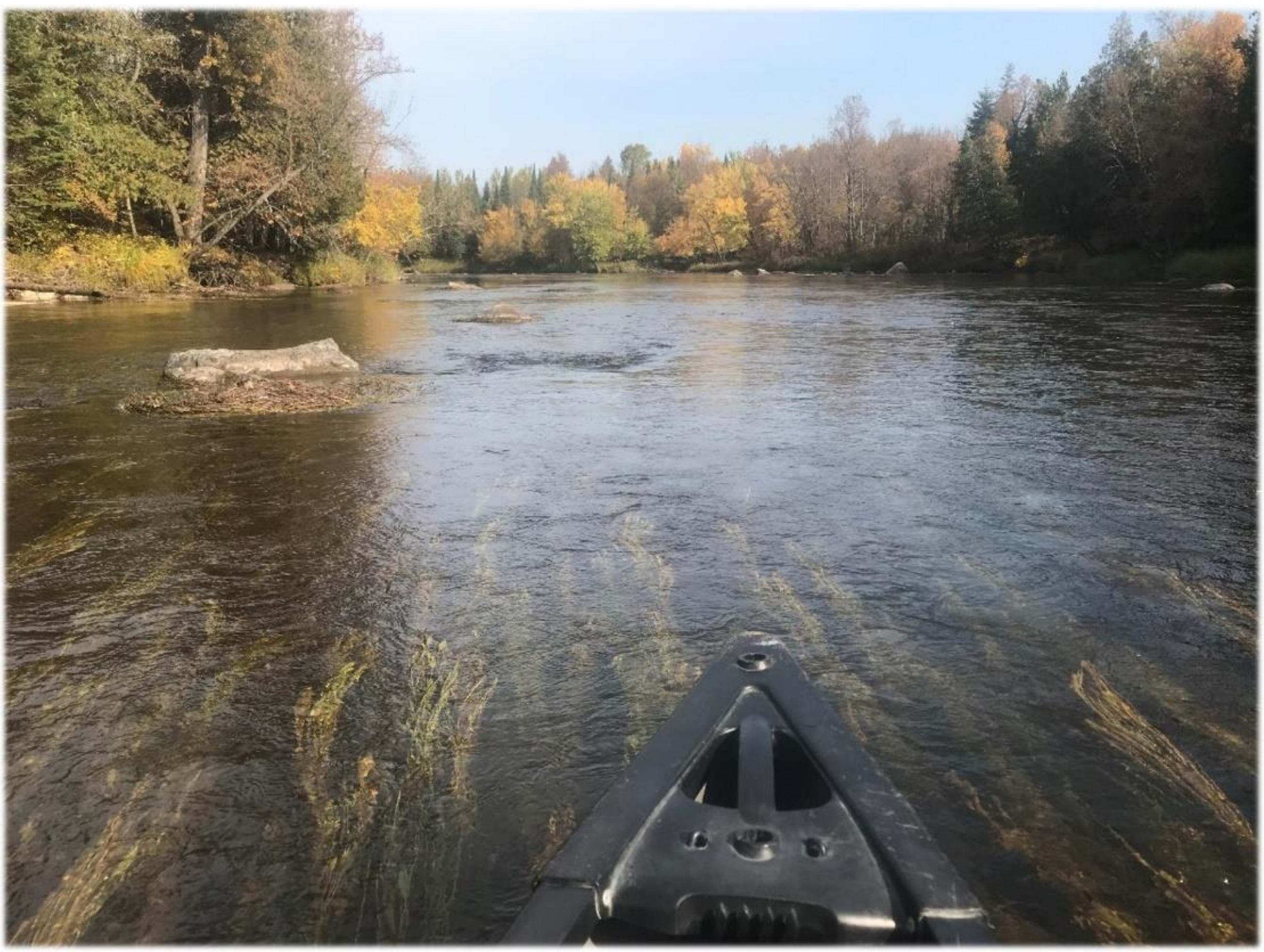
Proposed Designated Use-Class Changes for Streams

Listed in Table 2 are the use class changes from 2Bg (Aquatic Life and Recreation – General Warm Water Habitat) to 2Be (Aquatic Life and Recreation – Exceptional Warm Water Habitat) for streams. These new standards will be more protective for the biological fish and invert community. The new standards will be for the fish community-based index of biological integrity (FIBI) and macroinvertebrate community-based index of biological integrity (MIBI).

Table 2. Proposed use-class changes from 2Bg to 2Be.

AUID WID 09030006-	Water Body Name	Miles	Use Class	Changes Proposed
501	Big Fork River - Bear R to Rainy R	9.34	2Bg	2Be
502	Big Fork River- Sturgeon R to Bear R	38.03	2Bg	2Be
503	Big Fork River- Reilly Bk to Sturgeon R	24.85	2Bg	2Be
504	Big Fork River - Deer Crk to Caldwell Brk	39.57	2Bg	2Be
507	Big Fork River - Caldwell Brook to Reilly Brook	10.87	2Bg	2Be
644	Rice River – Headwaters (Cameron Lk) to Batson Lake Outlet	4.19	2Bg	2Be

Figure 8. The Big Fork River in Itasca County. Photo Credit: Itasca SWCD



4.2 Lakes

The lakes monitored and assessed in cycle 2 are shown in Table 3. Listed within the tables are the water body names and the water quality parameter results. If a water body is listed as "Sup" it is found to meet the water quality standard (supporting), if it's listed as "Imp" it does not meet the water quality standard and, therefore, is impaired, "IF" means the data collected was insufficient to make a finding, "NA" means not assessed, and "IC" is Inconclusive. If one parameter is impaired, that doesn't mean the overall assessment for the Use Class is impaired. Figure 9 is a map of the BFRW cycle 2 aquatic life assessment results for lakes and Figure 10. Big Fork River Watershed IWM aquatic recreation assessment results for lakes.is a map of aquatic recreation assessment results for lakes.

Table 3. 2013 to 2023 assessment status of lakes in the Big Fork River Watershed (09030006), presented (mostly) from north to south.

				Aquatic Recreation				Aquatic Life		
Lake ID	Lake Name	Lake Area (Acres)	Lake Method	Overall Assessment	Secchi	Chlorophyll-a	Total Phosphorus	Overall Assessment	Fish	Chloride
31-0530-00	Busties*	233	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	IF
31-0334-00	Deer	1829	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	NA
31-0339-00	Pickerel	233	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	NA
31-0197-00	Battle	237	Shallow Water	Sup	Sup	Sup	Sup	Sup	Sup	IF
31-0183-00	Five Island	203	Deep Water	Sup	Sup	Sup	Sup	NA	NA	NA
31-0160-00	Mirror	104	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	IF
31-0316-00	Bass	117	Deep Water	Sup	Sup	Sup	Sup	IF	IF	IF
31-0710-00	Connors	143	Deep Water	IF	Sup	IF	IF	NA	NA	NA
31-0898-00	Moose	400	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	IF
31-0913-00	Island	2934	Deep Water	Imp	Sup	Imp	Imp	Sup	Sup	IF
31-0910-00	Shallow Pond	217	Shallow Water	Imp	Imp	Imp	Imp	IF	IF	IF
31-0882-00	Dora	395	Shallow Water	IF	Sup	IF	IF	NA	NA	NA

				Aquatic Recreation				Aquatic Life		
Lake ID	Lake Name	Lake Area (Acres)	Lake Method	Overall Assessment	Secchi	Chlorophyll-a	Total Phosphorus	Overall Assessment	Fish	Chloride
31-0845-00	Clear	136	Deep Water	Sup	Sup	Sup	Sup	IF	IF	IF
31-0803-00	Trestle	106	Deep Water	Sup	Sup	Sup	Sup	IF	IF	IF
31-0782-00	Gunderson	175	Deep Water	NA	NA	NA	NA	Sup	Sup	NA
31-0524-01	Coon	375	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	IF
31-0524-02	Sandwick	211	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	IF
31-0843-00	Whitefish	507	Deep Water	NA	NA	NA	NA	Sup	Sup	IF
31-0836-00	Little Whitefish**	155	Shallow Water	Sup	Sup	Sup	Sup	IF	IF	IF
31-0904-00	Dunbar**	275	Deep Water	Imp	Imp	Imp	Imp	IF	IF	IF
31-0896-00	Round**	2798	Deep Water	Imp	Imp	Imp	Imp	IC	IC	IF
31-0853-00	Little Sand**	341	Deep Water	IC	Sup	Imp	Sup	IF	IF	IF
31-0826-00	Sand**	3552	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	NA
31-0832-00	Rush Island**	294	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	IF
31-0813-00	Bowstring**	9189	Deep Water	Imp	Sup	Imp	Imp	IC	Sup	IF
31-0784-00	Little Jessie	614	Deep Water	IF	IF	NA	NA	Sup	Sup	NA
31-0786-00	Jessie	1741	Deep Water	Imp	Sup	Imp	Imp	Sup	Sup	IF
31-0779-00	Little Turtle	453	Deep Water	IF	Sup	NA	NA	NA	NA	NA
31-0725-00	Turtle	2074	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	NA
31-0793-00	Big Too Much	275	Deep Water	NA	NA	NA	NA	Sup	Sup	NA
31-0773-00	Maple	244	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	IF

				Aquatic Recreation				Aquatic Life		
Lake ID	Lake Name	Lake Area (Acres)	Lake Method	Overall Assessment	Secchi	Chlorophyll-a	Total Phosphorus	Overall Assessment	Fish	Chloride
31-0771-00	Hatch	207	Deep Water	IF	Sup	NA	NA	NA	NA	NA
31-0781-00	Long	139	Deep Water	Sup	Sup	Sup	Sup	IF	NA	IF
31-0726-00	Bello	502	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	IF
31-0696-00	Horseshoe	252	Deep Water	IF	Sup	NA	NA	NA	NA	NA
31-0657-02	Jack the Horse South	254	Deep Water	Sup	Sup	Sup	Sup	IC	NA	IF
31-0657-01	Jack the Horse North	104	Deep Water	Sup	Sup	Sup	Sup	IF	NA	IF
31-0654-00	Burns	181	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	IF
31-0460-00	East	186	Deep Water	IF	Sup	NA	NA	NA	NA	NA
31-0540-00	Clubhouse	262	Deep Water	IF	Sup	NA	NA	Sup	Sup	NA
31-0463-00	Fox	257	Deep Water	IF	Sup	NA	NA	NA	NA	NA
31-0454-00	Eagle	277	Deep Water	IF	IF	NA	NA	Sup	Sup	NA
31-0473-00	Mary	203	Deep Water	IF	Sup	NA	NA	NA	NA	NA
31-0480-00	Gunn	375	Deep Water	Sup	Sup	Sup	Sup	IF	NA	IF
31-0542-00	Three Island	253	Deep Water	IF	Sup	NA	NA	NA	NA	NA
31-0671-00	Big Island	245	Shallow Water	Sup	Sup	Sup	Sup	Sup	Sup	IF
31-0670-00	Big Ole	221	Deep Water	Sup	Sup	Sup	Sup	IF	NA	IF
31-0653-00	North Star	808	Deep Water	Sup	Sup	Sup	Sup	Sup	Sup	IF
31-0616-00	East Smith	158	Deep Water	IF	Sup	NA	NA	NA	NA	NA
31-0497-00	Fifth Chain	105	Deep Water	IF	Sup	NA	NA	NA	NA	NA

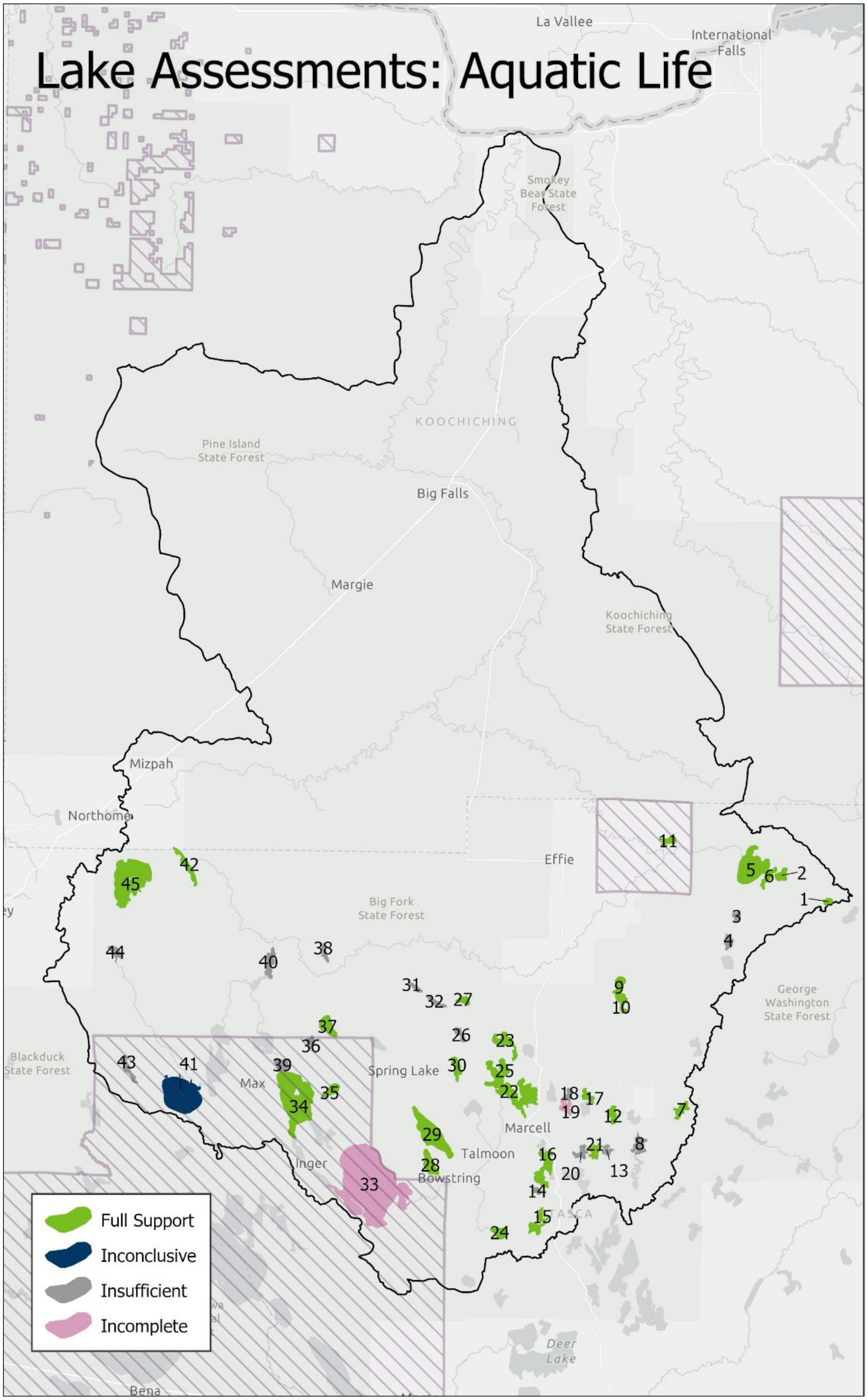
				Aquatic Recreation				Aquatic Life		
Lake ID	Lake Name	Lake Area (Acres)	Lake Method	Overall Assessment	Secchi	Chlorophyll-a	Total Phosphorus	Overall Assessment	Fish	Chloride
31-0416-00	Black Island	112	Deep Water	IF	Sup	NA	NA	NA	NA	NA
31-0622-00	Dead Horse	101	Deep Water	Sup	Sup	Sup	Sup	IF	NA	IF
31-0621-00	Little Dead Horse	77	Deep Water	IF	Sup	NA	NA	NA	NA	NA
31-0624-00	Grave	497	Deep Water	IF	Sup	NA	NA	Sup	Sup	NA
31-0758-00	Little Bowstring	316	Deep Water	IC	Sup	NA	NA	Sup	Sup	NA
31-0759-00	Maki	17	Deep Water	IF	Sup	NA	NA	NA	NA	NA

Sup = found to meet the water quality standard (supporting), 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

***Lakes wholly within the Bois Forte Reservation Boundary**

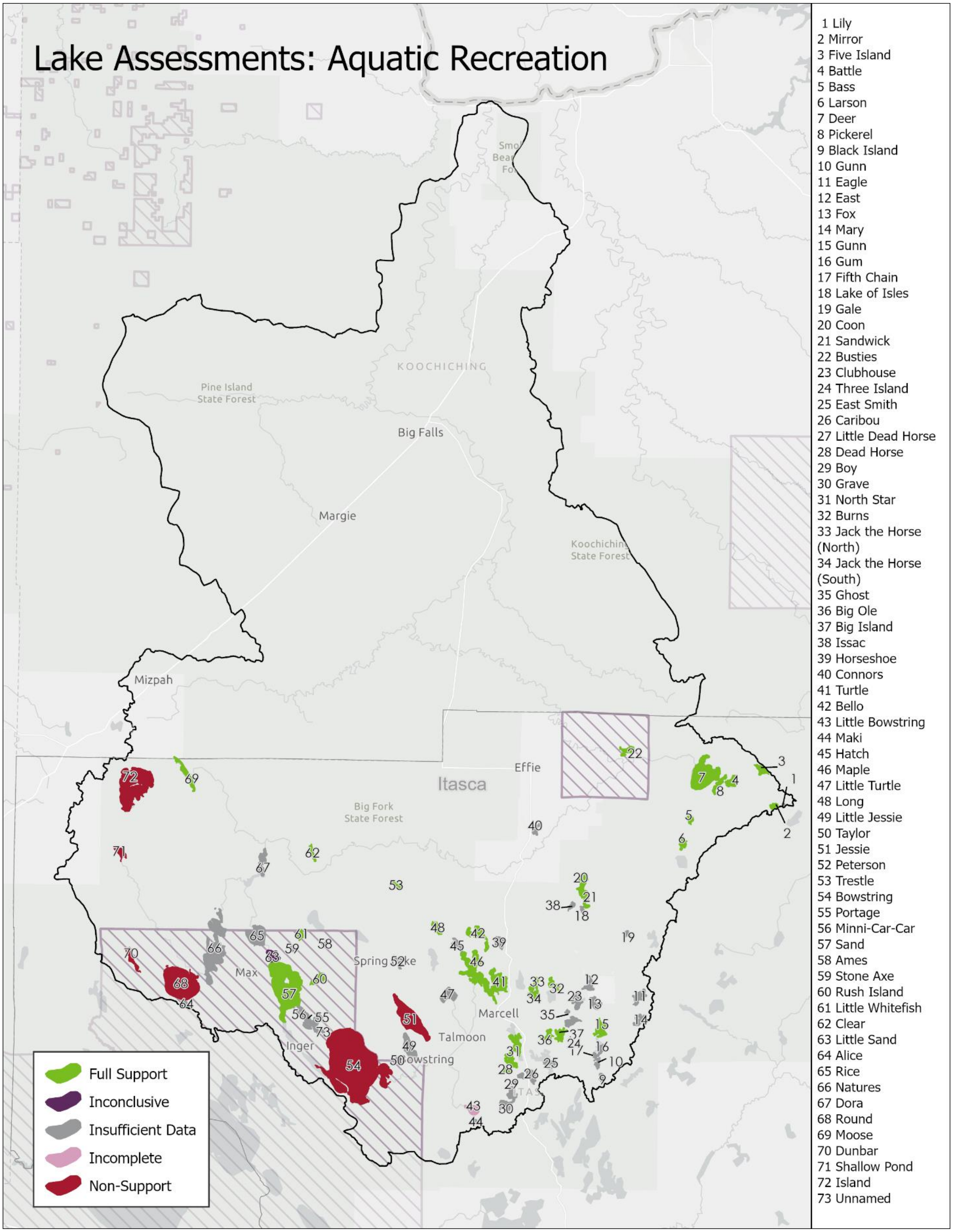
****Lakes wholly within the Leech Lake Reservation Boundary**

Figure 9. Big Fork River Watershed IWM aquatic life assessment results for lakes.



1 Mirror
2 Battle
3 Bass
4 Larson
5 Deer
6 Pickerel
7 Eagle
8 Gunn
9 Coon
10 Sandwick
11 Busties
12 Clubhouse
13 Crooked
14 Dead Horse
15 Grave
16 North Star
17 Burns
18 Jack the Horse (North)
19 Jack the Horse (South)
20 Big Ole
21 Big Island
22 Turtle
23 Bello
24 Little Bowstring
25 Maple
26 Long
27 Gunderson
28 Little Jessie
29 Jessie
30 Big Too Much
31 Trestle
32 Arrowhead
33 Bowstring
34 Sand
35 Rush Island
36 Little Whitefish
37 Whitefish
38 Clear
39 Little Sand
40 Dora
41 Round
42 Moose
43 Dunbar
44 Shallow Pond
45 Island

Figure 10. Big Fork River Watershed IWM aquatic recreation assessment results for lakes.



Proposed Changes in Lake Water Quality Standards as of 2024

There is a need to address gaps in protection for cold-water fishes, which are impacted by both eutrophication and increases in temperature. Lakes that are managed for trout have more stringent water quality standards, and lakes without trout but with cisco or lake whitefish fall under Minnesota's warm-water lake standards currently instead of cold-water. There is a gap in protections for these sensitive and important fish species, and the new cold-water standards will include and protect cisco and lake whitefish. For these native, cold-water fish species to survive, they need water below a certain temperature and oxygen above a certain threshold which can limit them to a very small portion of the lake during certain times of the year (MPCA 2024c). Figure 11 is a schematic showing cold water fish requirements. For a full explanation of the proposed changes from warm-water to cold-water standards, please see Development of Water Quality Standards to Protect Coldwater Lake Habitats in Minnesota (state.mn.us). There are also proposed changes to the shallow warm-water lake standards that some lakes in the BFRW are categorized in. Comments received during the cycle 1 BFRW WRAPS Report public notice suggested data-analysis be conducted to develop new eutrophication standards for shallow lakes in the Northern Lakes and Forest Ecoregion. For a full explanation of the proposed changes to the warm-water lake standard, please see Development of Eutrophication Standards for Northern Lakes in Minnesota (state.mn.us). A summary of the proposed cold-water and warm-water standards are listed in Table 4.

The draft lake eutrophication standards and use designations have gone through the required public comment period and an external peer review. The technical supporting documents were revised based on the feedback from the peer reviews. Following these revisions and the development of the Statement of Need and Reasonableness (SONAR), the MPCA intends to propose these rules and new water quality standards for adoption in Fall 2025. With this timeline, the rules should be formally adopted by spring 2026.

Figure 11. Cold-water fish requirements. They differ from warm-water and cool-water fishes by requiring cooler water and higher oxygen levels (MPCA 2024c).

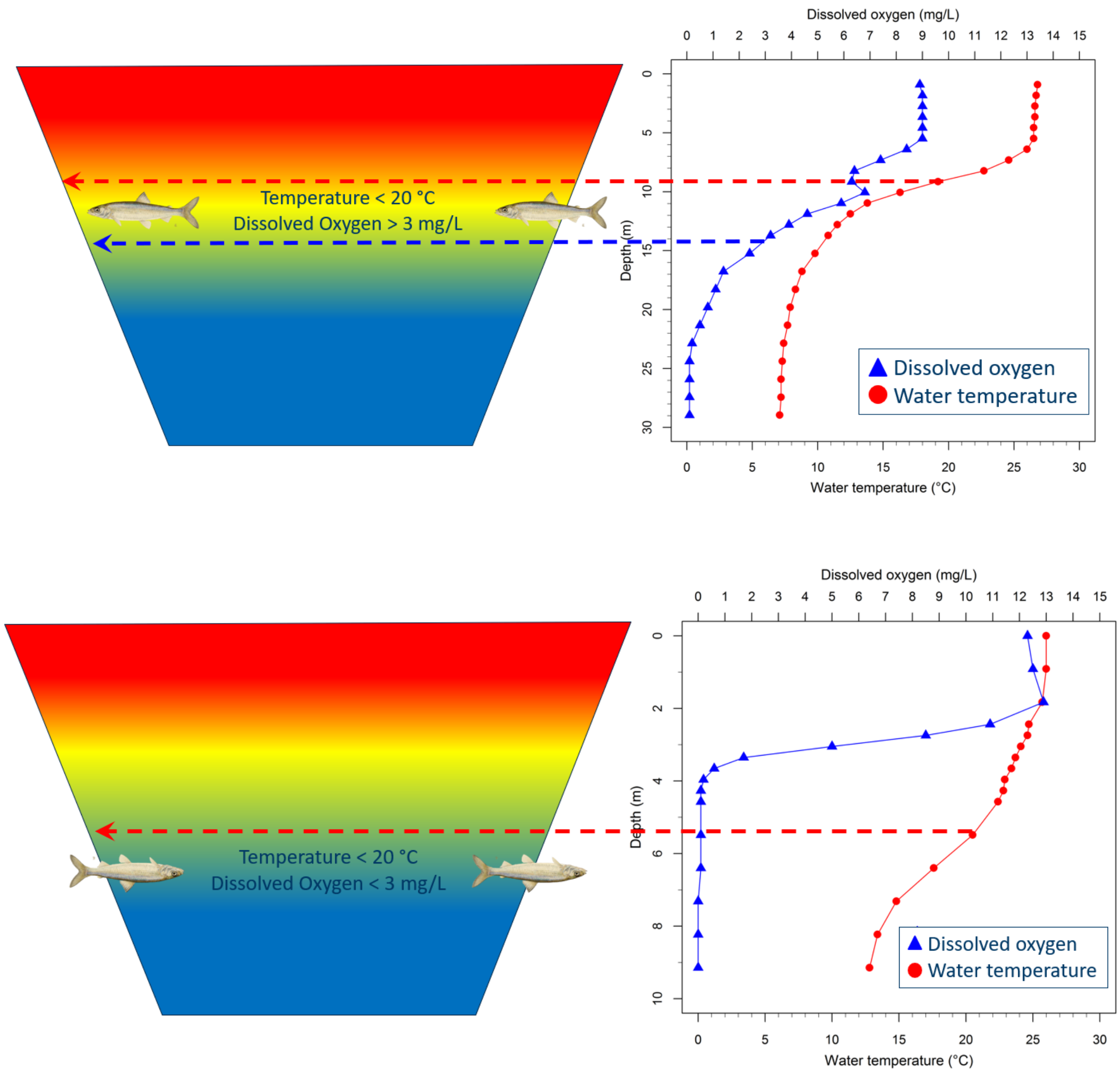


Table 4. Minnesota's proposed lake eutrophication standards for cold-water (Class 2A) and warm-water (Class 2Bg/2Bgd) habitats (MPCA 2024c and MPCA 2024d).

Species	T_{DO3} (°C)	TP (µg/L)	Chl-*a* (µg/L)	Secchi depth (m)
Coldwater: Lake trout	8.8	7	3	3.3
Coldwater: Lake whitefish	17.2	12	5	2.6
Coldwater: Cisco	21.5	25	12	1.4
Coldwater: Stream trout	--	15	6	2.4
Warmwater Stratified (Deep Lakes): Northern Lakes	NA	20	9	1.8
Warmwater Mixed (Shallow Lakes): Northern Lakes	NA	30	16	1.1

***lakes with color >73 platinum-cobalt units (PCU) or a440 >4 m-1 should not be assessed using Secchi depth and lakes with color >25 PCU or a440 >1.4 m-1 should be reviewed to determine the effect of CDOM on water transparency (MPCA 2024d).**

Listed in Table 5 are lakes within BFRW with a proposed designated use-class change. The changes are from 2Bg (aquatic life and recreation – general warm-water habitat) to 2Be (aquatic life and recreation – exceptional warm-water habitat) and 2Ag (aquatic life and recreation – general cold-water habitat) and 2Ae (aquatic life and recreation – exceptional cold-water habitat). The change from 2Bg to 2Be will affect the DNR lake FIBI standards but not the eutrophication standards. Changing the use-class from 2B to 2A will have different eutrophication standards and there will also be a new oxythermal habitat standard (temperature where dissolved oxygen concentration equals 3 mg/L; TDO3): temperature where dissolved oxygen (DO) concentration equals 3 mg/L. Lakes within the LLBO Reservation are subject to LLBO water quality standards. Figure 12 is a map of the proposed cold-water and warm-water use-class changes for streams and lakes.

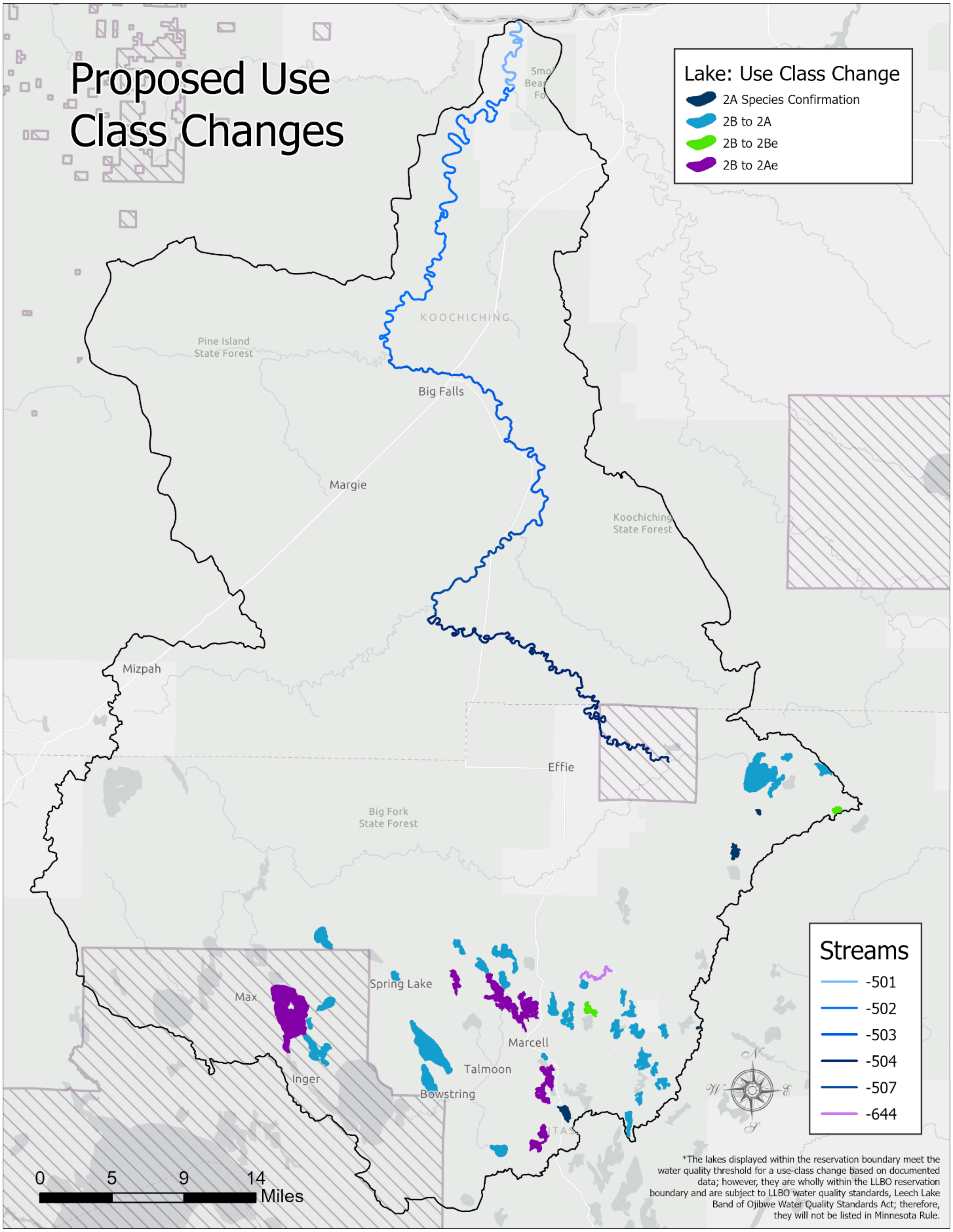
Table 5. Changes in proposed designated use-class in Big Fork River Watershed lakes.

Lake ID	Lake Name	Use-Class	Changes Proposed	Lakes with the LLBO Reservation Boundary; LLBO Designation
31-0160-00	Mirror	2B	2Be	No
31-0826-00	Sand*	2B	2Ae (Cisco)	Yes; 2A (Lake Whitefish)
31-0725-00	Turtle	2B	2Ae (Whitefish & Cisco)	No
31-0793-00	Big Too Much	2B	2Ae (Cisco)	No
31-0654-00	Burns	2B	2Be	No
31-0540-00	Clubhouse	2B	2Ae (Cisco)	No
31-0653-00	North Star	2B	2Ae (Cisco)	No
31-0624-01 & -02	Grave	2B	2Ae (Cisco)	No
31-0620-00	Caribou	2A (Lake Trout)	SC (Species Confirmation)	No
31-0704-00	Batson	2B	2A (Cisco)	No
31-0726-00	Bello	2B	2A (Cisco)	No
31-0834-00	Bird's Eye*	2B	2A (Cisco)	Yes; 2A (Lake Whitefish)
31-0829-00	Cedar*	2B	2A (Cisco)	Yes; 2A (Lake Whitefish)
31-0334-00	Deer	2B	2A (Cisco)	No
31-0460-00	East	2B	2A (Cisco)	No
31-0490-00	Elizabeth	2B	2A (Cisco)	No
31-0311-00	Erskine	2A (Stream Trout)	SC (Species Confirmation)	No
31-0183-00	Five Island	2B	2A (Cisco)	No
31-0463-00	Fox	2B	2A (Cisco)	No
31-0480-00	Gunn	2B	2A (Cisco)	No
31-0452-00	Gunn	2B	2A (Cisco)	No
31-0771-00	Hatch	2B	2A (Cisco)	No
31-0481-00	Highland	2B	2A (Cisco)	No
31-0466-00	Horseshoe	2B	2A (Cisco)	No

Lake ID	Lake Name	Use-Class	Changes Proposed	Lakes with the LLBO Reservation Boundary; LLBO Designation
31-0657-00, -01, -02	Jack the Horse	2B	2A (Cisco)	No
31-0786-00	Jessie	2B	2A (Cisco)	No
31-0687-00	Johnson	2B	2A (Cisco)	No
31-0317-00	Larson	2A (Stream Trout)	SC (Species Confirmation)	No
31-0758-00	Little Bowstring	2B	2A (Cisco)	No
31-0784-00	Little Jessie	2B	2A (Cisco)	No
31-0665-00	Little North Star	2B	2A (Cisco)	No
31-0781-00	Long	2B	2A (Cisco)	No
31-0773-00	Maple	2B	2A (Cisco)	No
31-0339-00	Pickerel	2B	2A (Cisco)	No
31-0196-00	Poplar	2B	2A (Cisco)	No
31-0824-00	Portage*	2B	2A (Cisco)	Yes; 2A (Lake Whitefish)
31-0422-00	Ruby	2B	2A (Cisco)	No
31-0832-00	Rush Island*	2B	2A (Cisco)	Yes; 2A (Lake Whitefish)
31-0502-00	Slauson	2B	2A (Cisco)	No
31-0789-00	Spring	2B	2A (Cisco)	No
31-0470-00	Unnamed (Nickel, Nichols)	2A (Stream Trout)	SC (Species Confirmation)	No
31-0843-00	Whitefish	2B	2A (Cisco)	No

*These lakes meet the water quality threshold for a use-class change based on documented data; however, they are wholly within the LLBO reservation boundary and are subject to LLBO water quality standards, Leech Lake Band of Ojibwe Water Quality Standards Act; therefore, they will not be listed in Minnesota Rule.

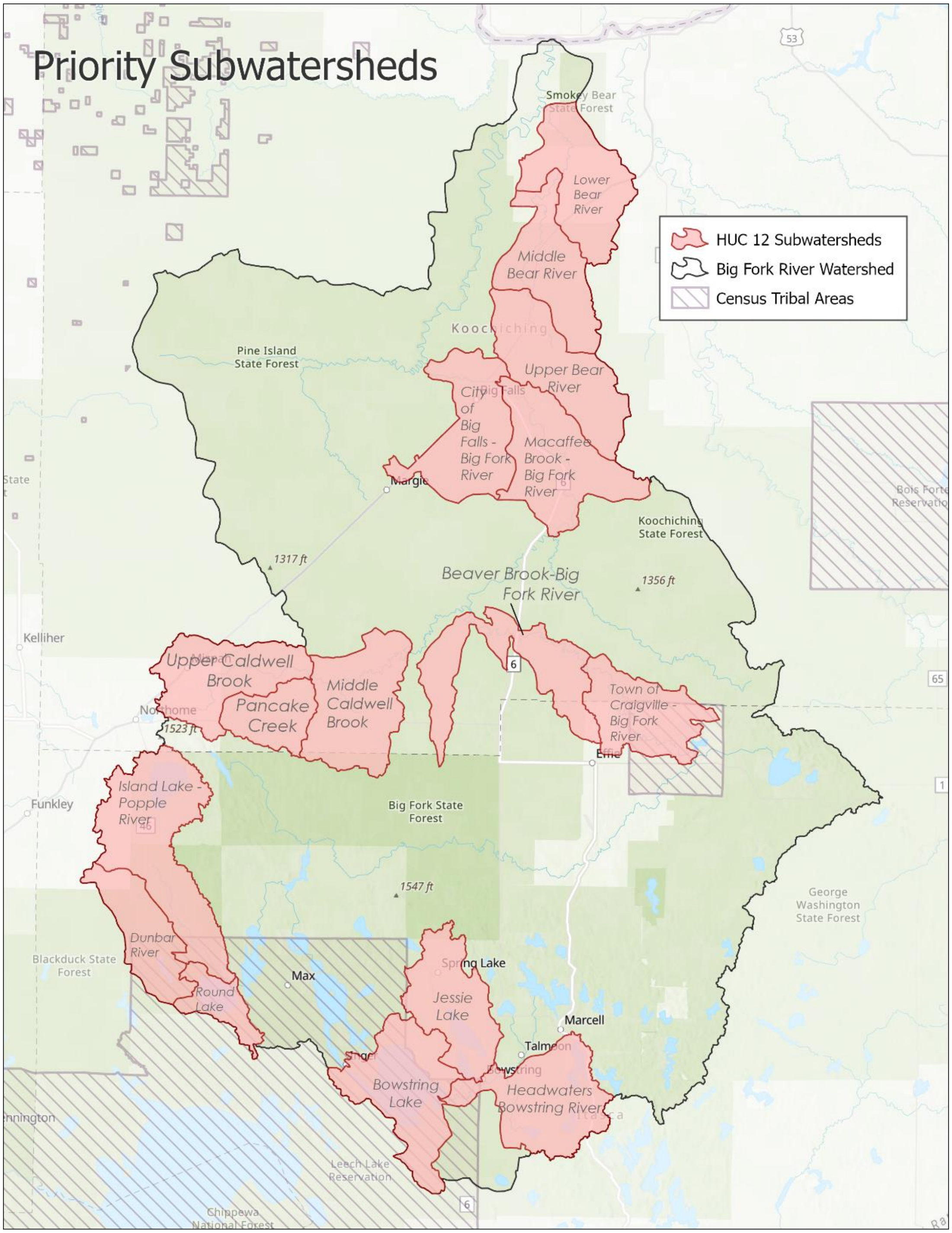
Figure 12. Changes in proposed designated use class in Big Fork River Watershed lakes and streams.



4.3 Priority Subwatersheds

Priority subwatersheds of the BFRW were selected as focus areas for additional study. Figure 13 is a map of the subwatersheds that were selected by the BFRW core team based on the assessment results for water bodies that are impaired or vulnerable to impairment.

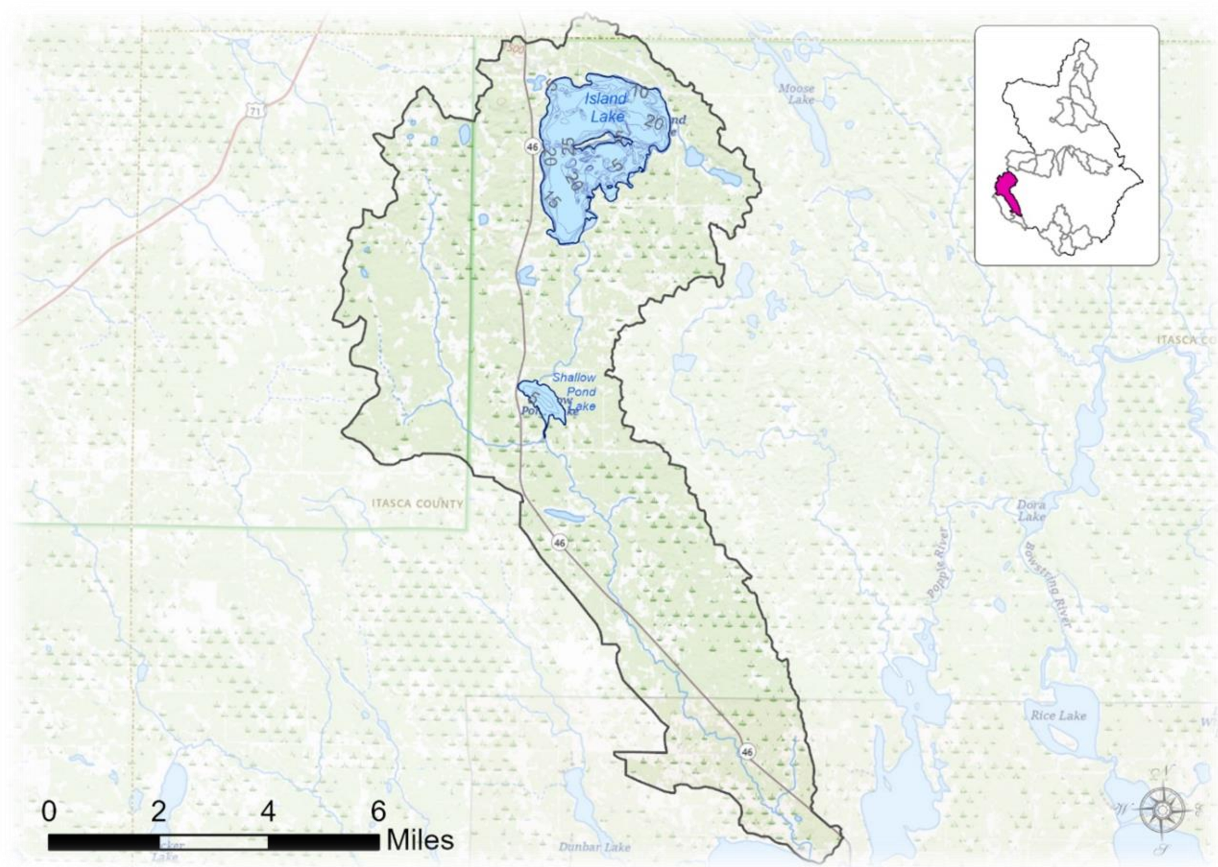
Figure 13. Priority HUC-12 subwatersheds.



Subwatershed: Island Lake – Popple River

The Island Lake – Popple River Subwatershed is a priority focus area because Island Lake and Shallow Pond lakes are impaired for excess nutrients and drain into Round Lake (which is another priority focus lake). Figure 14 is a map of the Island Lake – Popple River HUC-12 Subwatershed.

Figure 14. Island Lake – Popple River priority subwatershed.



Island Lake **(31-0913-00)**

Figure 15. The outlet of Island Lake. Photo Credit: MPCA

Island Lake is a priority focus lake and received a special phosphorus investigation study during the years of 2022 through 2024 by Itasca SWCD and MPCA. Island Lake is impaired by excess nutrients that leads to nuisance algal blooms. A TMDL was completed in 2017, [Island Lake Total Maximum Daily Load Report (state.mn.us)](). According to the 2023 assessment of Island Lake, the robust water quality dataset still indicates total phosphorus (TP) and chl-*a* standards are not attained; however, the Secchi disk readings are meeting standards. The nutrient eutrophication impairment remains in place. During the assessment window (2013 through 2022), TP consistently exceeded the eutrophication standard (30 µg/L) with a mean of 31.7 µg/L, which is an improvement from cycle 1, which was a mean of 34.9 µg/L. Chl-*a* is exceeding the eutrophication standard (9 µg/L) with a mean of 13.1 µg/L, which is an improvement from cycle 1, which was a mean of 16.2 µg/L. Nineteen Secchi measurements were taken over five separate years during the cycle 2 assessment window, resulting in a mean measurement of 3.0 m, which meets the standard (2.0 m) for Northern Lakes and Forest 2B lakes. The cycle 2 mean Secchi measurement of 3.0 m is an increase in clarity compared to the mean Secchi measurement from cycle 1 of 2.7 m.

The latest FIBI survey conducted on Island Lake was done in 2021, Island (31091300) | LakeFinder | Minnesota DNR. Select stressor information was reviewed for Island Lake: about 3% of the land use in the upstream watershed is classified as disturbed, with 2.7% developed, 1.8% pasture and hay, and <1% cultivated (NLCD 2016). Island Lake is fully supporting aquatic life use. Table 6 describes the physical characteristics of Island Lake from the Watershed Health Assessment Framework | Minnesota DNR.

Table 6. Island Lake characteristics (DNR 2024a).

Area (acres)	**3,108**
Lakeshed Area (acres)	**10,577**
Maximum Depth (feet)	**35**
Mean Depth (feet)	**15**
Littoral area (acres)	**1,203**
Shoreline (miles)	**14.3**
Managed fisheries lake	**Yes**
Lake finder	**Open Lake Finder to Lake**
Predicted TP Load (Pounds/year)	**1,418**
Phosphorus Load reduction goal (pounds/year)	**70**

The DNR Watershed Health Assessment Framework (WHAF) has given Island Lake an overall lake health score of 65 out of 100 (lake health grade is a B). Of the 137 lakes in the BFRW that were scored using the WHAF, Island Lake ranked 130 (1 having the best health score and 137 having the worst). The lake health score (0 to 100 scale) is an average of the water quality, biology, and hydrology scores. The water quality score is 32, the biology score is 60, and the hydrology score is 99. Figure 16 shows a graph of the lake health score. (DNR 2024a)

Figure 16. Island Lake health score (DNR 2024a).

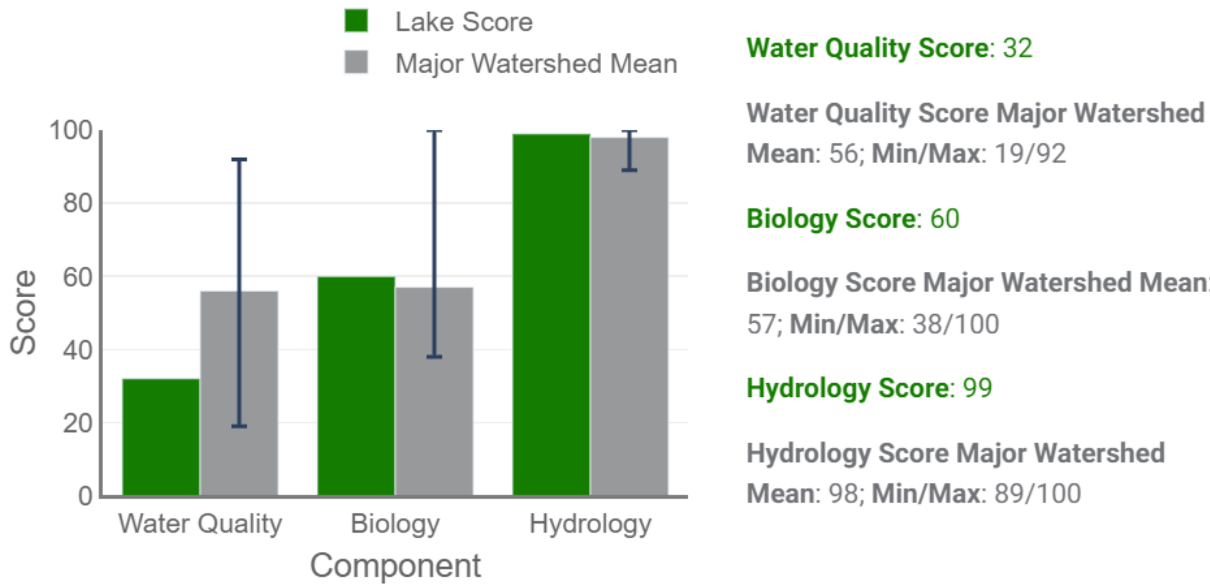
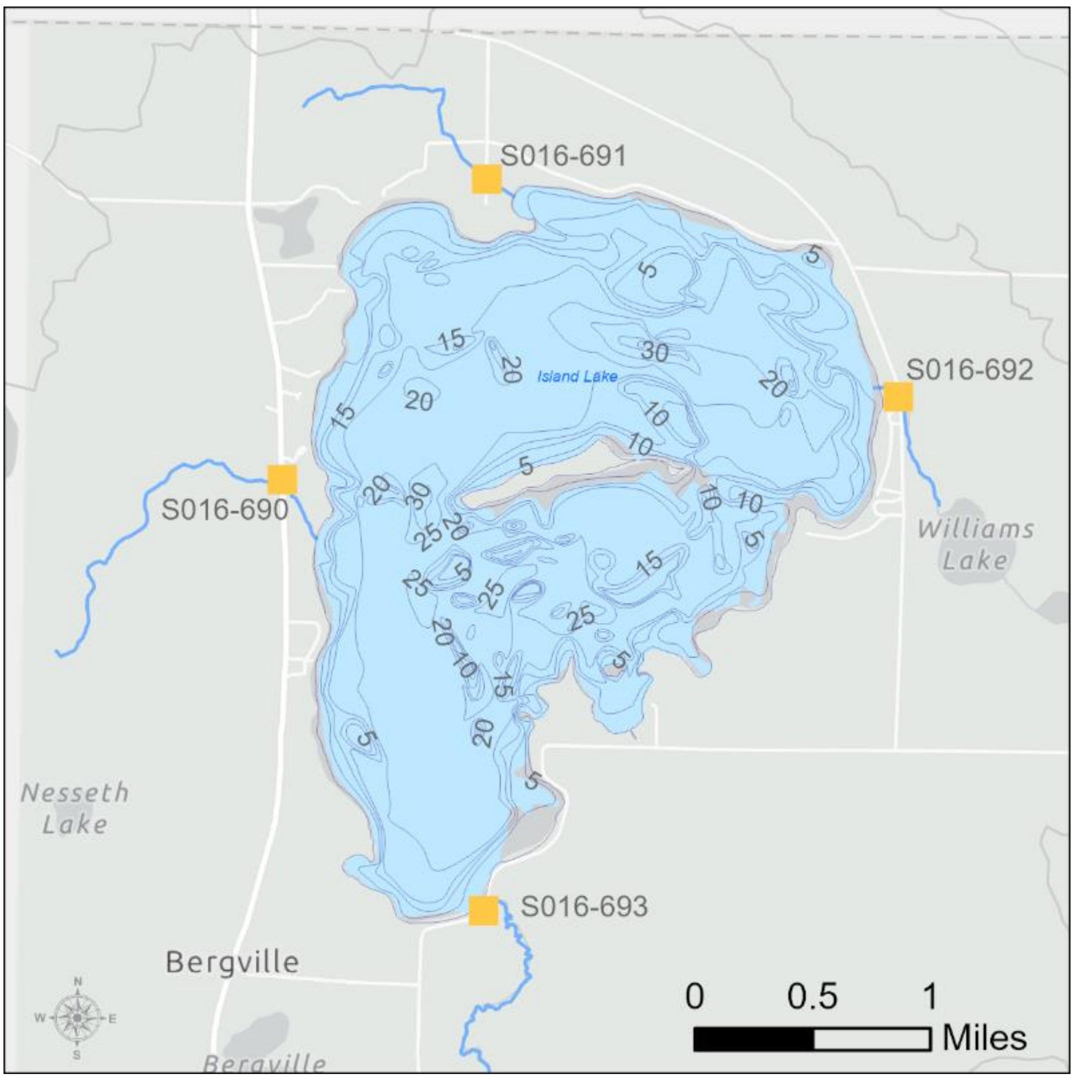


Figure 17. Island Lake tributaries and associated sampling sites



***Island Lake Phosphorus Investigation*.** Water quality data were collected on four tributaries to Island Lake as part of the 2022 through 2024 phosphorus loading investigation study. Tributary data collection was recommended in the TMDL under section 7.2 to gain a better understanding of watershed phosphorus loading to help define strategies for implementing restoration projects. Figure 17 shows the location of the three tributaries, the outlet, and their sampling points. Three of the tributaries are inlets to Island Lake (west S016-690, north S016-691, and east S016-692) and the fourth (south S016-693) is the outlet of Island Lake, which flows into Shallow Pond Lake. In each of the tributaries the following parameters were measured: TP, total suspended solids (TSS), DO, Secchi disk, temperature, pH and conductivity. Overall, the water flow in the tributaries was higher in the spring and early summer months and much lower to no flow into the mid-summer to fall months. Monitored TP concentrations in the west and east tributaries were almost identical. Mean TP concentrations for the north site were similar to the west and east sites but had a much narrower range (only three samples due to low/no flow). The 2022 mean TP of all three tributary sites (74 µg/L) was similar to the long-term mean TP concentration (81 µg/L) assumption used in the 2017 TMDL study. This suggests that the TMDL study likely provided a reasonable approximation of tributary phosphorus loading to Island Lake. Mean TP concentrations measured at the Island Lake outlet site were lower than all three tributaries indicating the lake is assimilating TP as expected.

Monitored TSS concentrations for the east tributary were occasionally high (mean = 8 mg/L; range = 1-32 mg/L) while the north (mean = 1 mg/L; range = 1-2 mg/L) and west (mean = 2 mg/L; range = 1-4 mg/L) tributaries were consistently lower. The TSS concentration of 32 mg/L from the east site was collected on October 14, 2022, after a 1” snow event. The increase in TSS could have been the result of the snowmelt and stirred up sediment that occurred above a beaver dam located upstream of the sample site. DO field measurements for the east and west tributaries were lower than the north tributary in 2022. However, it should be noted that no DO measurements were collected from the north tributary after the stream went stagnant from June through October. Figure 19 and Figure 20 show the two parameters of concern, TP and DO, on graphs.

Figure 18. The east Island Lake tributary (site S016-692). There were dozens of walleye, northern pike, and white sucker spawning in this tributary during a routine site visit in May 2022. Photo credit: MPCA and Itasca SWCD

Figure 19. 2022 TP levels in four Island Lake tributaries. The red line indicates the Minnesota river eutrophication standard (50 µg/L) for the northern river nutrient region. The west, north, and east sites are of concern.

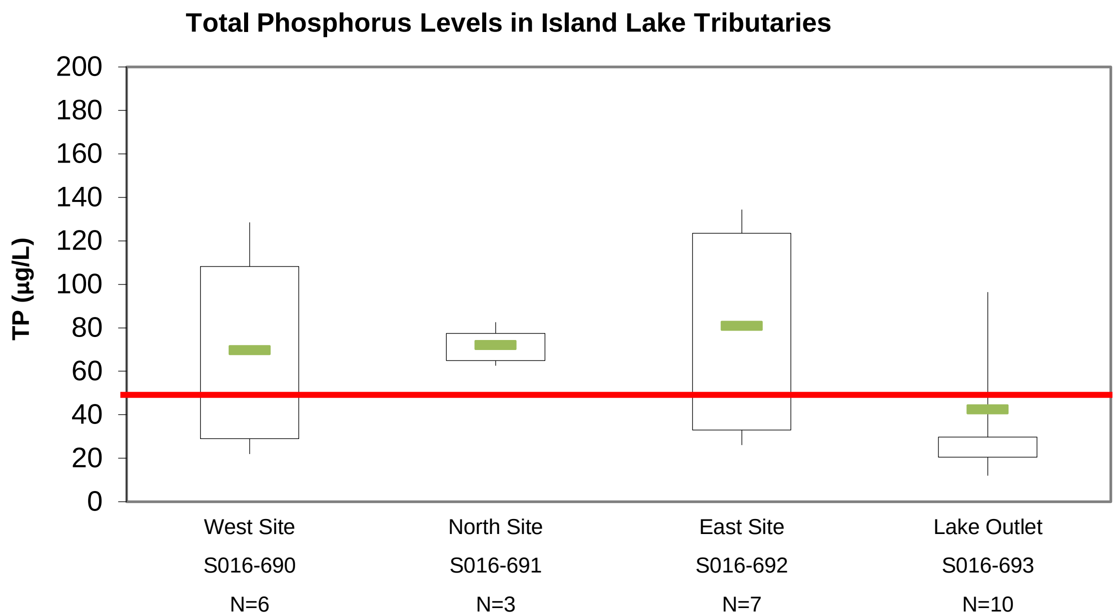
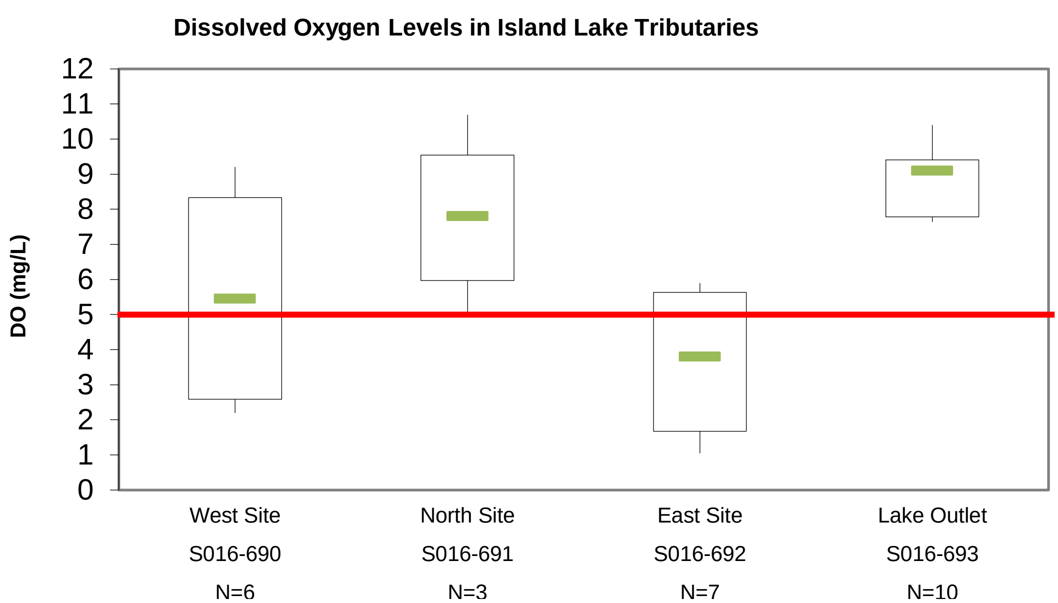


Figure 20. 2022 DO levels in four Island Lake tributaries. The red line indicates the Minnesota DO standard for class 2B waters, not less than 5 mg/L as a daily minimum. The west and east sites are of concern.
Forested wetlands within the drainage area to the west and east tributaries, combined with low/slow moving stream flows are likely the primary drivers of the occasional low-DO conditions observed at these sample sites.



Island Lake Score the Shore Study. MPCA and Itasca SWCD partnered to conduct a score the shore study on Island Lake following the DNR's Minnesota Lake Plant Survey Manual (DNR 2016). According to the DNR, "Score The Shore is a protocol developed to rapidly assess the quantity and integrity of lakeshore habitat. The survey is designed to assess differences in habitat between lakes and to detect changes over time" (DNR 2016). The survey can help gain an understanding of the health of the shoreline and aide in shoreline protection public outreach.

The results of the Score The Shore Study for the shoreland average was 28.23 (good), shoreline average was 30.27 (excellent), aquatic average 23.95 (fair), and the total lake average was 82.42 (good). Figure 21 explains the Score the Shore habitat zones and Figure 22 are photos of the shoreline during the study.

Figure 21. Score the Shore habitat zones and interpretation of Score the Shore data (DNR 2016).

Mean lakewide score	Mean Shoreland Score	Mean Shoreline Score	Mean Aquatic Score	Rating
90-100	30-33.3	30-33.3	30-33.3	Excellent
80-89	25-29	25-29	25-29	Good
70-79	20-24	20-24	20-24	Fair
<70	<20	<20	<20	Poor

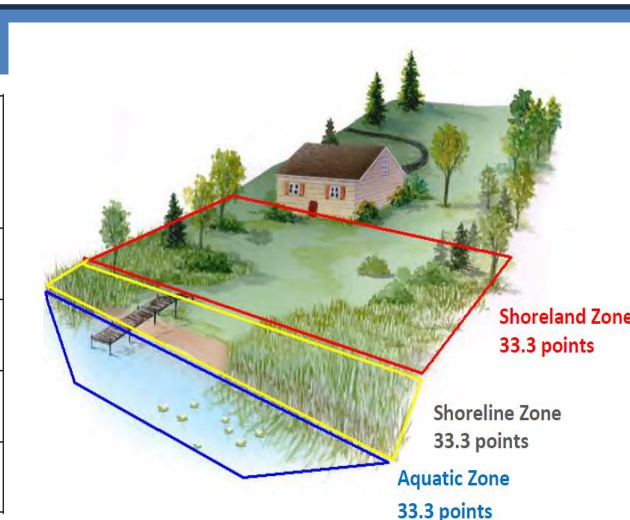
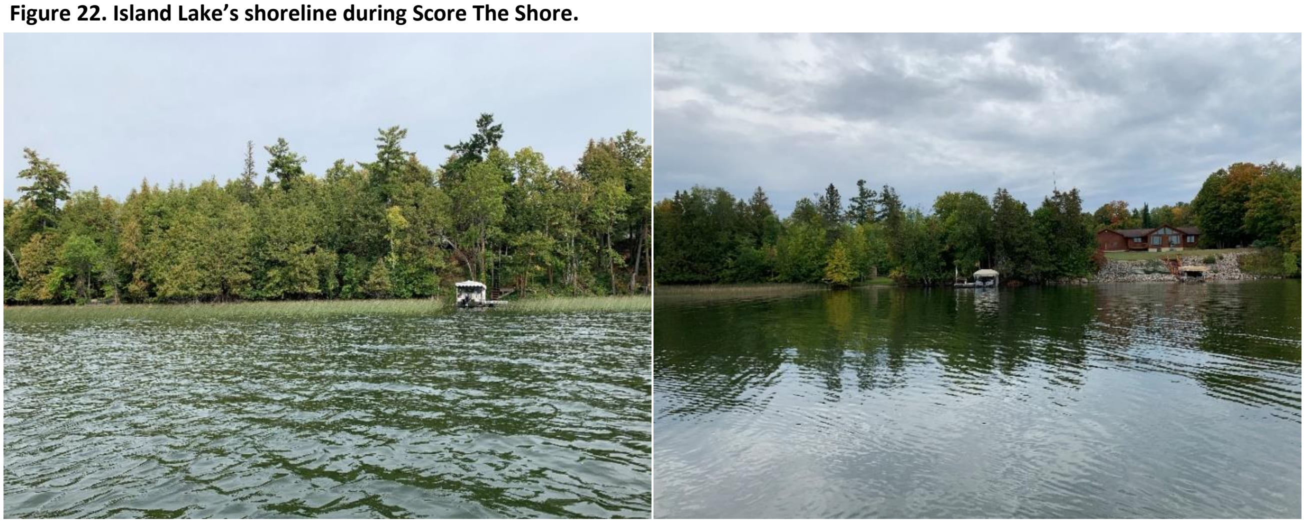


Figure 22. Island Lake's shoreline during Score The Shore.



***Shallow Pond* (31-0910-00)**

Shallow Pond is a priority focus lake and is impaired by excess nutrients. A TMDL study has not been completed yet, and it has been deferred until the shallow lake water quality standard is implemented for the northern lakes and forest ecoregion. Shallow Pond receives water from Island Lake through Unnamed Creek (Island Lake outlet) and connects to Round Lake via the Popple River. There was one year of water quality data collected on Shallow Pond in cycle 2. Over the assessment period (2013 through 2022), TP exceeded the eutrophication standard (30 ug/L) with a mean of 52 ug/L. Chl-*a* exceeded the eutrophication standard (9 ug/L) with a mean of 22.4 ug/L. Four Secchi measurements were taken over the assessment window resulting in a mean of 1.5m, also exceeding the standard (2.0 m) for northern lakes and forests ecoregion 2B lakes. As supplemental information, the most-recent University of Minnesota (U of M) remote sensing data, Minnesota LakeBrowser, also shows clarity of 1m to 2m over the summer of 2021 and the most-recent Citizen Lake Monitoring Program (CLMP) data has no evidence of a trend Volunteer monitoring reports and data | Minnesota Pollution Control Agency. This information confirms the existing aquatic recreation impairment from 2014.

Figure 23. Shallow Pond. Photo Credit: Itasca SWCD

The latest FIBI survey conducted on Shallow Pond was done in 2010, Shallow Pond (31091000) | LakeFinder | Minnesota DNR. Shallow Pond was fully supporting aquatic life use during cycle 1 assessments. Fish community data were compiled and scored with FIBI Tool 5, which was developed for lakes with characteristics similar to Shallow Pond Lake. The FIBI score of 43 from the recent survey was above the impairment threshold (24) and the upper limit of the 90% confidence interval (39).

The latest gill net and trap net survey was conducted in 2017; however, a FIBI survey was not conducted during this timeframe resulting in inconclusive data for assessment of Shallow Pond aquatic life in cycle 2. The most common species captured during the nearshore survey included bluegill, yellow perch, and largemouth bass. Northern pike, walleye and yellow perch comprised the most biomass in the gill nets and walleye and bowfin comprised the most biomass in the trap nets. Select stressor information was reviewed for Shallow Pond: about 5% of the land use in the upstream watershed is classified as disturbed, with 2.5% developed, 2.3% pasture and hay, and <1% cultivated (NLCD 2016). Shallow Pond data are inconclusive for aquatic life use. Table 7describes the physical characteristics of Shallow Pond from the Watershed Health Assessment Framework | Minnesota DNR.

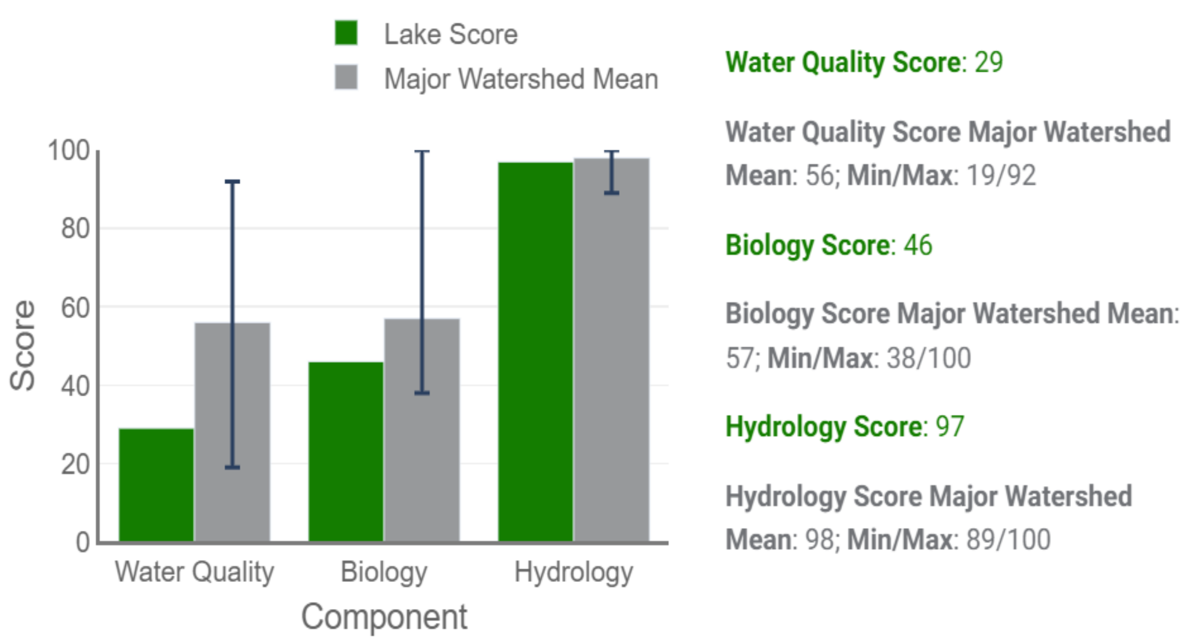
Table 7. Shallow Pond lake characteristics (DNR 2024a).

Area (acres)	**225**
Lakeshed Area (acres)	**16,801**
Maximum Depth (Feet)	**10**
Maximum Depth (Meters)	**3.0**
Mean Depth (Feet)	**4.0**
Mean depth (meters)	**1.2**
Littoral area (acres)	**225**
Shoreline (miles)	**3.9**
Managed fisheries lake	**Yes**
Lake finder	**Open Lake Finder to Lake**
Predicated TP Load (pounds/year)	**2,150**
Phosphorus Load Reduction Goal (pounds/year)	**110**

The WHAF has given Shallow Pond an overall lake health score of 60 out of 100 (lake health grade of C+). Of the 137 lakes scored in the BFRW, Shallow Pond is ranked 132 (with 1 having the best health score and 137 having the worst). The lake health score (0 to 100 scale) is an average of the water quality, biology, and hydrology score.

The water quality score is 29, the biology score is 46, and the hydrology score is 97. Figure 24 shows a graph of the lake health score (DNR 2024a).

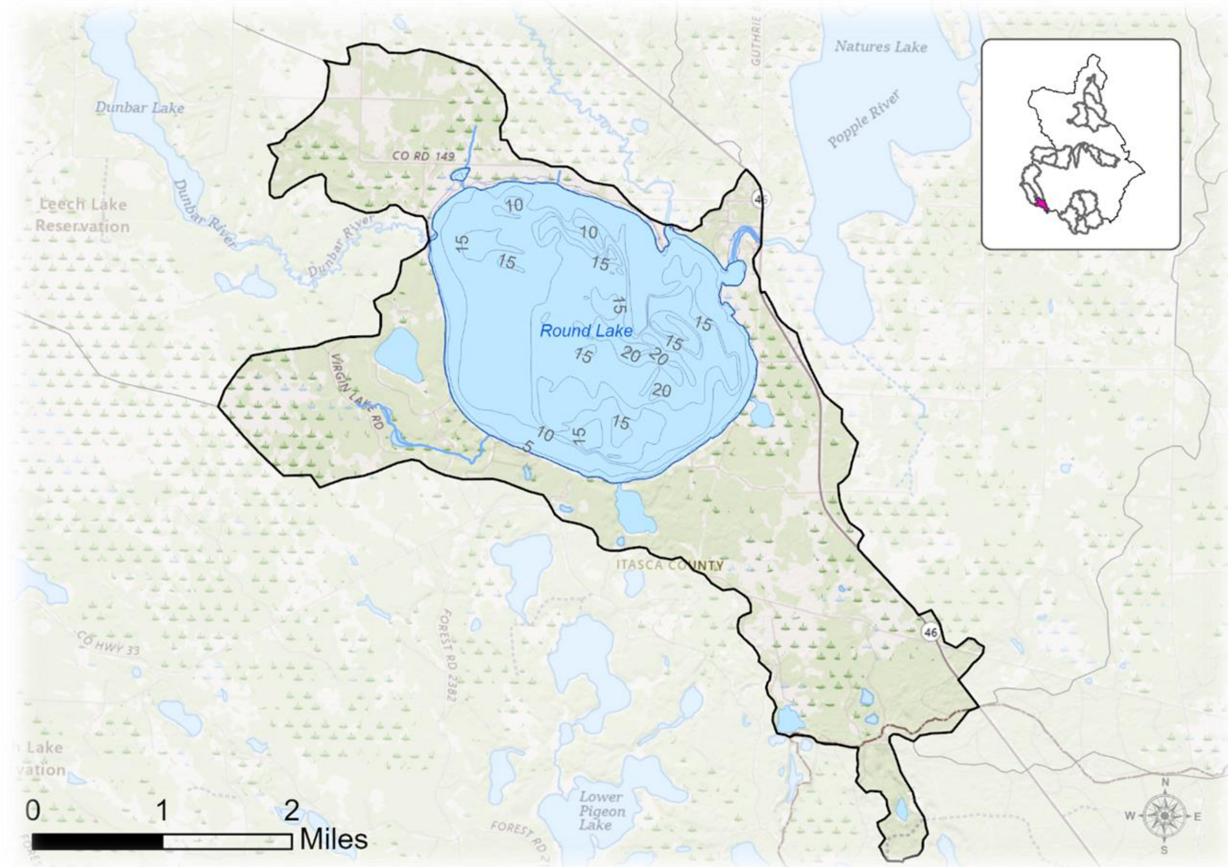
Figure 24. Shallow Pond health score (DNR 2024a).



Subwatershed: Round Lake

The Round Lake Subwatershed is a priority focus area in cycle 2 because Round Lake is potentially impaired by excess nutrients. Figure 25 is a map of the Round Lake HUC-12 Subwatershed.

Figure 25. Round Lake priority subwatershed.



***Round Lake* (31-0896-00)**

In partnership with LLBO, Round Lake was assessed in cycle 2 as potentially having impaired aquatic recreation due to excess nutrients; however, considering this body of water is located wholly within the Leech Lake Reservation, an impairment has not yet been designated and will be determined by EPA based on LLBO water quality data at a future date. The MPCA sent a list of such waters to the EPA, separate from the IWL but accompanying the IWL and included the following statement: "This assessment list was prepared under authority in state law to determine whether waters within the state are impaired. For purposes of the 303(d) list, these assessments are advisory to EPA only because these water bodies are located wholly within a federally recognized Indian reservation and EPA has stated that it does not approve the State's IWL for waters that are partially or wholly within the boundaries of an Indian reservation". Round Lake had a full aquatic recreation assessment in 2007; it was sampled for just one year in cycle 2 IWM as a check-up.

Over the assessment period (2013 through 2022), TP exceeded the eutrophication standard (30 ug/L) with a mean of 53.3 ug/L. Chl-*a* exceeded the eutrophication standard (9 ug/L) with a mean of 27.4 ug/L. Four Secchi disk measurements were taken over the assessment window resulting in a mean of 1.8 m, also exceeding the standard for northern lakes and forest ecoregion 2B lakes (2.0 m). As supplemental information, the most-recent U of M remote sensing data, Minnesota LakeBrowser, also shows poor clarity (0.5 to 1 m) over the summer of 2021 and the most-recent CLMP data has no evidence of a trend, Volunteer monitoring reports and data | Minnesota Pollution Control Agency. This information confirms the existing aquatic recreation impairment from 2008.

The most recent fish survey was conducted by DNR in 2019 and 2022, Round (31089600) | LakeFinder | Minnesota DNR. Select stressor information was reviewed for Round Lake: about 4% of the land use in the upstream watershed is classified as disturbed, with 2% developed, 1.7% pasture and hay, and <1% cultivated (NLCD 2016). One Score the Shore survey was completed to assess shoreline habitat in 2020 resulted in mean lakewide habitat score of 81 out of 100, indicating overall moderate quality lakeshore condition. Approximately 28% of the sites were developed. Developed sites generally scored lower, with a mean score of 59, while undeveloped sites had a mean score of 89. Review from 2020 Google imagery indicates that approximately 42 docks (4 docks per mile of shoreline) were present on the lake at that time. One floating-leaf and emergent mapping survey was completed in 2020 with 175 acres of emergent plants (93 acres of bulrush) and 27 acres of floating-leaf plants. Round Lake data are inconclusive for aquatic life use. Table 8 describes the physical characteristics of Round Lake from the Watershed Health Assessment Framework | Minnesota DNR.

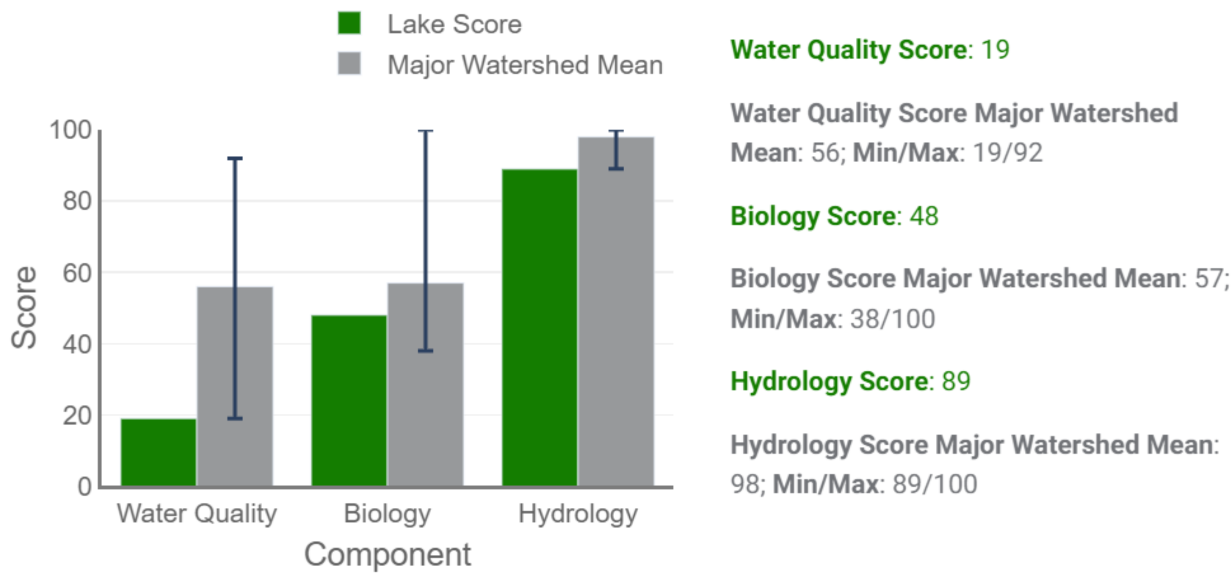
A lake study is planned to be completed in partnership with LLBO on Round Lake in the near future to help identify phosphorus sources and develop a water quality goal for protecting Round Lake.

Table 8. Round Lake characteristics (DNR 2024a).

Area (acres)	**2,860**
Lakeshed Area (acres)	**66,434**
Maximum Depth (Feet)	**24**
Maximum Depth (Meters)	**7.3**
Mean Depth (Feet)	**12**
Mean depth (meters)	**3.7**
Littoral area (acres)	**1,948**
Shoreline (miles)	**10.7**
Managed fisheries lake	**Yes**
Lake finder	**Open Lake Finder to Lake**
Predicted TP Load (Pounds/year)	**13,660**
Phosphorus Load reduction goal (lbs/year)	**680**

The WHAF has given Round Lake an overall lake health score of 50 out of 100 (lake health grade of C). Of the 137 lakes scored in the BFRW, Round Lake is ranked 137 (with 1 having the best health score and 137 having the worst). The lake health score (0 to 100 scale) is an average of the water quality, biology, and hydrology score. The water quality score is 19, the biology score is 48, and the hydrology score is 89. Figure 26 shows a graph of the lake health score (DNR 2024a).

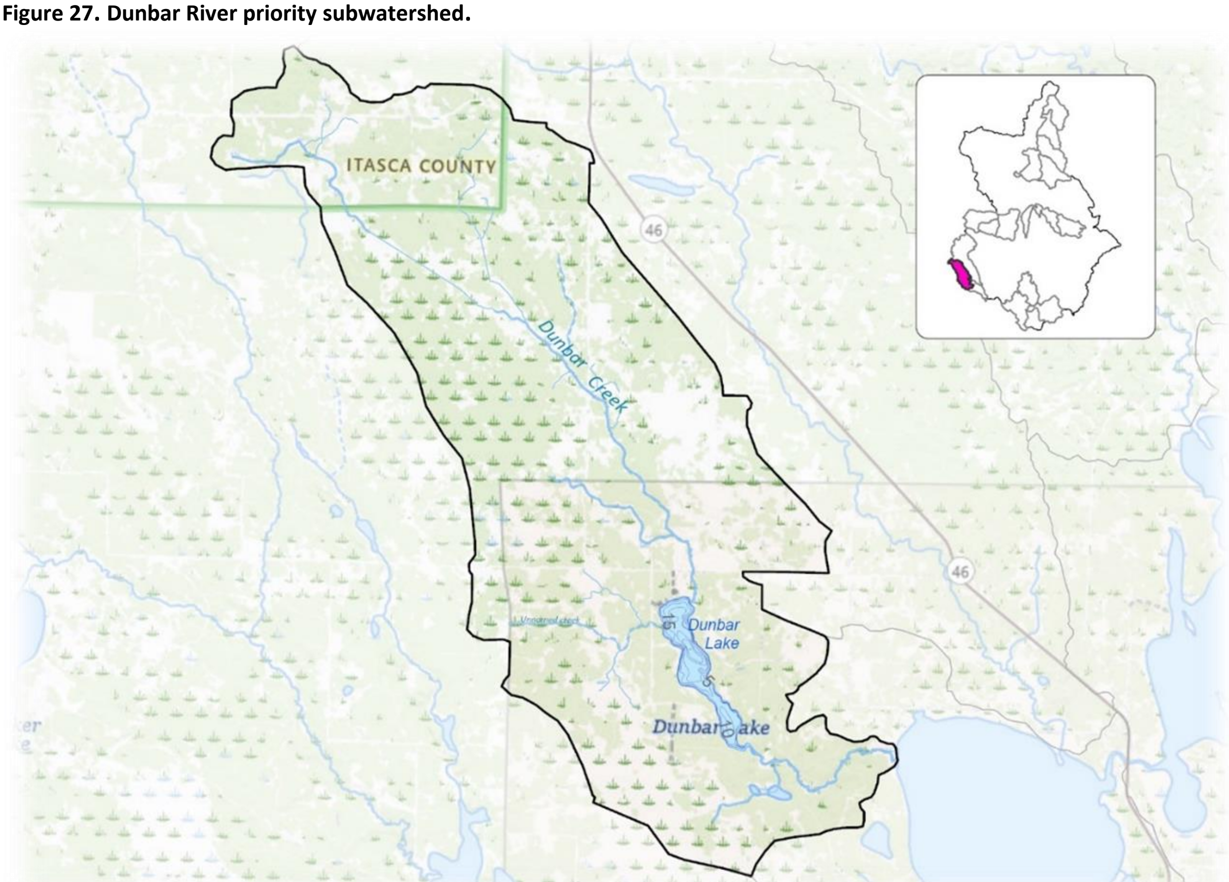
Figure 26. Round lake health score (DNR 2024a)



Subwatershed: *Dunbar River*

The Dunbar River Subwatershed is a priority focus area in cycle 2 because Dunbar Lake is potentially impaired by excess nutrients. Dunbar Lake and Dunbar River flow into Round Lake (which is also a priority focus lake). Figure 27 is a map of the Dunbar River HUC-12 Subwatershed.

Figure 27. Dunbar River priority subwatershed.



***Dunbar Lake* (31-0904-00)**

In partnership with LLBO, Dunbar Lake was assessed in cycle 2 as potentially having impaired aquatic recreation due to excess nutrients; however, considering this body of water is located wholly within the Leech Lake Reservation, an impairment has not yet been designated and will be determined by EPA based on LLBO water quality data at a future date. The MPCA sent a list of such waters to EPA, separate from the IWL but accompanying the IWL list and included the following statement: "This assessment list was prepared under authority in state law to determine whether waters within the state are impaired. For purposes of the 303(d) list, these assessments are advisory to EPA only because these water bodies are located wholly within a federally recognized Indian reservation and EPA has stated that it does not approve the State's IWL for waters that are partially or wholly within the boundaries of an Indian reservation".

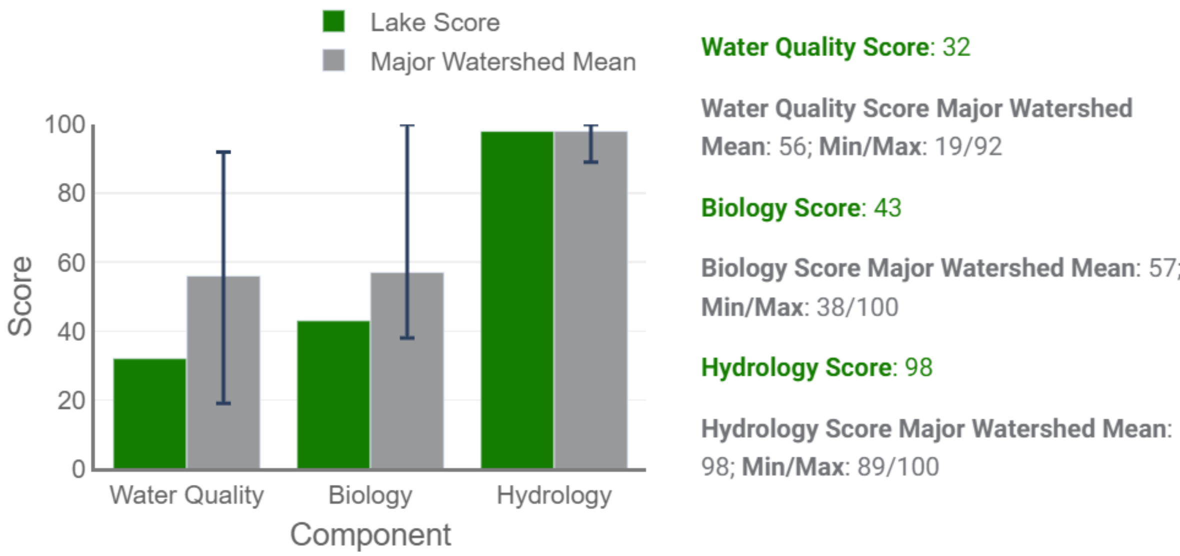
Dunbar Lake is exceeding all three MPCA's eutrophication standards, TP, chl-*a*, and Secchi disk transparency. Over the assessment period, TP exceeded the eutrophication standard with a mean of 37.1 ug/L, above the 30 ug/L standard. Chl-*a* exceeded the eutrophication standard (9 ug/L) with a mean of 14 ug/L. Eight Secchi disk measurements were taken over two recent years within the assessment window (2020-2021) resulting in a mean of 1.6 m, also exceeding the standard (2.0 m) for northern lakes and forest ecoregion 2B lakes. Select stressor information was reviewed for Dunbar Lake: about 5.5% of the land use in the upstream watershed is classified as disturbed, with 1.7% developed, 2.9% pasture and hay, and <1% cultivated (NLCD 2016).The most recent fish survey was conducted by DNR in 2011, Dunbar (31090400) | LakeFinder | Minnesota DNR, and because there is no recent FIBI survey data, Dunbar Lake is listed as having insufficient information based on the FIBI at this time. Dunbar Lake outlets to Dunbar River and flows into Round Lake. Table 9 describes the physical characteristics of Dunbar Lake from the Watershed Health Assessment Framework | Minnesota DNR.

Table 9. Dunbar Lake characteristics (DNR 2024a).

Area (acres)	**268**
Lakeshed Area (acres)	**16,279**
Maximum Depth (feet)	**30**
Mean Depth (feet)	**12**
Littoral area (acres)	**175**
Shoreline (miles)	**4.7**
Managed fisheries lake	**Yes**
Lake finder	Open Lake Finder to Lake
Predicted TP Load (lbs/year)	**2,010**
Phosphorus Load reduction goal (lbs/year)	**100**

The WHAF has given Dunbar Lake an overall lake health score of 60 out of 100 (lake health grade of C+). Of the 137 lakes scored in the BFRW, Dunbar Lake is ranked 129 (with 1 having the best health score and 137 having the worst). The lake health score (0 to 100 scale) is an average of the water quality, biology, and hydrology score. The water quality score is 32, the biology score is 43, and the hydrology score is 98. Figure 28 shows a graph of the Dunbar Lake health score (DNR 2024a).

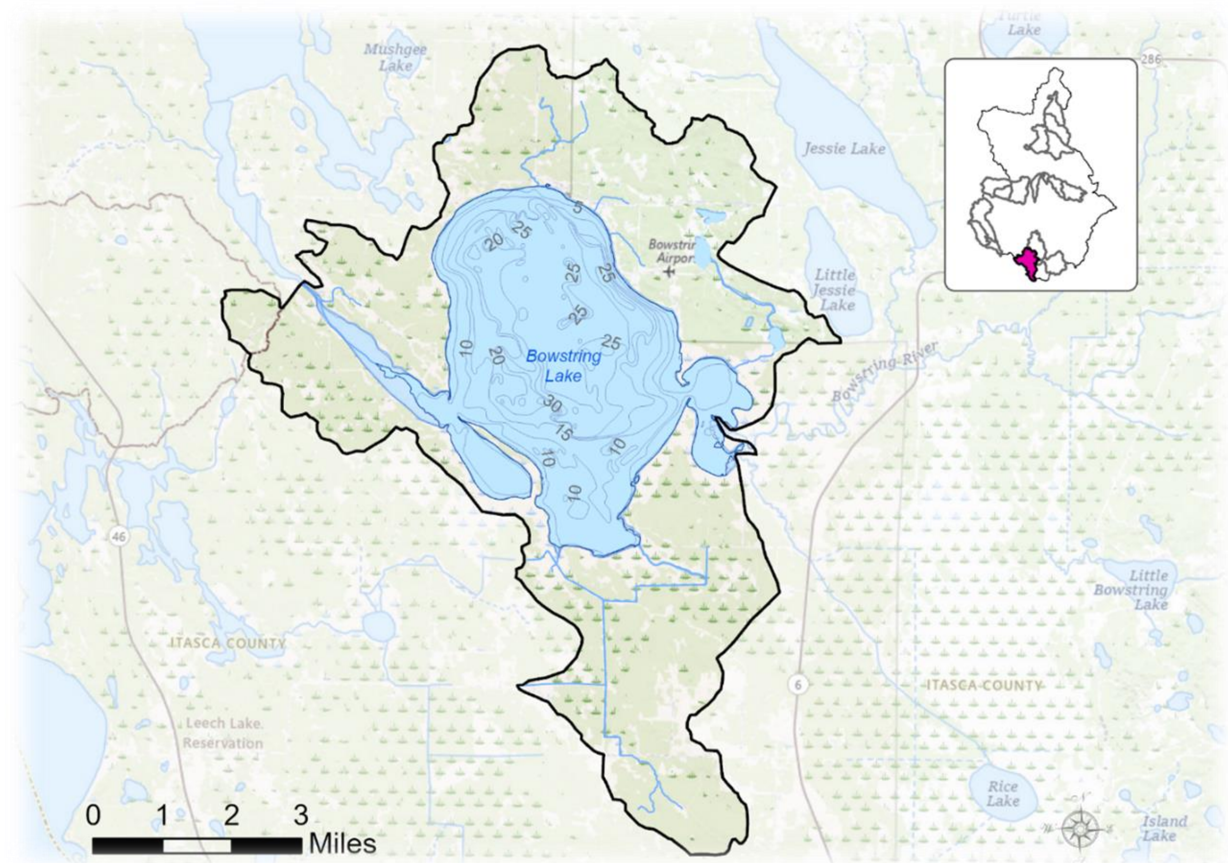
Figure 28. Dunbar Lake health score (DNR 2024a).



Subwatershed: Bowstring Lake

The Bowstring Lake Subwatershed is a priority focus area for cycle 2 because Bowstring Lake is potentially impaired by excess nutrients. Figure 29 is a map of Bowstring Lake HUC-12 Subwatershed. There are water bodies that drain into Bowstring Lake from outside of the HUC-12 Subwatershed as well.

Figure 29. Bowstring Lake priority subwatershed.



Bowstring Lake (31-0813-00)

In partnership with LLBO, Bowstring Lake was assessed in cycle 2 as potentially having impaired aquatic recreation due to excess nutrients; however, considering this body of water is located wholly within the Leech Lake Reservation, an impairment has not yet been designated and will be determined by EPA based on LLBO water quality data at a future date. The MPCA sent a list of such waters to EPA, separate from the IWL but accompanying the IWL and included the following statement: “This assessment list was prepared under authority in state law to determine whether waters within the state are impaired. For purposes of the 303(d) list, these assessments are advisory to EPA only because these water bodies are located wholly within a federally recognized Indian reservation and EPA has stated that it does not approve the State’s IWL for waters that are partially or wholly within the boundaries of an Indian reservation”.

Bowstring Lake had 45 Secchi measurements taken over five separate years through the assessment window resulting in a mean of 2.6 m, meeting the standard (2.0 m) for northern lakes and forest ecoregion 2B lakes. Transparency is the only aquatic recreation parameter meeting expectations on this lake; the other two, TP and chl-*a*, are not meeting expectations. Over the assessment period, TP exceeded the eutrophication standard (30 ug/L) with a mean of 31.1 ug/L. Chl-*a* exceeded the eutrophication standard (9 ug/L) with a mean of 11.2 ug/L. Both TP and chl-*a* are within the standard error of their respective standards, showing the lake has had noticeable improvement since the prior assessment in 2012. With TP and chl-*a* still both exceeding, however, this assessment confirms the existing aquatic recreation impairment from 2014.

The most recent fish survey was conducted by DNR in 2021, [Bowstring (31081300) | LakeFinder | Minnesota DNR]. Select stressor information was reviewed for Bowstring Lake: about 5% of the land use in the upstream watershed is classified as disturbed, with 3% developed, 1.8% pasture and hay, and <1% cultivated (NLCD 2016). Bowstring Lake is fully supporting aquatic life use. Table 10describes the physical characteristics of Bowstring Lake from the [Watershed Health Assessment Framework | Minnesota DNR].

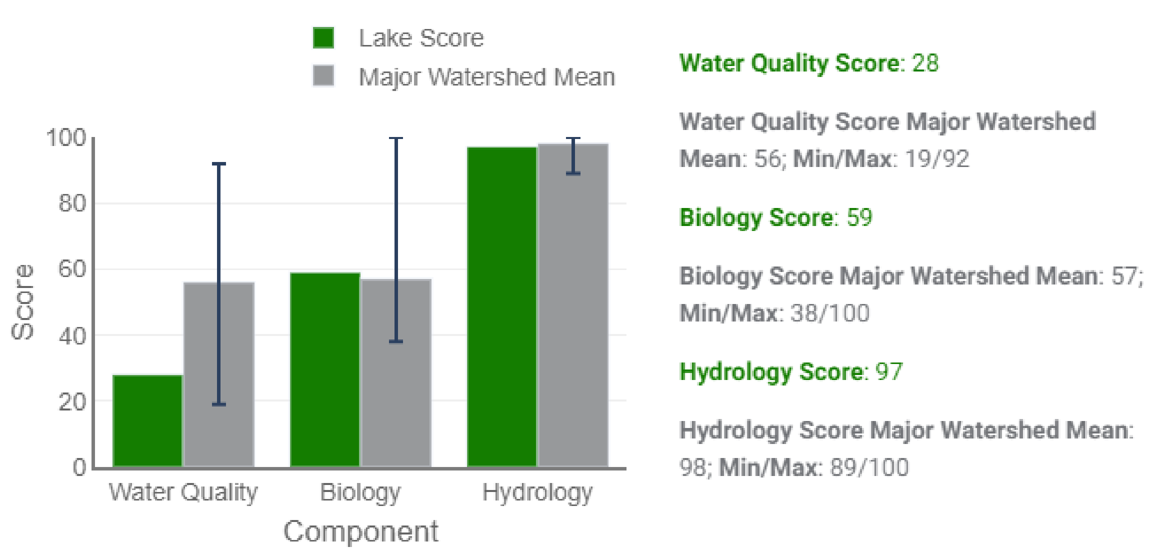
A lake study is planned to be completed in partnership with MPCA and LLBO on Bowstring Lake soon to help identify phosphorus sources and develop a water quality goal for protecting Bowstring Lake.

Table 10. Bowstring Lake characteristics (DNR 2024a).

Area (acres)	**9,528**
Lakeshed Area (acres)	**127,954**
Maximum Depth (feet)	**32**
Mean Depth (feet)	**15**
Littoral area (acres)	**4,893**
Shoreline (miles)	**34.1**
Managed fisheries lake	**Yes**
Lake finder	**Open Lake Finder to Lake**
Predicted TP Load (lbs/year)	19,390
Phosphorus Load reduction goal (lbs/year)	970

The WHAF has given Bowstring Lake an overall lake health score of 60 out of 100 (lake health grade of C+). Of the 137 lakes scored in the BFRW, Bowstring Lake is ranked 134 (with 1 having the best health score and 137 having the worst). The lake health score (0 to 100 scale) is an average of the water quality, biology, and hydrology score. The water quality score is 28, the biology score is 59, and the hydrology score is 97. Figure 30 shows a graph of the Dunbar Lake health score (DNR 2024a).

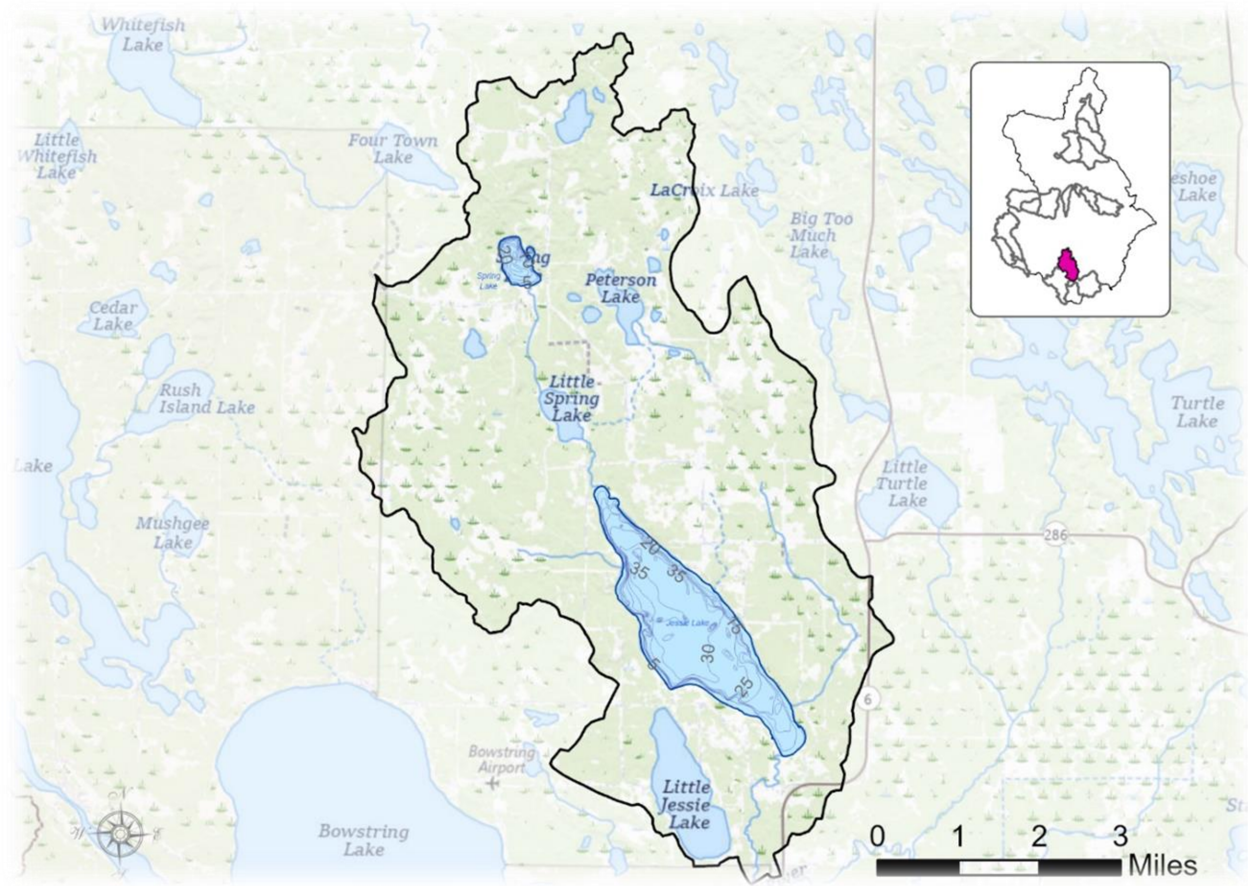
Figure 30. Bowstring Lake health score (DNR 2024a).



Subwatershed: *Jessie Lake*

Jessie Lake Subwatershed is a priority focus area for cycle 2. Jessie Lake and Little Spring lakes have impaired aquatic recreation. The subwatershed flows into Bowstring Lake (which is another priority focus lake), and Jessie Lake is a cold-water cisco species lake in need of protection. Figure 31 is a map of the Jessie Lake HUC-12 Subwatershed.

Figure 31. Jessie Lake priority subwatershed.



***Jessie Lake** (31-0786-00)*

Jessie Lake was assessed in cycle 2 as having impaired aquatic recreation due to excess nutrients. A TMDL was completed on Jessie Lake in 2011, Lake Nutrient TMDL for Jessie Lake. The recent robust dataset confirms the existing impairment still remains from 2004. Jesse Lake had 91 Secchi disk measurements taken over 10 separate years through the assessment window (2013 through 2022) resulting in a mean of 2.9 m, meeting the standard (2.0 m) for northern lakes and forest ecoregion 2B lakes. Transparency is the only aquatic recreation parameter meeting expectations on this lake, as it was in cycle 1 as well. Over the assessment period, TP exceeded the eutrophication standard (30 ug/L) with a mean of 52 ug/L. Chl-*a* exceeded the eutrophication standard (9 ug/L) with a mean of 17 ug/L. With TP and chl-*a* both exceeding expectations, this results in a nonsupport designation for aquatic recreation. Implementation activities that have occurred on Jessie Lake include:

1. May 2014, Jessie Lake. 150’ x 6’ shoreline buffer and shoreline stabilization.
2. Sept 2017, Jessie Lake. Shore stabilization and buffer, 60’ x 6’.

3. Oct 2017, Jessie Lake. 1,200 sq ft buffer planning.
4. Sept 2016, Jessie Lake. 100’ x 6’ buffer planting (plus 100’ x 20’ of riprap between buffer and lake).
5. May 2012. Tillys Creek (Unnamed creek, flows into NW area of Jessie Lake, near Tillys Rd). Creek bank restoration and buffer/stabilization. 60ft length of creek bank, 58ft deep.

The most recent FIBI survey was conducted by DNR in 2018, Jessie (31078600) | LakeFinder | Minnesota DNR. An additional survey was completed in August 2008 that is also provided as supplemental information. Select stressor information was reviewed for Jessie Lake: about 5% of the land use in the upstream watershed is classified as disturbed, with 2.9% developed, 2% pasture and hay, and <1% cultivated (NLCD 2016). Jessie Lake is fully supporting Aquatic Life Use. Jessie Lake’s outlet flows into Bowstring Lake. Table 11 describes the physical characteristics of Jessie Lake from the Watershed Health Assessment Framework | Minnesota DNR.

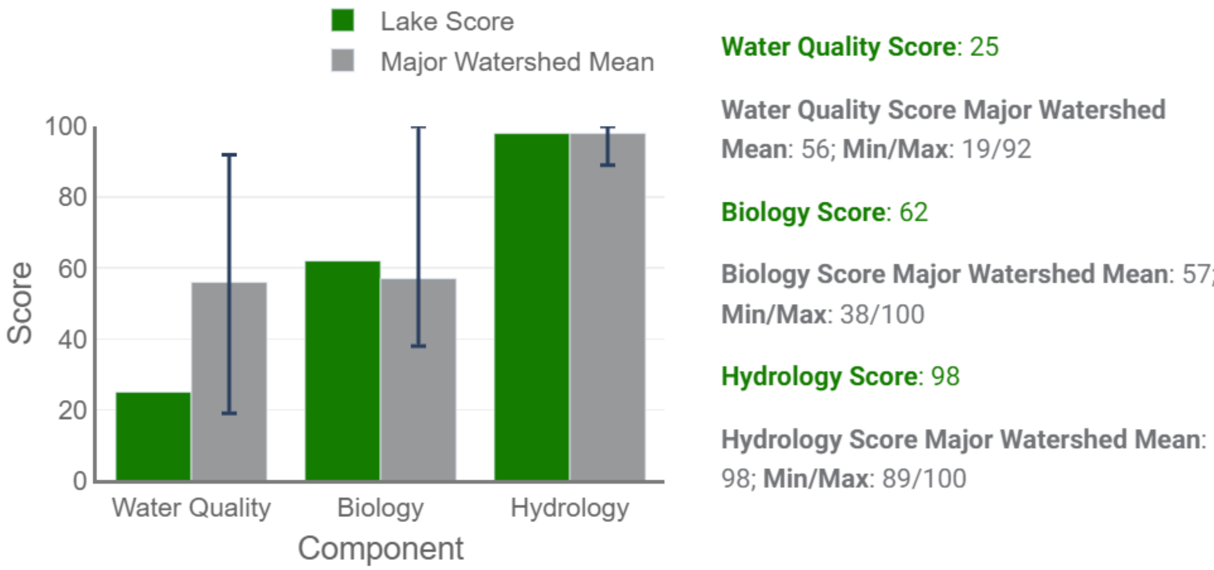
A special thanks goes out to the volunteer water quality monitor that took 27 consecutive years of water samples and Secchi disk measurements, Harold Goetzman and the Jessie Lake Watershed Association.

Table 11. Jessie Lake characteristics (DNR 2024a).

Area (acres)	**1,740**
Lakeshed Area (acres)	**17,189**
Maximum Depth (feet)	**40**
Mean Depth (feet)	**23**
Littoral area (acres)	**465**
Shoreline (miles)	**9.7**
Managed fisheries lake	**Yes**
Lake finder	**Open Lake Finder to Lake**
Predicted TP Load (lbs/year)	**3,320**
Phosphorus Load reduction goal (lbs/year)	**170**

The WHAF has given Jessie Lake an overall lake health score of 60 out of 100 (lake health grade of C+). Of the 137 lakes scored in the BFRW, Jessie Lake is ranked 136 (with 1 having the best health score and 137 having the worst). The lake health score (0 to 100 scale) is an average of the water quality, biology, and hydrology score. The water quality score is 25, the biology score is 62, and the hydrology score is 98. Figure 32 shows a graph of the Jessie Lake health score (DNR 2024a).

Figure 32. Jessie Lake health score (DNR 2024a)

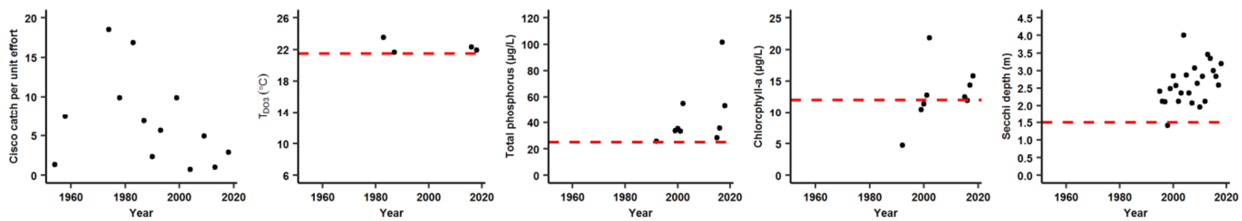


The following is an excerpt from the MPCA report on Development of Water Quality Standards to Protect Coldwater Lake Habitats in Minnesota explaining how Jessie Lake has a proposed use class change from warmwater to coldwater designation:

> "Jessie Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. It is not listed in Minnesota Department of Conservation (1967) as a trout lake. Lake trout were stocked from 1912-1945, but no lake trout have been sampled in 13 DNR fisheries surveys. There is no indication that this lake supports a population of lake trout, but surveys did demonstrate that a population of cisco are present. Cisco were sampled in all thirteen fisheries surveys. Considering this information, it is reasonable to designate Jessie Lake a Class 2A for the protection of coldwater aquatic life and habitat and assign protections for cisco (Class 2A [TLC]). Jessie Lake site-specific standard: Summer average estimates of TP (46 µg/L), chl-a (13 µg/L), and TDO3 (22.4 °C) for Jessie Lake currently exceed the recommended thresholds for these parameters despite DNR fisheries surveys consistently indicating the presence of a healthy population of cisco. Summer average Secchi depth is also good for this lake (2.6 m). There is also low disturbance (5.0%) in the watershed for this lake indicating that water quality in this lake is largely natural. Monitoring in this lake in 2001 and 2008 indicated that it has a good macrophyte community. The DNR also monitored the fish community in 2008 and 2018 and determined that Jessie Lake supports a healthy fish community. Recreational suitability data were collected from Jessie Lake from 1992-2019 on 135 days and >11% of the days had recreational suitability scores indicating non-attainment of recreation goals. Although chl-a and TP are elevated compared to the recommended eutrophication standard for northern stratified lakes, aquatic life (i.e., cisco, macrophytes, and fish community) and recreation measures demonstrate that this lake meets goals although recreational suitability may be threatened. However, watershed disturbance indicates watershed conditions in this lake are likely near natural conditions. Jessie Lake is in the Chippewa Plains and is relatively shallow and naturally fertile. The geometry ratio is also greater than 4 m-0.5, indicating that this lake may not be strongly stratified. As a result, it is reasonable to assign a SSS to this lake to address the atypical conditions which are suitable for the maintenance of a population

of cisco and other beneficial uses. At this time water quality goals for this lake should be based on near current conditions as these are attaining aquatic life and recreation goals. There are some indications that recreational suitability is degraded, and the cisco population may be declining. As a result, the recommended lake eutrophication standards for Jesse Lake are slightly below the current conditions for most parameters: TDO3 = 22.0 °C and TP = 45 µg/L. Standards for chl-*a* and Secchi depth would be unchanged from recommend thresholds. The average TDO3 value is based on a dataset consisting of 4 years of data and these measures consistently indicate TDO3 near 22-23 °C. Chl-*a* and TP estimates are based on data from 9 summers. However, additional sampling may indicate an adjustment to the recommended SSS will be required. Although beneficial uses in Jessie Lake are currently protected, water quality is potentially near thresholds that will result in the loss of these uses and this lake should therefore be considered vulnerable and in need of protection". (MPCA 2024c).

Figure 33. Annual water quality measures for Jessie Lake (31-0786-00). TDO3 is the maximum TDO3 measured during the period of maximum oxythermal stress for each year. TP, chl-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. (MPCA 2024c)



***Little Spring Lake* (31-0797-00)**

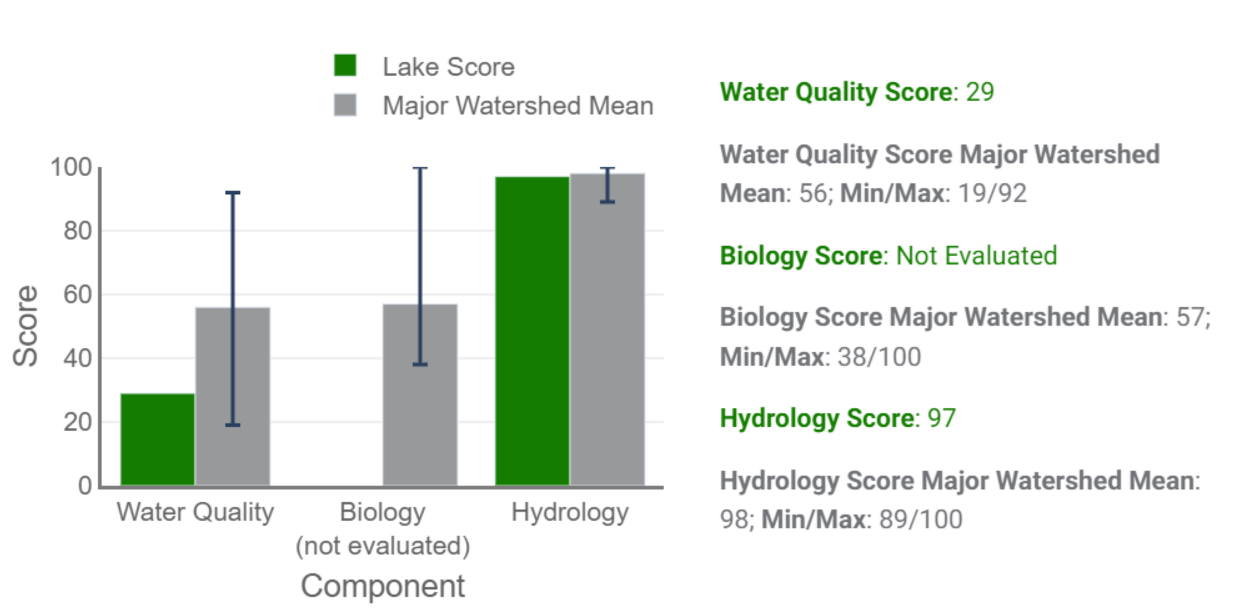
Little Spring Lake was not assessed in cycle 2; however, the nutrient impairment from cycle 1 remains. Little Spring Lake has impaired aquatic recreation due to excess nutrients. For more information on Little Spring Lake from cycle 1 assessments, please see Big Fork River Watershed Monitoring and Assessment Report. Table 12 displays the Little Spring Lake characteristics from the Watershed Health Assessment Framework | Minnesota DNR (DNR 2024a).

Table 12. Little Spring Lake characteristics (DNR 2024a).

Area (acres)	**136**
Lakeshed Area (acres)	**8,231**
Maximum Depth (feet)	**9**
Mean Depth (feet)	**5**
Littoral area (acres)	**136**
Shoreline (miles)	**2.2**
Managed fisheries lake	**Yes**
Lake finder	**Open Lake Find to Lake**
Predicted TP Load (lbs/year)	**1,320**
Phosphorus Load reduction goal (lbs/year)	**70**

The WHAF has given Little Spring Lake an overall lake health score of 65 out of 100 (lake health grade of B). Of the 137 lakes scored in the BFRW, Little Spring is ranked 133 (with 1 having the best health score and 137 having the worst). The lake health score (0 to 100 scale) is an average of the water quality, biology, and hydrology score. The water quality score is 29, the biology score was not evaluated, and the hydrology score is 97. Figure 34 shows a graph of the Little Spring Lake health score (DNR 2024a).

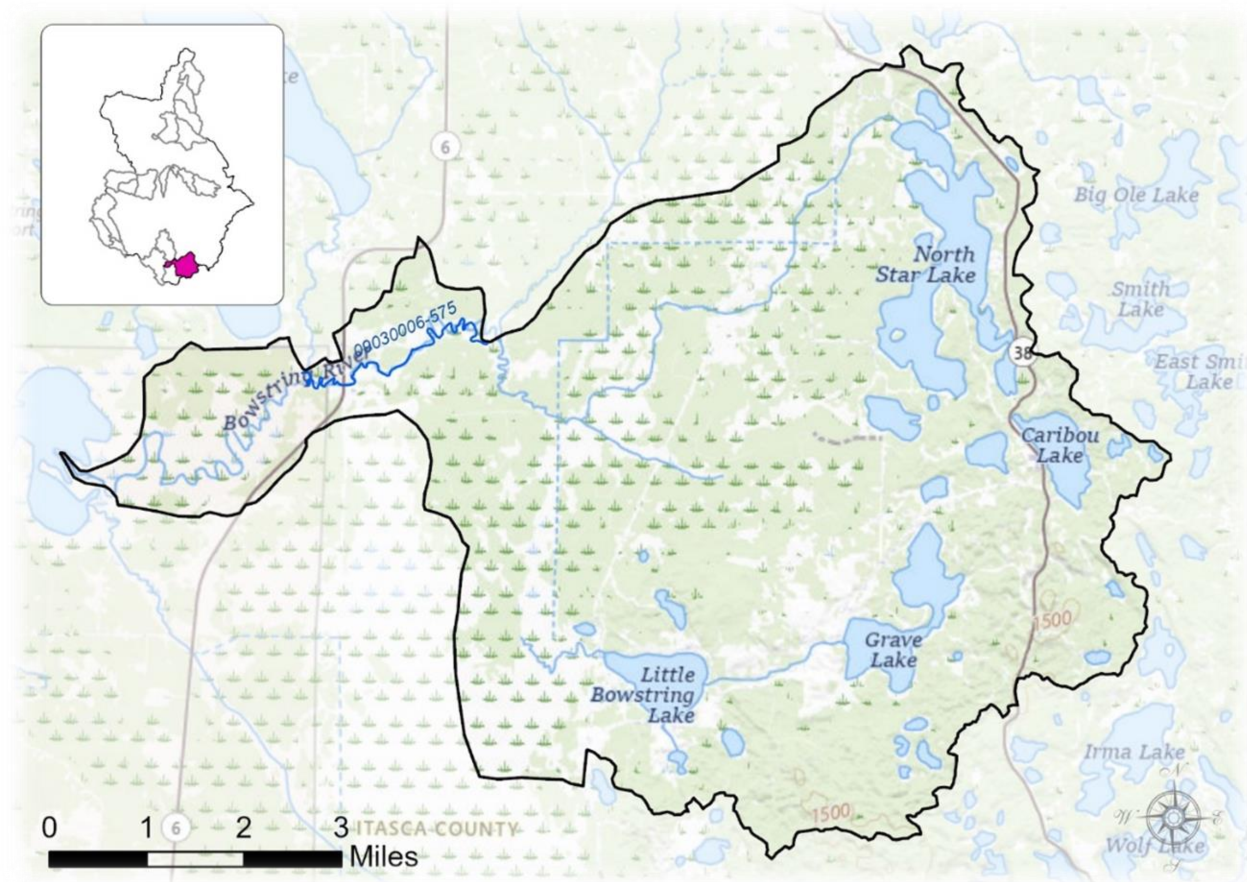
Figure 34. Little Spring Lake health score (DNR 2024a).



Subwatershed: Headwaters Bowstring River

The Headwaters Bowstring River Subwatershed is a priority during cycle 2 because it flows into Bowstring Lake (which is a priority lake) and the Bowstring River is nearly impaired by *E. coli*. Figure 35 is a map of the Headwaters Bowstring River HUC-12 Subwatershed.

Figure 35. Headwaters Bowstring River priority subwatershed.



Bowstring River (09030006-575)

The section of the Bowstring River from Turtle River to Jesse Brook was assessed in cycle 2. Bowstring River is located partially within the Leech Lake Reservation and is subject to both LLBO and State of Minnesota water quality standards. The assessment results show that Bowstring River is meeting water quality standards for aquatic life use but data are incomplete for the aquatic recreation use. It was determined that more *E. coli* samples were needed to complete the assessment. From *E. coli* data collected in 2020 and 2021, there were no exceedances of the individual *E. coli* standard (1260/100mL). One geometric monthly mean had a sufficient number of samples (5) to use for aquatic recreation assessment. June exceeded the 126/100mL geometric monthly mean *E. coli* standard with 128/100mL. Though July is short of the number of samples, it was approaching the exceedance threshold with a geomean of 147/100mL.

It was determined more *E. coli* data would need to be collected to help determine if there is an impairment. Table 13 shows the 2024 *E. coli* data in addition to the *E. coli* data collected during IWM in the years of 2020 and 2021. Overall, the 2024 data collected shows lower levels than the previous data collected during the assessment window (2013 through 2022). The Minnesota *E. coli* standard is not to exceed the monthly geometric mean of 126 organisms per 100 mL or not to exceed the individual standard of 1260 organisms per 100 mL (MPCA 2024a).

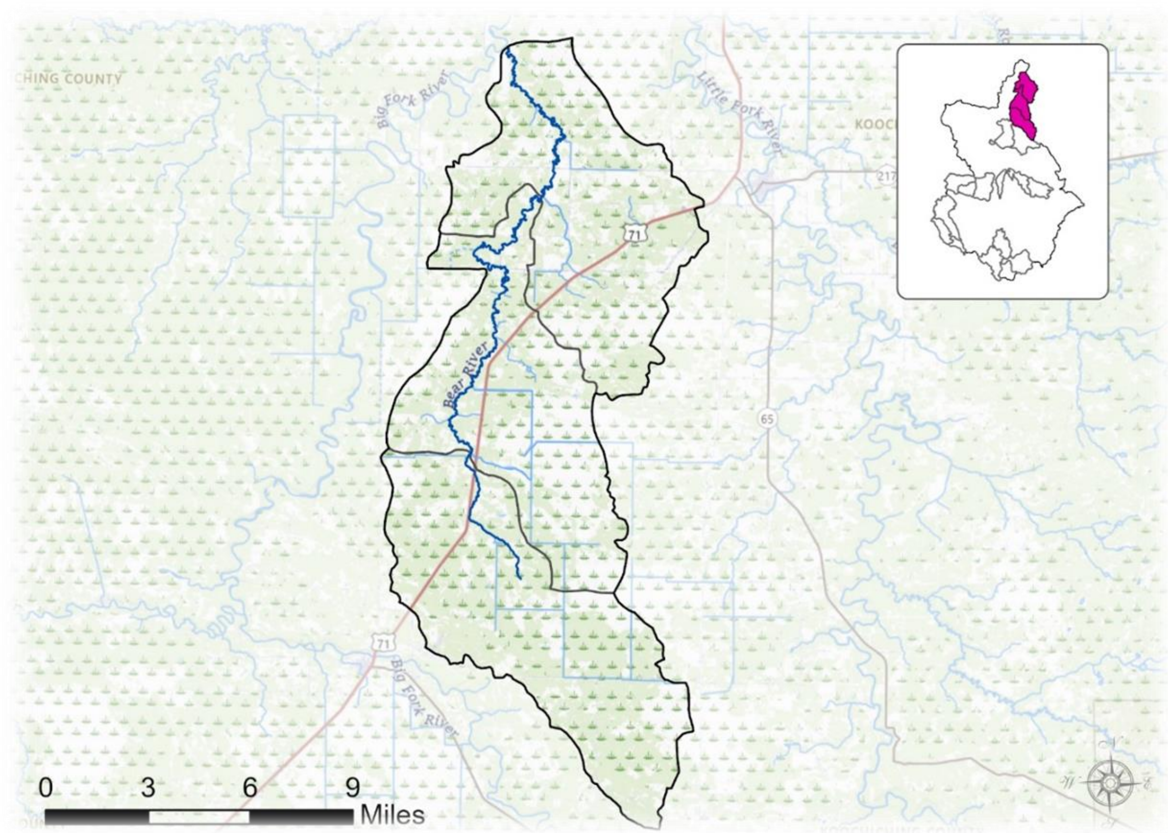
Table 13. Bowstring River *E. coli* data from station S011-617, Bowstring River at Hwy 6

Station ID	Date	Time	*E. coli* MPN/100 ml
S006-212	6/2/2020	11:40:00	291
S006-212	8/20/2020	10:30:00	45.5
S006-212	8/12/2020	10:00:00	83.3
S006-212	7/29/2020	10:55:00	120
S006-212	6/17/2020	10:45:00	345
S006-212	6/24/2020	10:50:00	58.6
S006-212	7/8/2020	11:05:00	219
S006-212	8/5/2020	10:45:00	58.3
S006-212	7/15/2020	11:10:00	122
S006-212	6/8/2021	11:17:00	166.4
S006-212	6/23/2021	10:32:00	36.4
S006-212	7/6/2021	9:41:00	30.5
S006-212	7/28/2021	10:45:00	16
S006-212	8/4/2021	10:43:00	25.9
S006-212	8/25/2021	10:30:00	12.8
S006-212	5/30/2024	12:45:00	35.4
S006-212	7/1/2024	12:30:00	51.2
S006-212	8/1/2024	13:05:00	172.6
S006-212	8/22/2024	14:00:00	41.4
S006-212	9/11/2024	13:00:00	62

Subwatershed: Upper, Middle, and Lower Bear River

The Upper, Middle, and Lower Bear River Subwatershed is a priority during cycle 2 because the Bear River is nearly impaired for *E. coli.* Figure 36 is a map of the Upper, Middle, and Lower Bear River HUC-12 subwatersheds.

Figure 36. Upper, Middle, and Lower Bear River priority subwatersheds.



[Bear River](#) (09030006-516)

Bear River was assessed in cycle 2. This site was greatly affected by the 2021 drought and 2022 flood, which led to the inconclusive biology data for fish; however, based on the macroinvertabrete data the Bear River fully supports aquatic life use. The *E. coli* assessment results show two exceedances of the individual *E. coli* standard (1260/100mL), which would equate to a 13.3% exceedance rate - just above the impairment threshold. Two of three geometric monthly means exceeded the 126/100mL geometric monthly mean *E. coli* standard: 170/100mL for June and 315/100mL for July. For August, the geomean was also near exceeding, being 110/100mL. There was a significant beaver dam below the bridge at the sampling site (S001-150), Bear River at CR 1.

It was determined that in 2024 more *E. coli* data would need to be collected to help determine if there is an impairment. Table 14 shows the 2024 *E. coli* data in addition to the *E. coli* data collected during IWM in the years of 2020 and 2021. Overall, the 2024 data collected shows lower levels than the previous data collected during the assessment window (2013-2022). The Minnesota *E. coli* standard is not to exceed the monthly geometric mean of 126 organisms per 100 mL or not to exceed the individual standard of 1,260 organisms per 100 mL (MPCA 2024a). In 2022/2023, the bridge crossing at the sampling site, Bear River and CR 1, was replaced with three box culverts that allow the streamflow to move through the crossing much better, especially during high flows. Figure 37 shows the Bear River before and after the bridge was replaced.

Figure 37. The Bear River before replacing the bridge to a culvert, on the left, June 8, 2021. The Bear River after culvert installation, November 12, 2024.

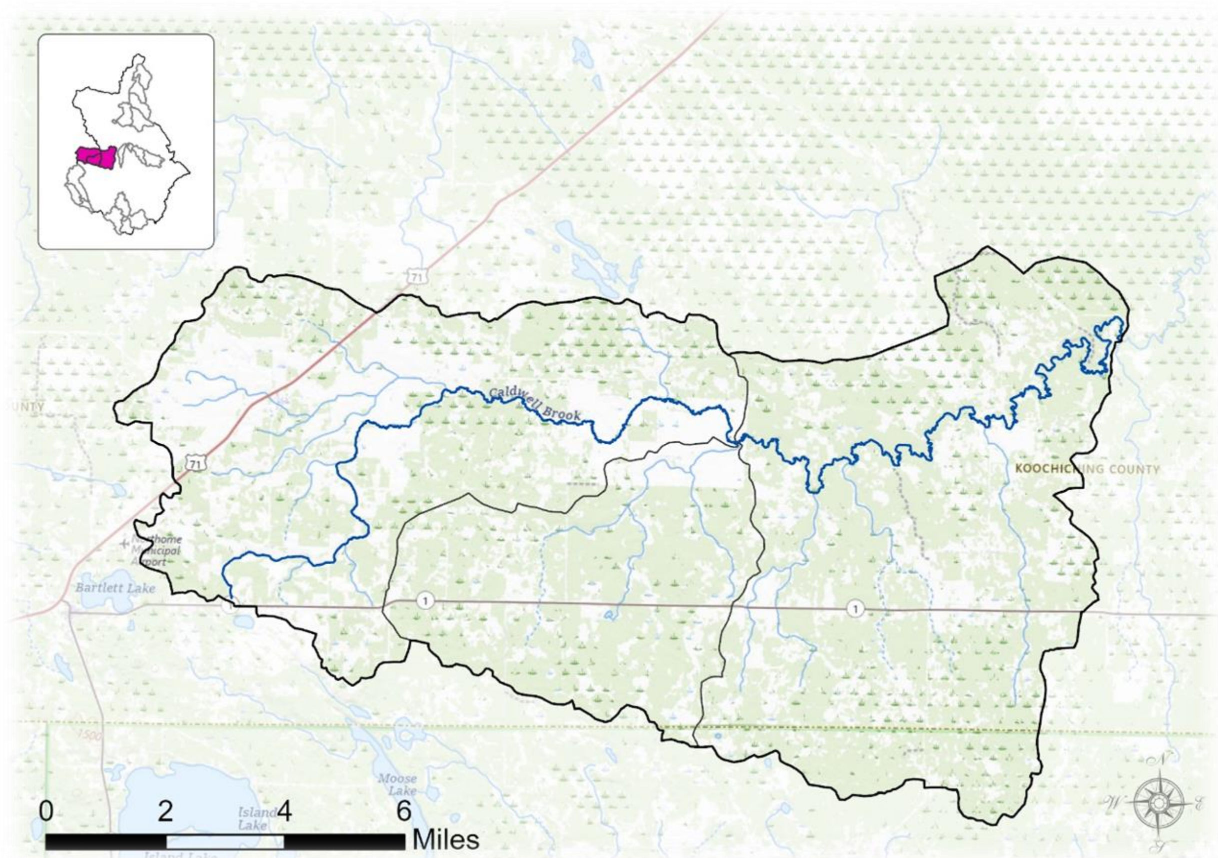
Table 14. Bear River *E. coli* data from station S001-150, Bear River at County Road 1.

Station ID	Date	Time	*E. coli* MPN/100 ml
S001-150	6/02/2020	8:40:00	101
S001-150	8/19/2020	7:35:00	86.5
S001-150	8/12/2020	7:30:00	71.2
S001-150	7/29/2020	7:50:00	47.4
S001-150	6/17/2020	8:00:00	48
S001-150	6/24/2020	8:05:00	111
S001-150	7/8/2020	8:15:00	172
S001-150	8/5/2020	7:30:00	39.3
S001-150	7/15/2020	7:45:00	152
S001-150	6/8/2021	8:30:00	727
S001-150	6/23/2021	7:43:00	365.4
S001-150	7/6/2021	7:12:00	1046.2
S001-150	7/28/2021	7:47:00	2419.6
S001-150	8/4/2021	8:00:00	1732.9
S001-150	8/25/2021	8:00:00	38.9
S001-150	6/05/2024	8:50:00	54.6
S001-150	6/27/2024	10:20:00	26.2
S001-150	7/11/2024	10:20:00	36.4
S001-150	7/30/2024	10:30:00	47.9
S001-150	8/15/2024	11:00:00	67.7
S001-150	9/18/2024	9:40:00	344.8

Subwatershed: Upper Caldwell Brook, Pancake Creek, and Middle Caldwell Brook

Upper Caldwell Brook, Pancake Creek, and Middle Caldwell Brook subwatersheds have all been identified as priorities during cycle 2 because Caldwell Brook is vulnerable to impairment of aquatic life use due to data on the fish community. Figure 38 is a map of Upper Calwell Brook, Pancake Creek, and Middle Caldwell Brook HUC-12 subwatersheds.

Figure 38. Upper Caldwell Brook, Pancake Creek, and Middle Caldwell Brook priority subwatersheds.



Caldwell Brook (09030006-510)

Caldwell Brook was assessed in cycle 2 for aquatic life use and aquatic recreation use. Caldwell Brook is currently meeting standards but is vulnerable to aquatic life impairment due to data on the fish community. There has been a decline in the fish community – possibly a result of channel instability. This system was severely impacted by the 2021 drought. Several beaver dams were also observed near the sampling reaches and may be restricting the recolonization of this system. The DNR completed a geomorphology study with assistance from MPCA and Itasca SWCD on Caldwell Brook in 2024 to evaluate stream channel stability and to identify potential causes – see Figure 39 for photos of the study. The BFRW Stressor Identification (SID) Report report explains that the geomorphology study concluded:

> "The channel is indeed unstable, having incised significantly from its original elevation, meaning a loss of connectivity to the floodplain. This results in high flows not being able to spill out onto the

floodplain and dissipate energy. This channel-containment of flood flows exerts much energy instead on the bed and banks, resulting in excessive erosion" (MPCA 2025a).

Additionally, the BFRW SID Report explains that "the symptoms of this instability found at Caldwell Brook noted in the report were:

- A Pfankuch Stability Index score of 130, with a condition rating of "Poor".
- High, steep unvegetated and sloughing banks.
- Unstable channel bottom that is in a frequent state of flux.
- Excessive tree toppling into the stream channel, including creation of large debris jams.
- Measurements that classify the stream as an "F" channel type (Rosgen 1996).
- Disconnection of the channel to its floodplain, leading to more erosive conditions in the channel.
- Accelerated lateral channel migration.
- Gravel in riffles is embedded by sand and fine particles" (MPCA 2025a).

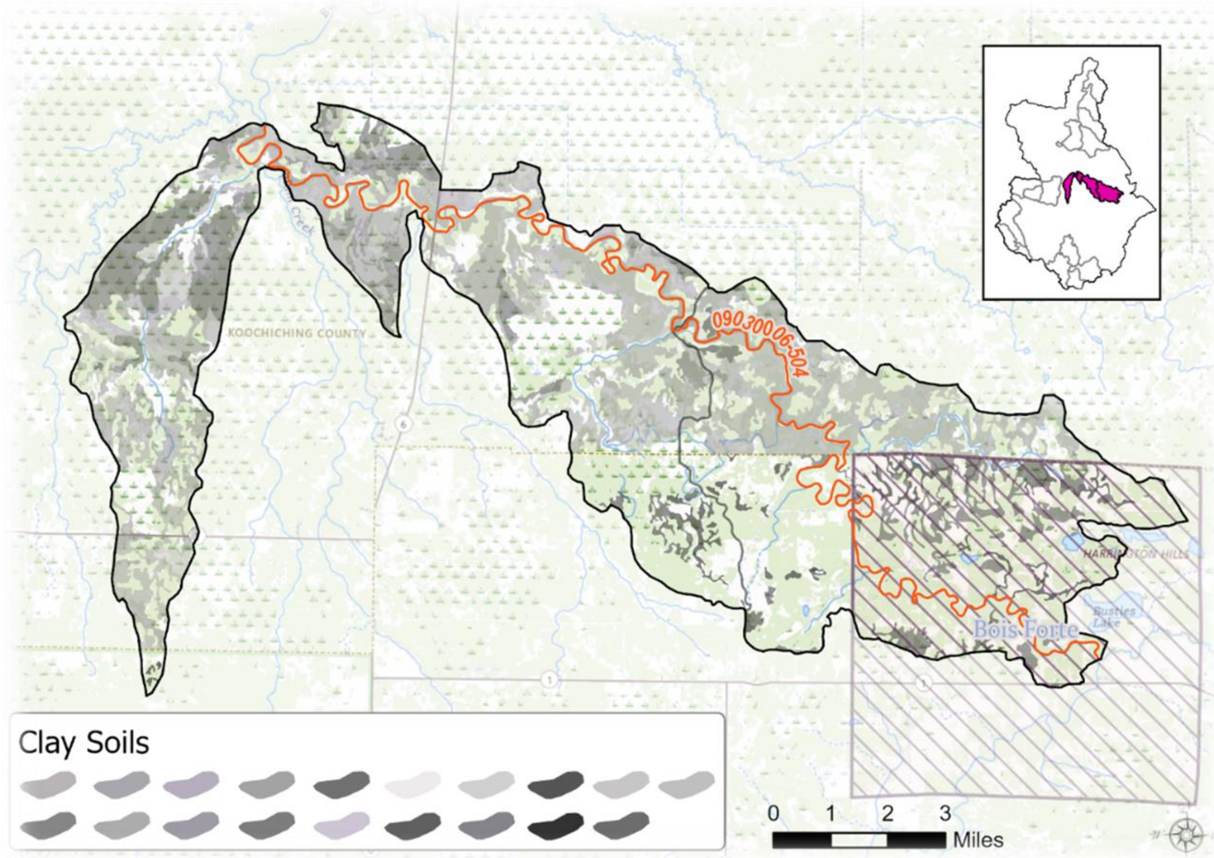
Please refer to the BFRW SID Report for a full summary of this study in the section called *Caldwell Brook channel instability - DNR geomorphology study.*

Figure 39. Geomorphology study on Caldwell Brook in 2024.

Subwatershed: Big Fork River - Town of Craigsville and Big Fork River – Beaver Brook

The 40-mile section of the Big Fork River from Deer Creek to Caldwell Brook has been identified as a priority during cycle 2 because it's vulnerable to becoming impaired for aquatic life use due to high levels of TSS. Figure 40 is a map of the Big Fork River – Town of Craigsville and Big Fork River – Beaver Brook HUC-12 subwatersheds.

Figure 40. Big Fork River – Town of Craigsville and Big Fork River – Beaver Brook subwatersheds.



<u>Big Fork River - Deer Creek to Caldwell Brook</u> (09030006-504)

The Big Fork River was assessed in cycle 2 from Deer Creek to Caldwell Brook for aquatic life use. The chemistry and biological data are conflicting, TSS and S-tube data are exceeding the standard, yet biota (fish and macroinvertebrates) are meeting the exceptional use thresholds. The biology is remaining strong, even through extreme drought in 2021, flooding events in 2022, and known periods of elevated TSS.

During the summer of 2021 two stations were monitored for benthic macroinvertebrates and one station for fish, and during the summer of 2022 one station was sampled for benthic macroinvertebrates and one station for fish. All MIBI scores were above the exceptional use threshold for the northern forest rivers class. A rare mayfly taxa (Neoephermera bicolor) was observed and several sensitive dragonfly, caddisfly, mayfly, and stonefly taxa were observed throughout this stretch of the Big Fork River, which is an indication of good water quality. Both visits' FIBI scores exceeded the upper confidence interval, and over half of the individuals collected in each sample were nontolerant insectivores. Numerous sensitive taxa and multiple intolerant taxa were also present in both samples.

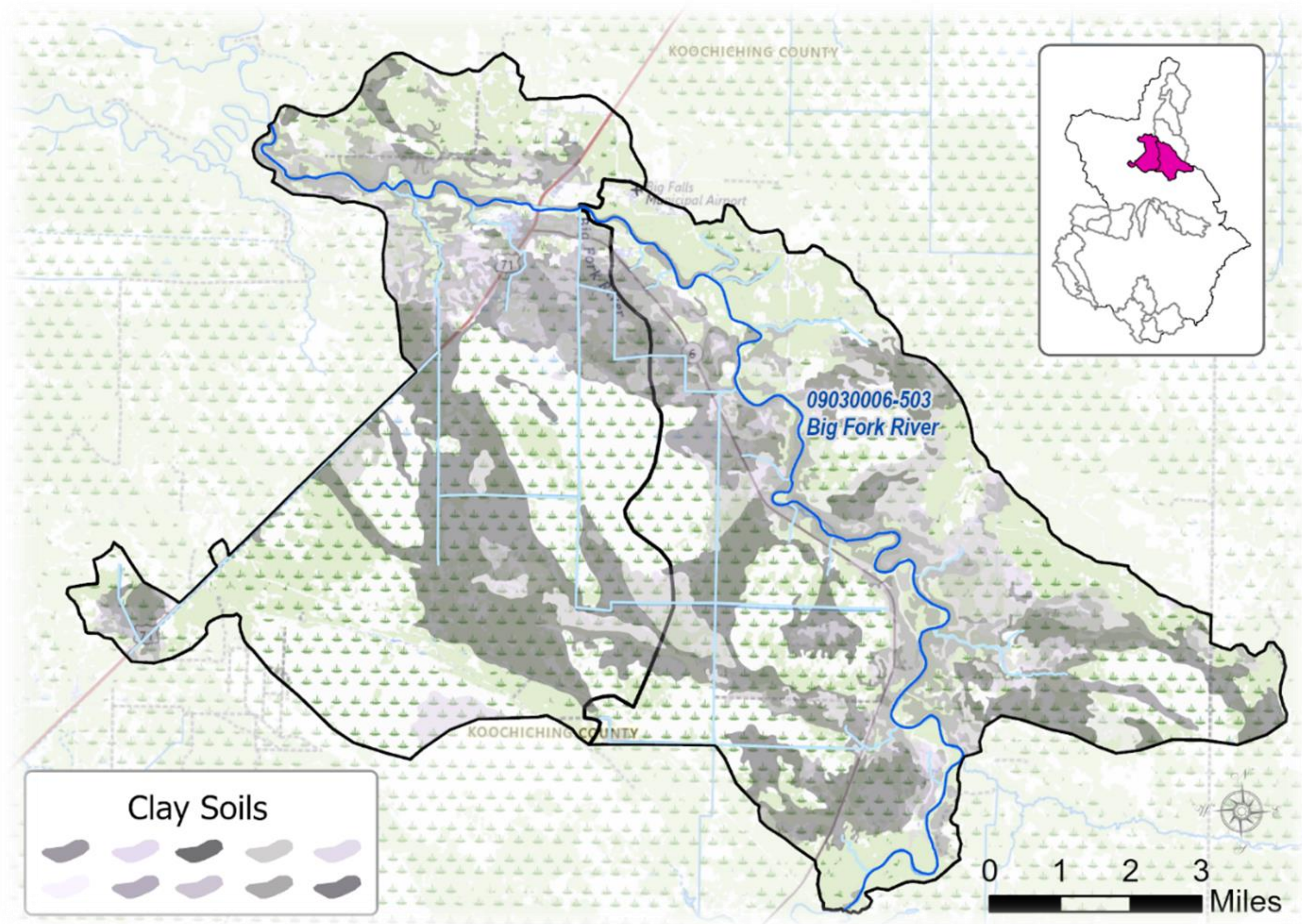
Though it is acknowledged there are periods of high TSS, there are no indications that it is causing a decline in the biological communities. The vast majority of the TSS and Secchi tube exceedances were seen during spring melt and large rainfall events. Most of the exceedances can be attributed to high rainfall events of an inch or more or the spring melt when flows were high. Due to the high-quality biology communities, the assessment result is full support for aquatic life use. Given the proximity of TSS data to impairment thresholds, the reach is vulnerable for aquatic life impairment.

The Big Fork River from Deer Creek to Caldwell Brook is within the lower portion of the BFRW. According to the BFRW SID Report, "The lower portion of the BFRW was covered by glacial lake Agassiz. During those long years, clay accumulated on the bottom of the lake, forming the clay soils that now exist in this part of the BFRW. While clay soils are very cohesive and therefore somewhat resistant to erosion, when they do erode, the particles stay in the water column for extended time, creating a cloudiness (reduced transparency) to the water. The MPCA measures TSS as an aspect of water quality. Minnesota's TSS standard for the northern region is 15 mg/L" (MPCA 2025a). Figure 40 displays the clay soils within the Big Fork River – Town of Craigsville and Big Fork River – Beaver Brook HUC-12 subwatersheds. Please see the BFRW SID Report for a full explanation of TSS in the Big Fork River.

Subwatershed: Big Fork River – City of Big Falls and Big Fork River – Macaffee Brook

This 24-mile section of the Big Fork River from Reilly Brook to Sturgeon River has been identified as a priority during cycle 2 because it's vulnerable to becoming impaired for Aquatic Life due to high levels of TSS. Figure 41 is a map of Big Fork River – city of Big Falls and Big Fork River – Macaffee Brook subwatersheds.

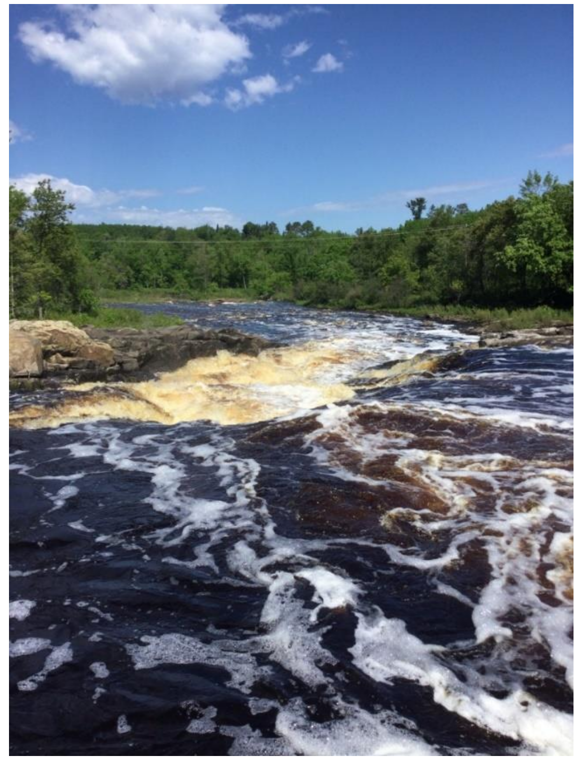
Figure 41. Big Fork River - City of Big Falls and Big Fork River - Macaffee Brook priority subwatersheds.



Big Fork River - Reilly Brook to Sturgeon River (09030006-503)

The Big Fork River between Reilly Brook and Sturgeon River was assessed in cycle 2 for aquatic life use. The chemistry and biological data are conflicting; TSS and S-tube data are exceeding the standard, yet biota (fish and macroinvertebrates) are meeting the exceptional use thresholds. The biology is remaining strong, even through extreme drought in 2021, flooding events in 2022, and known periods of elevated TSS. Two biological monitoring stations were sampled for MIBI and FIBI within this assessment period (2013 through 2022). One of the stations is unique in the sense that the MPCA utilizes this site as part of the LTBM network, and as such benthic macroinvertebrates were collected during the summers of 2014, 2017, 2019, 2020, 2021, and 2022. With the exception of the 2022 sample, all MIBI scores are above the exceptional use threshold for the Northern Forest Rivers class. The reach includes rare invertebrate mayfly taxa (Neoephermera bicolor). There are only six records of this taxa in the MPCA dataset, three originating in the Big Fork River and three from the Little Fork River. Several sensitive caddisfly, mayfly, and stonefly taxa were observed throughout this stretch of the Big Fork River.

Figure 42. Big Fork River at Big Falls, MN



FIBI was also applied to both stations. One of the stations was visited in August of 2014, July of 2017, July of 2019, August of 2021, and August of 2022. The 2014 visit FIBI score was just above the impairment threshold; all other visit FIBI scores were at or above the upper confidence interval. All samples contained a similar number of species (17 to 21) and high numbers of sensitive, insectivorous individuals. Multiple intolerant taxa were also present in most samples (7 were present in the 2021 sample). The other station was visited in August of 2021. The FIBI score exceeded the upper confidence interval, and fifteen species of fish were collected. Over 50% of the total number of individuals collected were sensitive and/or lithophilic spawners.

The vast majority of the TSS and Secchi tube exceedances were seen during spring melt and large rainfall events. Due to the high-quality biology communities, the assessment result is full support for aquatic life use. Given the proximity of TSS data to impairment thresholds, the reach is vulnerable for aquatic life use impairment.

The Big Fork River from Reilly Brook to Sturgeon River is also within the lower portion of the BFRW. Figure 41 displays the clay soils within the Big Fork River – city of Big Falls and Big Fork River – Macaffee Brook HUC-12 subwatersheds. Please see the BFRW SID Report for a full explanation of TSS in the Big Fork River.

Groundwater

The Minnesota Department of Health (MDH) coordinates the [Groundwater Restoration and Protection Strategies (GRAPS) program.] Many state agencies work together to gather data and create GRAPS reports for each watershed in Minnesota. The BFRW GRAPS will not be started before the WRAPS cycle 2 report is published. MDH has provided the following series of groundwater maps for this report to help explain some of the groundwater information and water quality in the BFRW's groundwater.

Figure 43. Big Fork River Watershed groundwater flow dominated lakes.

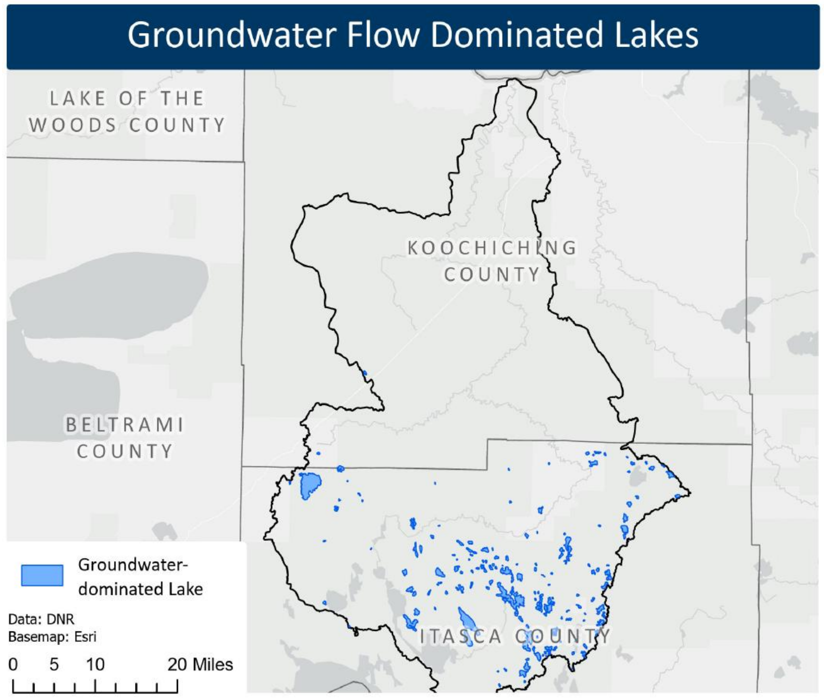


Figure 44. Big Fork River Watershed drinking water wells.

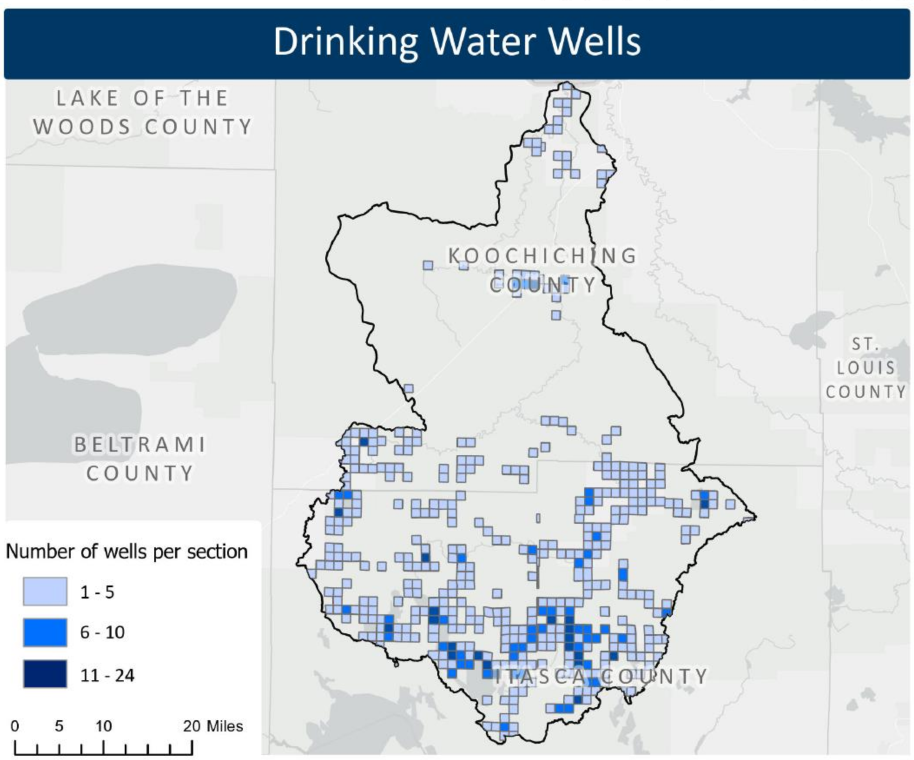


Figure 45. Big Fork River Watershed drinking water supply management areas.

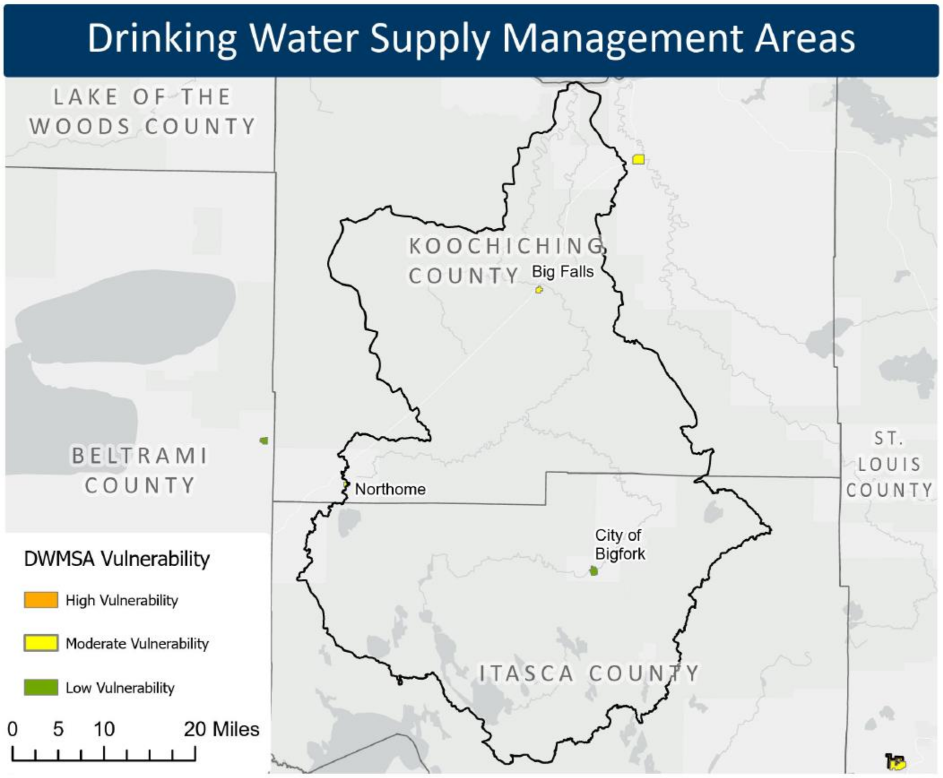


Figure 46. Big Fork River Watershed pollution sensitivity of near-surface materials.

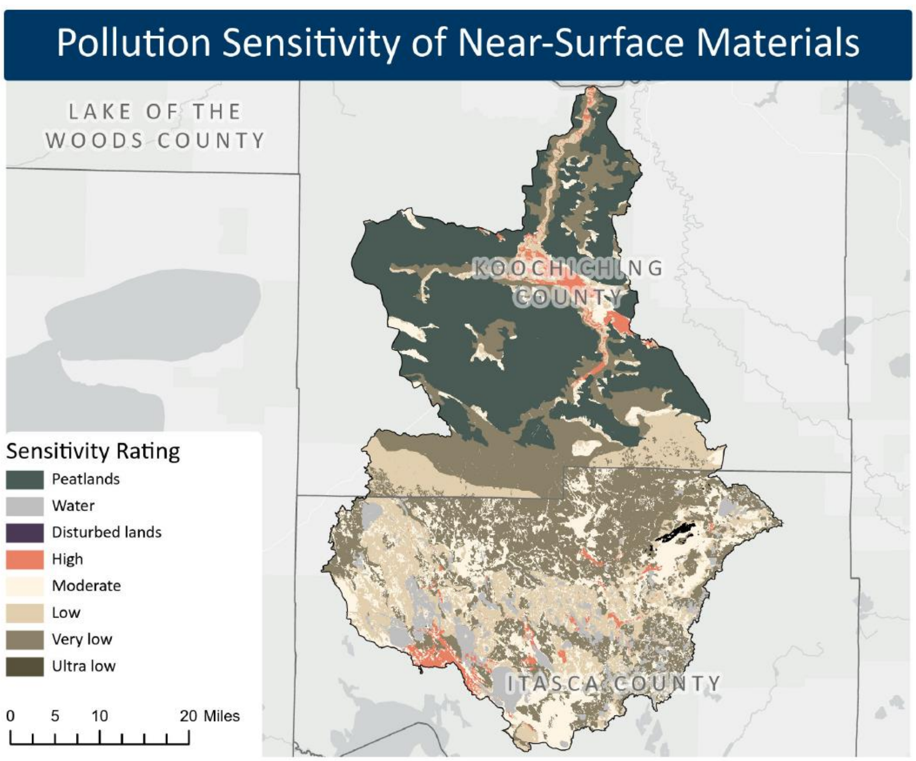


Figure 47. Big Fork River Watershed drinking water wells containing arsenic.

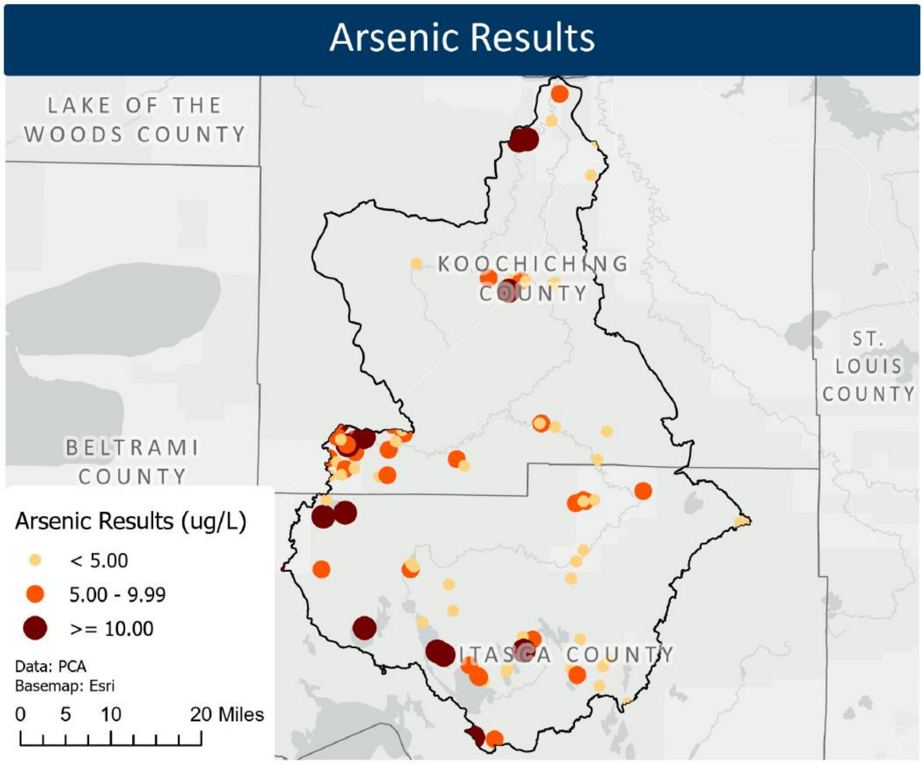
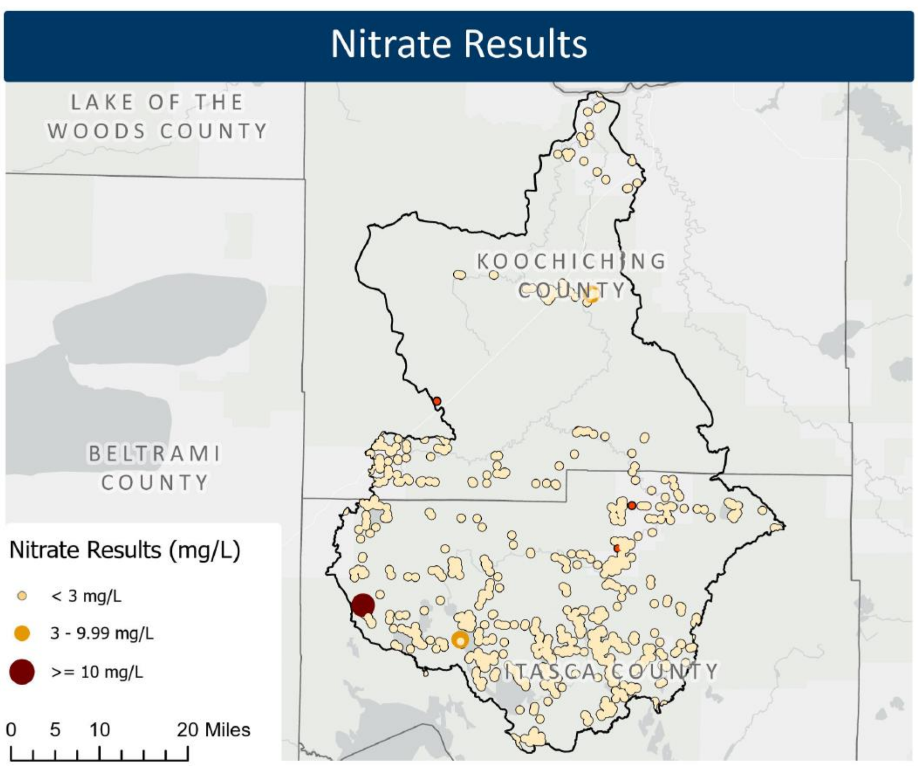


Figure 48. Big Fork River Watershed drinking water wells containing nitrate.



Wastewater and Stormwater

There are four active wastewater permitted point sources in the BFRW: Big Falls wastewater treatment plant (WWTP), Bigfork WWTP, Effie WWTP, and Northome WWTP. Figure 49 is a map of the wastewater facilities. The DNR Scenic State Park WWTP was decommissioned in 2023. A discharge permit was issued in 2003 for the Berger Horticultural Products – Pine Island Bog but a discharge has never been reported from that site. Figure 50 is a graph that shows the TP effluent levels for each year from 2000-2024. Figure 51 is a graph that shows the total nitrogen effluent levels for each year from 2000-2024. Figure 52 is a graph that shows the TSS levels for each year from 2000-2024. There are no permitted municipal separate storm sewer systems (MS4s) in the BFRW, and the amount of permitted construction stormwater is miniscule. There are only two industrial stormwater facilities – a salvage yard and a sand and gravel facility.

Figure 49. Big Fork River Watershed wastewater permitted facilities.

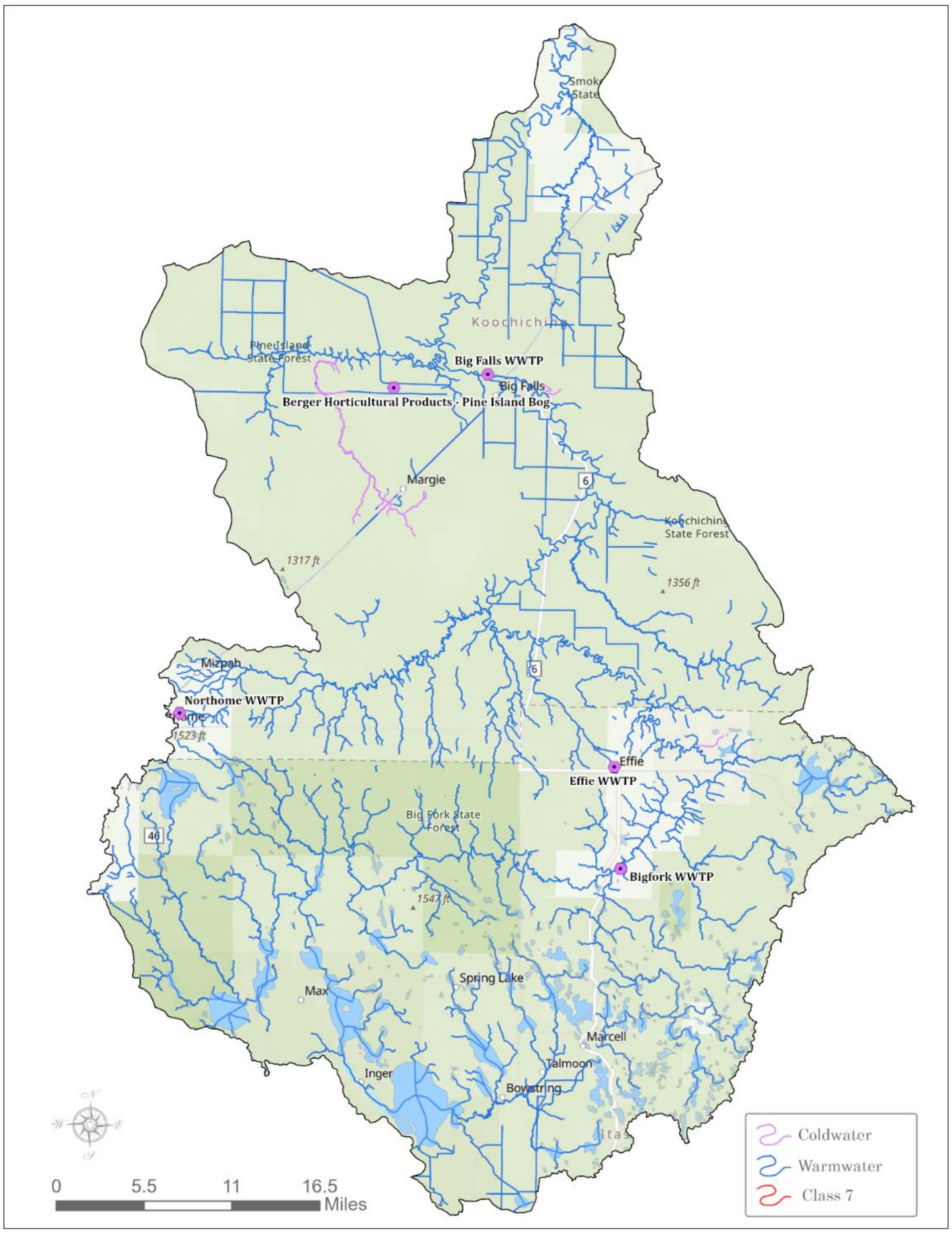


Figure 50. Big Fork River Watershed wastewater TP from 2000-2024.

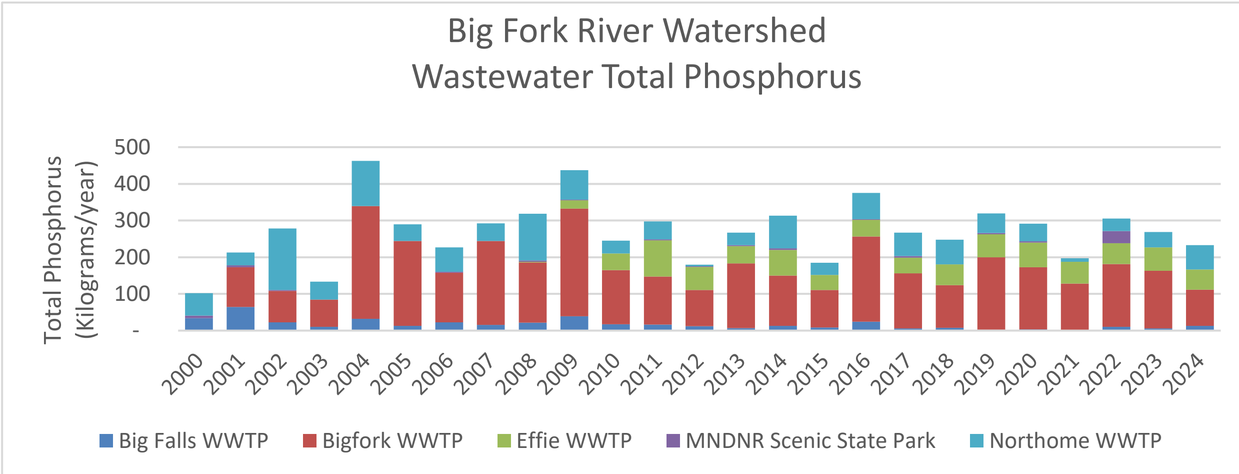


Figure 51. Big Fork River Watershed wastewater total nitrogen from 2000-2024.

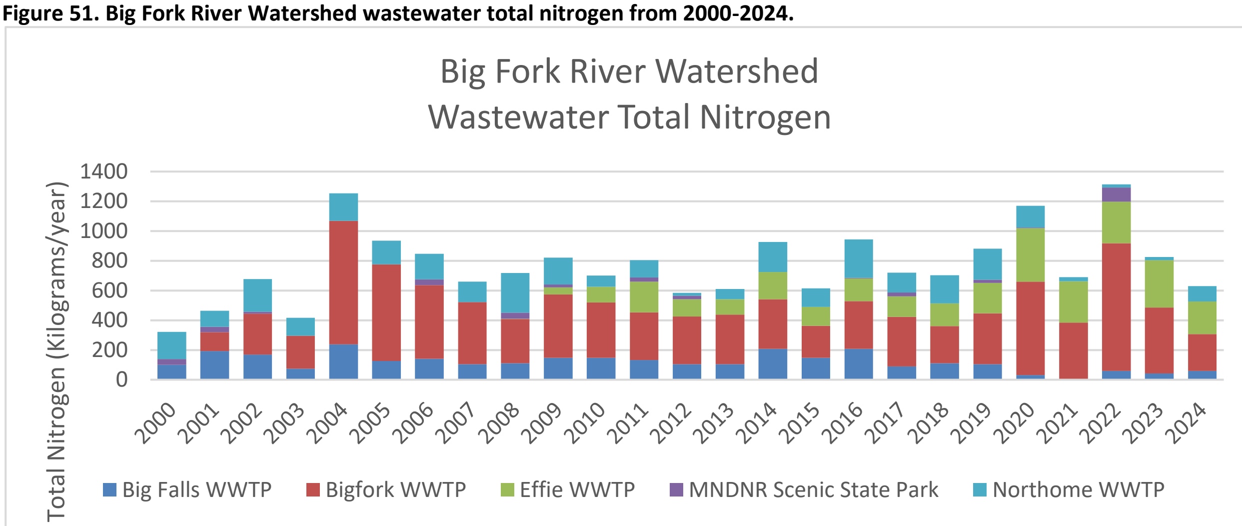
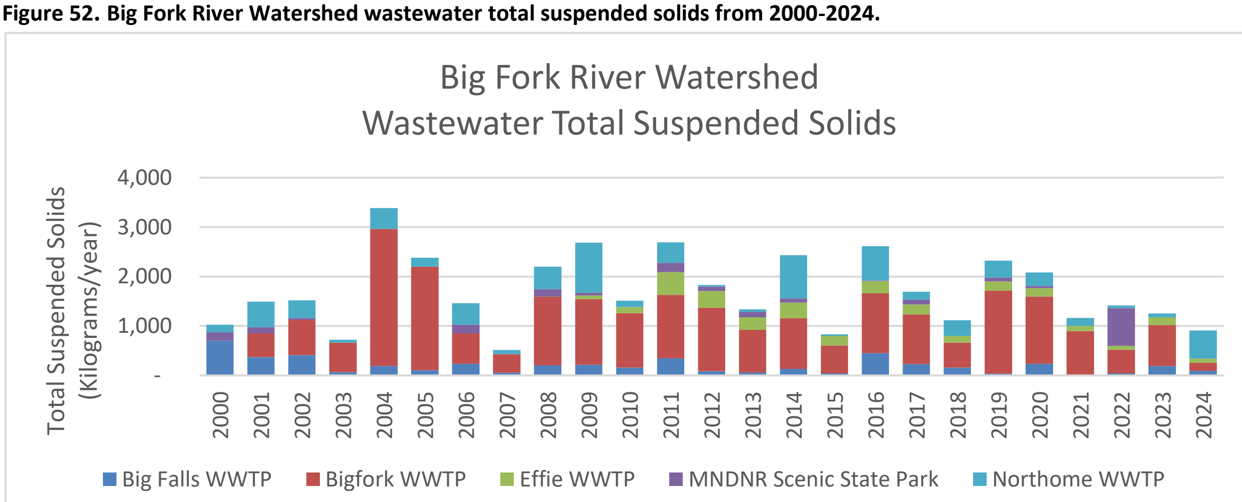


Figure 52. Big Fork River Watershed wastewater total suspended solids from 2000-2024.



4.4 Water quality trends

Streams

The MPCA's Tableau Report for long term stream trends explains that "river nutrient trend analysis conducted over long periods of time provide an understanding of the combined outcomes of land use changes, management practices, and other key factors affecting water quality" (MPCA 2024e). The report also explains that "trends (patterns over time) were calculated over two different time periods for phosphorus, nitrate, and TSS in major rivers and streams in Minnesota. Specifically, trends were determined for flow-adjusted and nonflow-adjusted concentrations and loads, highlighting nitrogen (referred to as "nitrate", representing nitrite+nitrate-N), TP (referred to as "phosphorus" or "TP"), and "TSS" using a bootstrapped seasonal-Kendall statistical test for data collected at each of its monitoring sites during the past 10 years" (MPCA 2024e). The trend analysis conducted on the Big Fork River for phosphorus is currently showing a decreasing trend on the Big Fork River at Big Falls, Minnesota, which means the phosphorus between 2008 through 2022 has gone down. The trend analysis conducted on the Big Fork River for nitrogen and TSS is currently showing no significant trend on the Big Fork River at Big Falls, Minnesota, which means the nitrogen and TSS between 2008 through 2020 has remained the same.

Lakes

A transparency trend analysis was conducted on many of the lakes in the BFRW. The trend analysis was performed with a Seasonal Mann Kendall test. This statistical test detects changes in water clarity over time by comparing months across years; for, example - Mays are compared to Mays, Junes to Junes, etc. (MPCA 2024f). Table 15 shows the lake water quality trends, impairment status for aquatic recreation, the average TP, average chl-*a*, average transparency, and trend analysis results taken from the MPCA Surface Water Data website, Surface Water. An increasing trend means the lake has an increasing clarity and a decreasing trend decreasing clarity. Of the 58 lakes analyzed for trends, three lakes (Battle, Jack the Horse North, and Jack the Horse South) show evidence of worsening trend (i.e., lower clarity, or poorer water quality), 9 lakes (Sand, Jessie, Little Turtle, Turtle, Long, Clubhouse, Three Island, Maki, and Caribou) show evidence of improving trend (i.e., higher clarity, or improving water quality), and 23 lakes show no evidence of a trend. The remaining lakes did not have sufficient information for a trends analysis. For more trend data from cycle 2, please see the Big Fork River Watershed Assessment and Trends Update Report.

Table 15. Lake water quality trends (MPCA 2024f).

Lake ID	Lake Name[1]	Impaired (Y/N)	Average Total Phosphorus (µg/L)	Chlorophyll-a (µg/L)	Average Transparency (m)	Trend in Clarity [2]
31-0530-00	Busties*	N	15	6	3	N
31-0334-00	Deer	N	17	5	3	N
31-0339-00	Pickerel	N	18	7	3	N
31-0197-00	Battle	N	16	4	2	↓
31-0183-00	Five Island	N	11	3	4	N
31-0160-00	Mirror	N	13	2	5	--

Lake ID	Lake Name[1]	Impaired (Y/N)	Average Total Phosphorus (µg/L)	Chlorophyll-a (µg/L)	Average Transparency (m)	Trend in Clarity [2]
31-0316-00	Bass	N	10	2	6	--
31-0710-00	Connors	N	--	--	4	N
31-0898-00	Moose	N	20	6	3	--
31-0913-00	Island	Y	30	13	3	N
31-0910-00	Shallow Pond	Y	60	18	2	--
31-0882-00	Dora	--	26	7	3	N
31-0845-00	Clear	N	14	3	5	--
31-0803-00	Trestle	N	15	4	4	--
31-0782-00	Gunderson	N	15	5	4	N
31-0524-01	Coon	N	15	5	4	--
31-0524-02	Sandwick	N	13	3	4	--
31-0843-00	Whitefish	N	11	3	3	--
31-0836-00	Little Whitefish	N	14	2	3	--
31-0904-00	Dunbar**	Y	36	11	2	--
31-0896-00	Round**	Y	56	25	2	N
31-0853-00	Little Sand**	N	28	10	3	--
31-0826-00	Sand**	N	18	3	4	↑
31-0832-00	Rush Island**	N	17	7	3	N
31-0813-00	Bowstring**	Y	30	9	3	N
31-0784-00	Little Jessie	N	--	--	5	N
31-0786-00	Jessie	Y	39	14	3	↑
31-0779-00	Little Turtle	N	--	--	3	↑
31-0725-00	Turtle	N	10	2	5	↑
31-0793-00	Big Too Much	N	8	2	4	--
31-0773-00	Maple	N	12	4	4	--
31-0771-00	Hatch	N	--	--	5	↑
31-0781-00	Long	N	9	3	5	--
31-0726-00	Bello	N	15	3	3	N
31-0696-00	Horseshoe	N	--	--	3	N
31-0657-02	Jack the Horse South	N	10	3	4	↓
31-0657-01	Jack the Horse North	N	10	3	4	↓

Lake ID	Lake Name[1]	Impaired (Y/N)	Average Total Phosphorus (µg/L)	Chlorophyll-a (µg/L)	Average Transparency (m)	Trend in Clarity [2]
31-0654-00	Burns	N	9	2	6	--
31-0460-00	East	N	--	--	4	--
31-0540-00	Clubhouse	N	--	--	5	↑
31-0463-00	Fox	N	--	--	4	--
31-0454-00	Eagle	N	--	--	3	N
31-0473-00	Mary	N	--	--	3	N
31-0480-00	Gunn	N	11	3	4	--
31-0542-00	Three Island	N	--	--	8	↑
31-0671-00	Big Island	N	15	3	5	N
31-0670-00	Big Ole	N	9	2	7	--
31-0653-00	North Star	N	10	2	5	N
31-0616-00	East Smith	N	--	--	4	N
31-0497-00	Fifth Chain	N	--	--	4	N
31-0416-00	Black Island	N	--	--	3	N
31-0622-00	Dead Horse	N	22	5	2	--
31-0621-00	Little Dead Horse	N	--	--	4	N
31-0758-00	Little Bowstring	N	--	--	2	N
31-0759-00	Maki	N	--	--	3	↑
31-0620-00	Caribou	N	--	--	10	↑

[1] *Lakes located wholly within the Bois Forte Band of Chippewa reservation.

**Lakes located wholly within the LLBO reservation.

[2] ↑ : increasing trend, ↓: decreasing trend, N: no evidence for a trend --: insufficient information

5. Climate change

The *Climate summary for watersheds: Big Fork* (DNR 2019) report shows that annual average temperatures in the BFRW have increased over the last century and that most years during the past two decades have been warmer than average, see Figure 53. Annual precipitation has also shown an upward trend across the watershed. Monthly precipitation is typically highest in June and increases in precipitation in recent years were most pronounced in May, June, October, and December. The largest monthly average temperature change is occurring in the winter months, where the temperatures on average are increasing over time, see Figure 54. (DNR 2019).

Figure 53. Annual average temperature in the Big Fork River Watershed (DNR 2019).

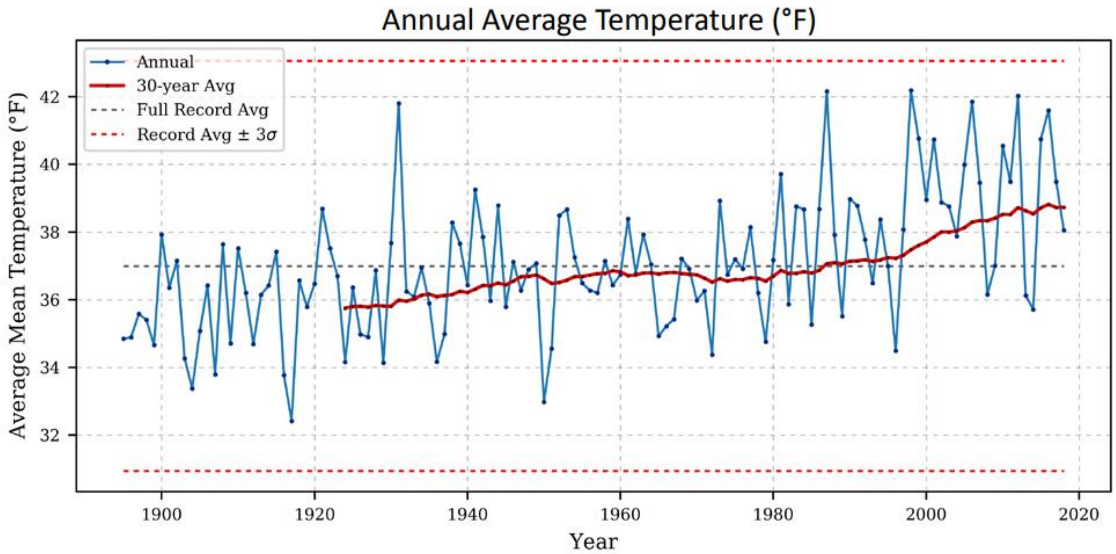
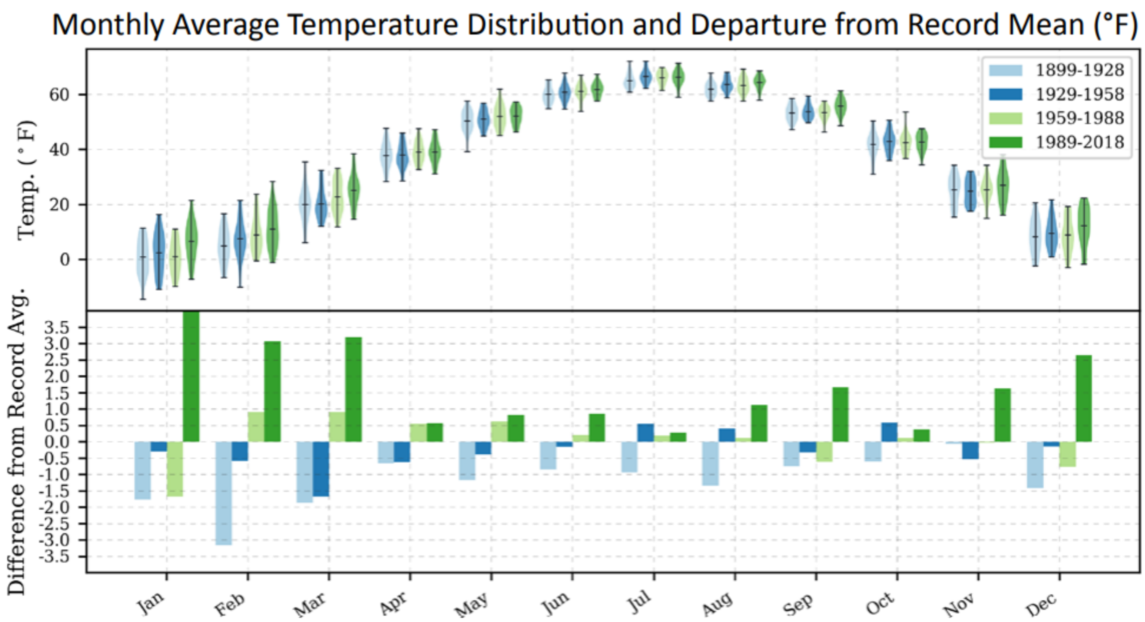


Figure 54. Monthly average temperature in the Big Fork River Watershed (DNR 2019).



Statewide lake data collected by the DNR, MPCA, and local partners shows that the climate trends described above have already impacted lakes throughout the state and region. According to MPCA's Workbook: Climate change and Minnesota's surface waters, Minnesota lakes are getting warmer, especially during mid to late summer. Minnesota lake surface temperatures have warmed during all seasons throughout the entire state. During July and August, Minnesota lakes are about 3°F to 4.3°F warmer now, on average, than 56 years ago. Additionally, the duration of ice cover on Minnesota lakes is decreasing. Average lake ice duration has decreased by up to 17 days over the last 50 years and 10 to 27 days over the last 100 years. (MPCA 2025b).

Reduced ice coverage, higher year-around water temperatures, and more intense and frequent precipitation events can result in significant impacts to lakes and lake users, including but not limited to (MPCA 2021):

- Overall increase in flow, sediment, and nutrient loading from the lake drainage area
- Longer periods of stratification and anoxia resulting in increased internal phosphorus recycling
- Longer open water and growing season for algae and cyanobacteria blooms
- Larger fluctuations in lake level from year to year
- Potential for more fish kills as fish are squeezed into smaller zones to access oxygen.

Winter temperatures and overnight lows continue to warm at a rapid pace, which will likely lead to even shorter ice seasons in the future, and impact like:

- Shortened season for safely recreating on ice-covered lakes
- Loss of cold-water habitat for fish species such as trout, cisco, and whitefish - these species may decline in some lakes and increase in others
- Altered lake evaporation rates that impact lake levels and humidity, which result in changes to fish and invertebrate populations.
- A longer growing season for algal blooms
- Potential for increased densities of aquatic invasive plants, such as curly leaf pondweed and Eurasian watermilfoil.

The U of M has developed a climate modeling tool called Minnesota CliMAT (Climate Mapping and Analysis Tool), Minnesota CliMAT (Climate Mapping and Analysis Tool) | UMN Climate Adaptation Partnership. This mapping tool is an interactive online tool that provides highly localized climate projections for Minnesota. In a high emissions scenario projected out to the end of the century (2080-2099), the CliMAT tool projects the annual number of days in the BFRW with a minimum temperature below -20°F is 1.8 days (Figure 55) when historically, between 1995 through 2014, it was 11.9 days (Figure 56) (Leiss et al. 2023).

Figure 55. Climate model projection into the end of the century under high emissions for number of days with a minimum temperature below -20°F in the Big Fork River Watershed (Leiss et al. 2023).

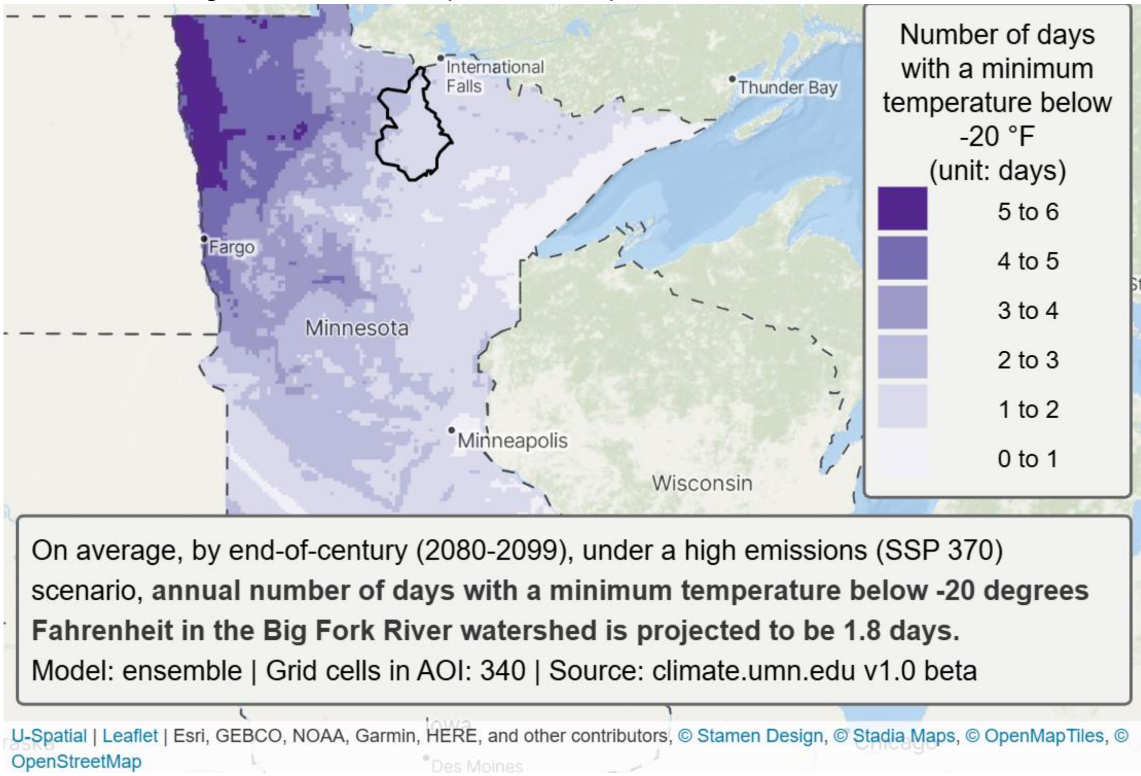
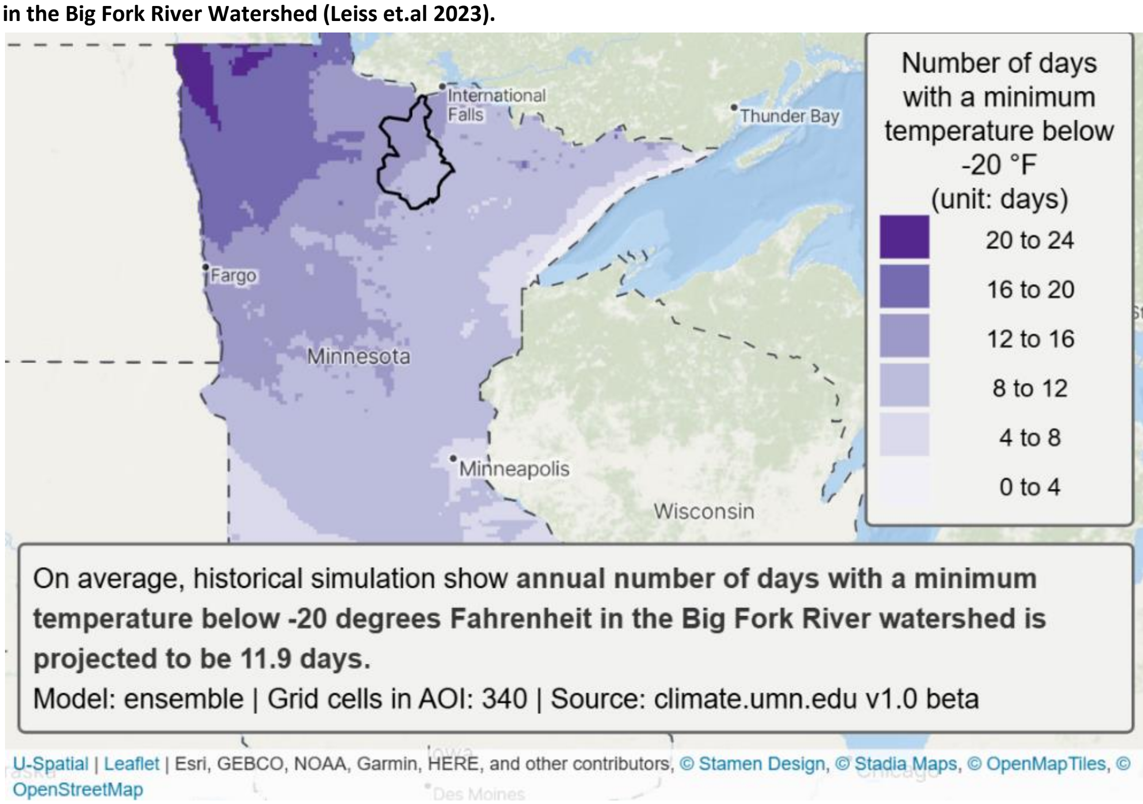


Figure 56. Climate model projection of historical record from 1995-2014 for number of days with a minimum temperature below -20°F in the Big Fork River Watershed (Leiss et.al 2023).



In a high emissions scenario projected out to the end of the century (2080 through 2099), the CliMAT tool projects the annual number of days in the BFRW with a maximum temperature exceeding 90°F is 26.2 days (Figure 57), when historically, between 1995-2014, it was 24 days (Figure 58) (Leiss et al. 2023).

Figure 57. Climate model projection into the end of the century under high emissions for number of days with a maximum temperature exceeding 90°F in the Big Fork River Watershed (Leiss et al. 2023).

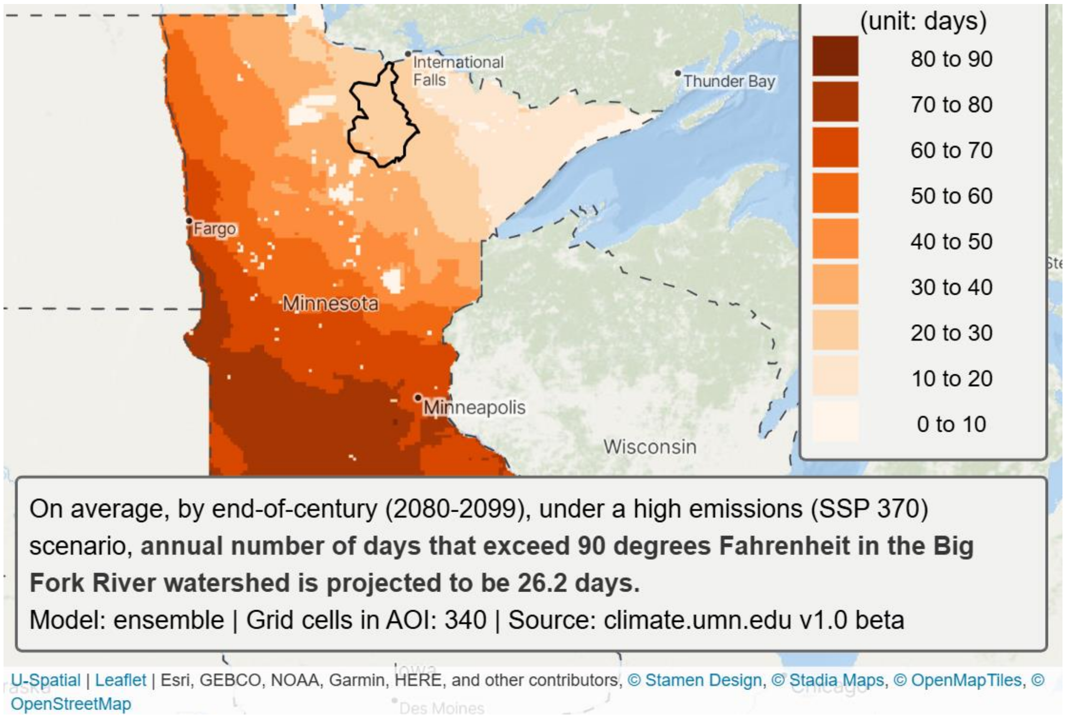
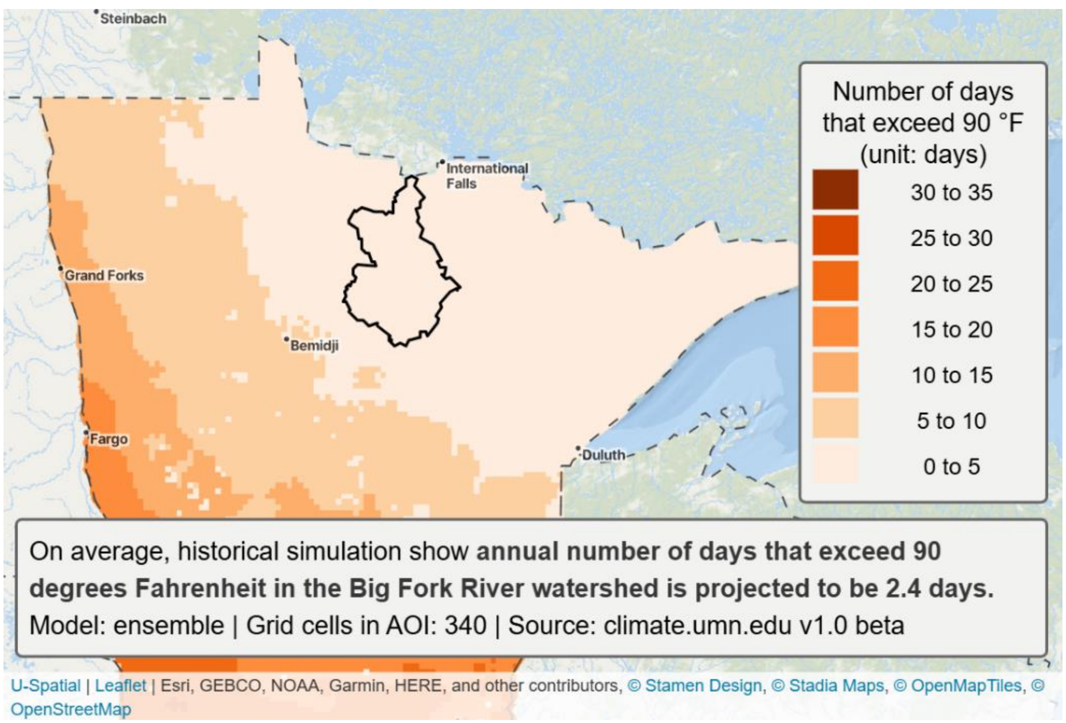


Figure 58. Climate model projection of historical record from 1995-2014 for number of days with a maximum temperature exceeding 90°F in the Big Fork River Watershed (Leiss et al. 2023).



In a high emissions scenario projected out to the end of the century (2080 through 2099), the CliMAT tool projects the annual number of days in the BFRW with snow cover depth greater than 6 inches is 67.9 days (Figure 59), when historically, between 1995 through 2014, it was 104.1 days (Figure 60) (Leiss et al. 2023).

Figure 59. Climate model projection into the end of the century under high emissions for annual number of days with snow cover depth greater than 6 inches in the Big Fork River Watershed (Leiss et al. 2023).

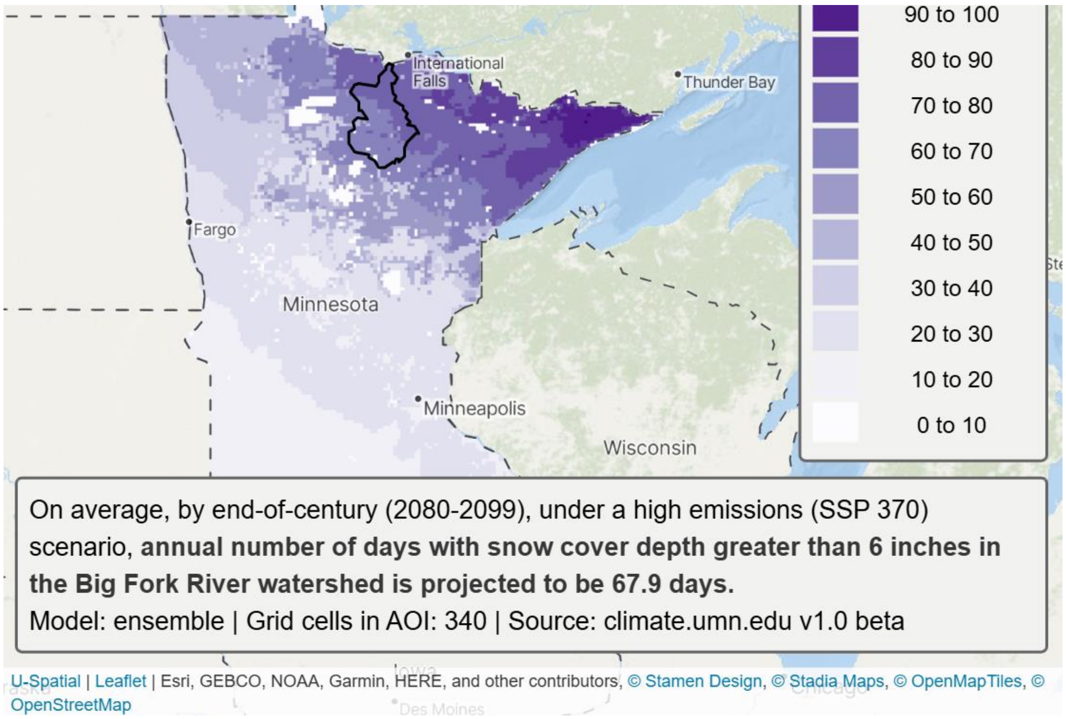
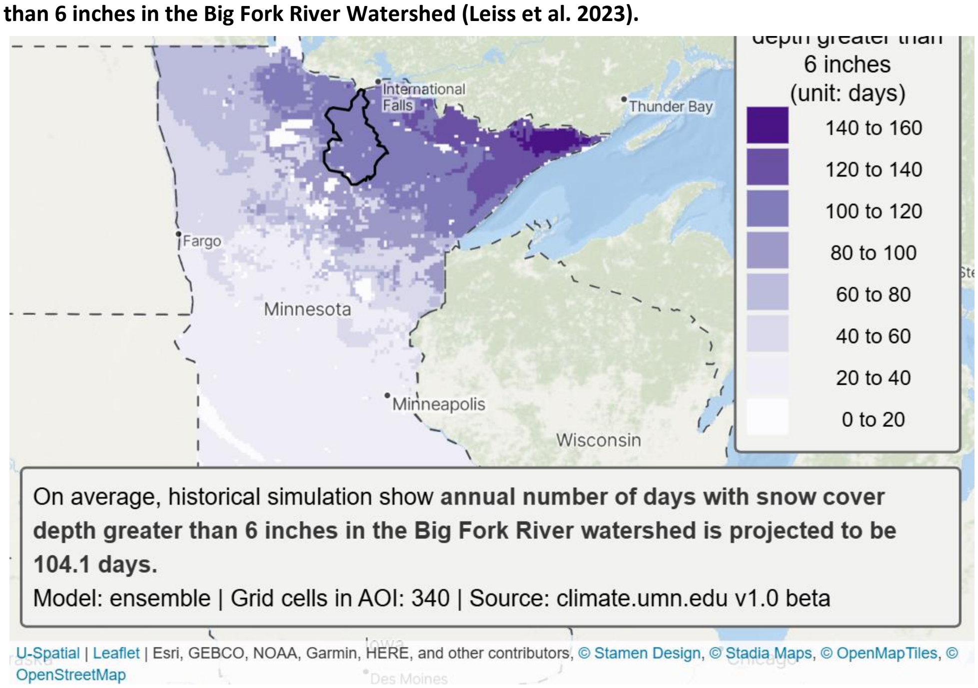


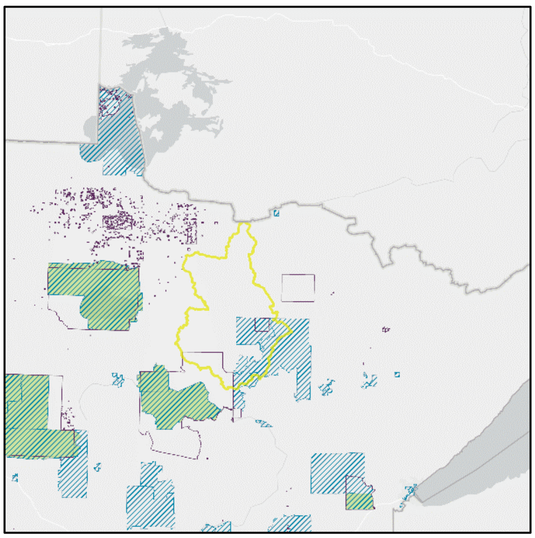
Figure 60. Climate model projection of historical record from 1995-2014 for annual number of days with snow cover depth greater than 6 inches in the Big Fork River Watershed (Leiss et al. 2023).



6. 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. The MPCA considers tribal areas and census tracts with higher concentrations of low-income residents and people of color as areas of increased concern for environmental justice. The below map shows census tracts where additional consideration or effort is warranted to ensure meaningful community engagement and to evaluate the potential for disproportionate adverse impacts using three criteria (the BFRW is within the yellow highlighted area):

Figure 61. Minnesota environmental justice areas.



At least 40% of people reported income less than 185% of the federal poverty level

50% or more people of color

Federally recognized tribal areas

***The data are from the US Census Bureau.**

It is important that environmental justice is considered in MPCA's watershed work throughout the WRAPS update process. Environmental justice areas comprised about 90% of the BFRW at the time the project charter was finalized in 2020 – see Figure 61 for a map of current Minnesota environmental justice areas. It should be noted that MPCA has recently updated the metrics in which an environmental justice area is defined and the BFRW doesn't have as much poverty areas as previously defined; however, the cycle 2 outreach work was based on the 2020 environmental justice criteria. Public outreach work was emphasized to reach everybody throughout the watershed, as the BFRW is sparsely populated, rural, and predominantly low income. A traveling exhibit of the cycle 2 BFRW work was displayed at multiple locations for the public to receive the information. Considering a large population in this watershed consumes a lot of fish

Figure 62. Big Fork River Watershed traveling exhibit.

with a subsistence lifestyle, increased awareness on mercury pollution and fish contamination was provided by sharing recent data and fish consumption advisory brochures at display booths. For a complete list of locations where the traveling exhibit was placed and photos of the contents, please see Section 11, Public Participation.

7. Goals to meet water quality standards and fully supporting uses

The water quality goals for the BFRW are the following:

1. Improve water quality in impaired lakes: Jessie Lake, Island Lake, and Shallow Pond.
2. For the potentially impaired lakes located wholly within the LLBO reservation (Round Lake, Dunbar Lake, and Bowstring Lake), the Bowstring and Round Lake protection study will be conducted in the near future. The focus of this study will be on Bowstring and Round Lake but will include the tributaries of Dunbar Lake. The goal of this project is to develop water quality protection targets for Bowstring Lake and Round Lake in partnership with LLBO and MPCA, and together they will create a report with water quality targets and protection strategies for both Bowstring and Round lakes. This will be achieved by LLBO and MPCA conducting water quality monitoring within Bowstring and Round lakes and their tributaries according to the sampling plan developed in partnership with MPCA and LLBO. Water quality monitoring results will be analyzed to better characterize lake mixing, seasonal changes, internal load, and phosphorus loading to the lake. Lake models will be developed using monitored data, hydrological simulation program – FORTRAN (HSPF) output, and typical assumptions MPCA uses in TMDLs (e.g., septics, atmospheric deposition), which will help quantify sources and develop phosphorus budgets for the lakes. The lake models will help evaluate load reductions needed to achieve the identified TP (or other) water quality targets and other tools such as the Watershed Pollutant Load Reduction Calculator (or other tool) will be used to help determine general best management practices (BMPs) and level of implementation needed to meet TP targets and load reduction goals.
3. Maintain water quality in vulnerable and exceptional water bodies and cisco refuge lakes.

8. Restoration and protection

Restoration and protection strategies have been developed based on priority areas within the BFRW.

8.1 Impaired Lakes

It is important to improve lake water quality in impaired lakes. The following lakes are impaired and have been identified as priority in cycle 2: (Please see the dedicated priority subwatershed section for more information on each of these water bodies).

***Island Lake* (31-0913-00)**

A TMDL study was completed in 2017, Final Island Lake Total Maximum Daily Load Report.

***Jessie Lake* (31-0786-00)**

A TMDL study was completed in 2011, Lake Nutrient TMDL for Jessie Lake.

***Shallow Pond* (31-0910-00)**

A TMDL study has not been completed yet, and it has been deferred until the shallow lake standard is implemented for the Northern Lakes and Forest Ecoregion.

***Little Spring* (31-0797-00)**

A TMDL study has not been completed yet, and it has been deferred until the shallow lake standard is implemented for the Northern Lakes and Forest Ecoregion.

8.2 Potentially Impaired Lakes

The following lakes are wholly within the LLBO reservation boundary. An impairment has not yet been designated and will be determined by EPA based on LLBO water quality data at a future date.

***Bowstring Lake* (31-0813-00)**

A protection study is being planned on this lake in partnership with LLBO and MPCA.

***Round Lake* (31-0896-00)**

A protection study is being planned on this lake in partnership with LLBO and MPCA.

***Dunbar Lake* (31-0904-00)**

A protection study is being planned on the tributaries to and from Dunbar Lake as part of the Bowstring and Round Lake Study in partnership with LLBO and MPCA.

8.3 Vulnerable Lakes

The following lakes are vulnerable to becoming impaired for Aquatic Recreation Use and have been identified as priority for protection in cycle 2:

***Little Sand Lake* (31-0853-00)**

Little Sand Lake is wholly within the Leech Lake Reservation and is subject to LLBO water quality standards. Water quality has declined since 2012.

***Dora Lake* (31-0882-00)**

Dora Lake has insufficient information to assess for aquatic life and aquatic recreation; however, it is considered vulnerable to becoming impaired due to TP and chl-*a* being close to the standard. It is suggested to collect more TP and chl-*a* samples in order for it to be assessed. The Secchi parameter is currently meeting standards.

***Busties Lake* (31-0530-00)**

Busties Lake is entirely within the Bois Forte Reservation. Busties Lake is meeting standards for aquatic life and aquatic recreation; however, is it considered vulnerable to becoming impaired due to an increase in chl-*a* since cycle 1.

***Little Bowstring Lake* (31-0758-00)**

Little Bowstring Lake is meeting standards for aquatic life and has insufficient information for aquatic recreation; however, it is considered vulnerable to becoming impaired due to relatively low Secchi disk readings.

Impaired and Vulnerable Lake Analysis:

Several BFRW WRAPS focus lakes with poorer water quality were analyzed for similarities that sets them apart from other BFRW lakes. The impaired lakes, vulnerable lakes, and lakes with general lower water quality in the BFRW have a few morphological and watershed characteristics that set them apart from lakes exhibiting good water quality in the BFRW. The eight lakes that were analyzed were Island, Dunbar, Shallow Pond, Little Bowstring, Little Sand, Round, Bowstring and Dora. It is worth noting these lakes have some of the lowest land disturbances in all of the BFRW. Common characteristics of the impaired and vulnerable lakes include:

- All have max depths and mean depths less than 40 ft and 15 ft, respectively
- Nearly all have watershed to lake area ratios greater than 10 to 1
- All have higher potential for weak stratification and periodic mixing events as demonstrated by lower Osgood index (i.e., less than 5) (relationship of lake size and mean depth; Osgood 1988) and larger fetch to max depth ratios (i.e, greater than 150) (similar to Osgood index) compared to lakes exhibiting better water quality
- Generally higher percentage of wetlands in their drainage areas (i.e., greater than 30%)
- Generally lower percentage of forested land (i.e., less than 50%) in their drainage areas compared to other lakes in the watershed

The characteristics of the eight lakes are graphed in Appendix A. Table 16 is a summary list of the BFRW lake characteristics.

Table 16. Big Fork River Watershed Lake Characteristics.

Characteristic (approximate "breakpoint")	All Big Fork Lakes (N=135)	Big Fork Lakes meeting criteria (N=96)	Big Fork Lakes not meeting criteria (N=39)*	Big Fork WRAPS focus lakes (N=8)
Max depth (<=40 ft)	46%	35%	**77%**	**100%**
Mean depth (<=15 ft)	50%	38%	**75%**	**88%**
Watershed size (>=2,500 acres)	40%	33%	**56%**	**100%**
Watershed to lake area ratio (>=10)	50%	47%	56%	**88%**
Watershed size/mean depth (>=200)	53%	42%	**75%**	**100%**
Osgood Index (<=5)	44%	22%	**88%**	**100%**
Fetch/max depth (>=100)	58%	41%	**87%**	**100%**
Watershed % disturbed (>=5)	24%	26%	18%	**0%**
Watershed % wetland (>=20)	60%	54%	**77%**	**88%**
Watershed % forested (<50)	42%	33%	**64%**	**88%**

Red = denotes significant difference (i.e., >25%) from lakes meeting criteria in the Big Fork Watershed

*meeting/not meeting TP criteria of 20 ug/L criteria, Secchi criteria of 3.0 m, or both

8.4 Vulnerable Streams

The following streams are vulnerable to becoming impaired for Aquatic Life Use and have been identified as priorities for protection in cycle 2:

Caldwell Brook ***(*****09030006-510)**

Caldwell Brook is meeting standards for aquatic life; however, it is considered vulnerable to becoming impaired due to decline in fish community which could be from channel instability. Caldwell Brook is exceeding the standard for TP and has inconclusive data for TSS.

Big Fork River (Deer Creek to Caldwell Brook 09030006-504)

The Big Fork River from Deer Creek to Caldwell Brook is meeting standards for aquatic life; however, it is considered vulnerable to becoming impaired due to TSS and Secchi tube exceeding the standard.

Big Fork River (Reilly Brook to Sturgeon River 09030006-503)

The Big Fork River from Reilly Brook to Sturgeon River is meeting standards for aquatic life; however, it is considered vulnerable to becoming impaired due to TSS and Secchi tube exceeding the standard.

Hay Creek (09030006-610)

Hay Creek is meeting standards for aquatic life; however, it is considered vulnerable to becoming impaired due to changes in macroinvertebrate community. The change in macroinvertebrates is reasonably a result of the drought in 2021 and the high water in 2022. The extreme fluctuations in precipitation patterns in 2021 and 2022 suggest climate change may be playing a role in the biological changes observed at this location. This water is currently meeting standards but is vulnerable to impairment for macroinvertebrates.

Bowstring River (09030006-575)

Bowstring River is meeting standards for aquatic life; however, there is incomplete information to assess it against aquatic recreation standards with respect to *E. coli*. More samples are necessary to make an assessment.

Bear River (09030006-516)

Bear River is meeting standards for aquatic life; however, there is incomplete information to assess it against aquatic recreation standards with respect to *E. coli*. More samples are necessary to make an assessment.

Reilly Creek (09030006-625)

Reilly Creek is meeting standards for aquatic life; however, it is considered vulnerable to becoming impaired based on fish community. A geomorphological study is recommended to further understand bank instability in this reach.

8.5 Exceptional Streams

Protecting streams and rivers that are currently healthy is far more cost-effective than restoring lost health and function.

The following streams have been identified as exceptional and are priority for protection in cycle 2:

<u>Big Fork River</u> (Bear River to Rainy River 09030006-501)

This section of the Big Fork River was recommended for a change in its designated aquatic life use to a warm water exceptional use stream based on cycle 2 assessment data.

<u>Big Fork River</u> (Sturgeon River to Bear River 09030006-502)

This section of the Big Fork River was recommended for a change in its designated aquatic life use to a warm water exceptional use stream based on cycle 2 assessment data.

<u>Big Fork River</u> (Reilly Brook to Sturgeon River 09030006-503)

This section of the Big Fork River was recommended for a change in its designated aquatic life use to a warm water exceptional use stream based on cycle 2 assessment data.

<u>Big Fork River</u> (Deer Creek to Caldwell Brook 09030006-504)

This section of the Big Fork River was recommended for a change in its designated aquatic life use to a warm water exceptional use stream based on cycle 2 assessment data.

<u>Big Fork River</u> (Caldwell Brook to Reilly Brook 09030006-507)

This section of the Big Fork River was recommended for a change in its designated aquatic life use to a warm water exceptional use stream based on cycle 2 assessment data.

<u>Rice River</u> (Headwaters (Cameron Lake) to Batson Lake Outlet 09030006-644)

This section of the Rice River was recommended for a change in its designated aquatic life use to a warm water exceptional use stream based on cycle 2 assessment data.

8.6 Exceptional Lakes

<u>Big Too Much Lake</u> (31-0793-00)

Big Too Much Lake is proposed as exceptional use for aquatic life, based on DNR's Fish IBI, this new classification is pending as part of future changes to Minnesota Rules. The FIBI scores of 80 and 73 from the surveys were well above the impairment threshold of 45 and exceptional threshold of 64. Big Too Much Lake has a transparency of 4 meters, 2 parts per billion (ppb) chl-*a*, and 8 ppb TP based on a 10-year average of all summer samples.

According to the DNR's WHAF tool for TP Sensitivity Significance Priority Class, Big Too Much Lake has been rated higher for phosphorus sensitivity, out of high, higher, and highest. The DNR's WHAF explains phosphorus sensitivity is "the predicted loss in lake clarity with additional phosphorus loading into the lake", and that Big Too Much Lake would lose 29 inches in water clarity with an addition of 100 pounds of phosphorus to the lake. *(DNR 2024a)*

<u>Burns Lake</u> (31-0654-00)

Burns Lake is proposed as exceptional use for aquatic life, based on DNR's Fish IBI, this new classification is pending as part of future changes to Minnesota Rules. The FIBI score of 78 from the survey was above the impairment threshold of 45 and exceptional threshold of 64. Burns Lake has a transparency of 6 meters, 2 ppb chl-*a*, and 9 ppb TP based on a 10-year average of all summer samples.

According to the DNR’s WHAF Tool for TP Sensitivity Significance Priority Class, Burns Lake has been rated highest for phosphorus sensitivity, out of high, higher, and highest. The DNR’s WHAF explains phosphorus sensitivity is “the predicted loss in lake clarity with additional phosphorus loading into the lake”, and that Burns Lake would lose 75 inches in water clarity with an addition of 100 pounds of phosphorus to the lake. (DNR 2024a)

<u>Clubhouse Lake</u> (31-0540-00)

Clubhouse Lake is proposed as exceptional use for aquatic life, based on DNR’s Fish IBI, this new classification is pending as part of future changes to Minnesota Rules. The FIBI scores of 77 and 64 from the surveys were above the impairment threshold of 45 and exceptional threshold 64. Clubhouse Lake has a transparency of 5 meters based on a 10-year average of all summer samples.

According to the DNR’s WHAF Tool for TP Sensitivity Significance Priority Class, Clubhouse Lake has been rated higher for phosphorus sensitivity, out of high, higher, and highest. The DNR’s WHAF explains phosphorus sensitivity is “the predicted loss in lake clarity with additional phosphorus loading into the lake”, and that Clubhouse Lake would lose 11 inches in water clarity with an addition of 100 pounds of phosphorus to the lake (DNR 2024a).

<u>Mirror Lake</u> (31-0160-00)

Mirror Lake is proposed as exceptional use for aquatic life, based on DNR’s Fish IBI, this new classification is pending as part of future changes to Minnesota Rules. The FIBI scores of 71 and 72 from the surveys were above the impairment threshold of 45 and exceptional threshold of 64. Mirror Lake has a transparency of 5 meters, 2 ppb chl-*a*, and 13 ppb TP based on a 10-year average of all summer samples.

According to the DNR’s WHAF Tool for TP Sensitivity Significance Priority Class, Mirror Lake has been rated highest for phosphorus sensitivity, out of high, higher, and highest. The DNR’s WHAF explains phosphorus sensitivity is “the predicted loss in lake clarity with additional phosphorus loading into the lake”, and that Mirror Lake would lose 119 inches in water clarity with an addition of 100 pounds of phosphorus to the lake (DNR 2024a).

<u>North Star Lake</u> (31-0653-00)

North Star Lake is proposed as exceptional use for aquatic life, based on DNR’s Fish IBI, this new classification is pending as part of future changes to Minnesota Rules. The FIBI score of 80 from the survey was well above the impairment threshold of 45 and exceptional threshold of 64. North Star Lake has a transparency of 5 meters, 2 ppb chl-*a*, and 10 ppb TP based on a 10-year average of all summer samples.

According to the DNR’s WHAF Tool for TP Sensitivity Significance Priority Class, North Star Lake has been rated highest for phosphorus sensitivity, out of high, higher, and highest. The DNR’s WHAF explains phosphorus sensitivity is “the predicted loss in lake clarity with additional phosphorus loading into the lake”, and that North Star Lake would lose 50 inches in water clarity with an addition of 100 pounds of phosphorus to the lake (DNR 2024a).

***Sand Lake* (31-0826-00)**

Sand Lake is wholly within the Leech Lake Reservation. This lake is proposed as exceptional use for aquatic life, based on DNR's Fish IBI, this new classification is pending as part of future changes to Minnesota Rules. The FIBI score of 79 from the survey was well above the impairment threshold of 45 and exceptional threshold of 64. Sand Lake has a transparency of 4 meters, 3 ppb chl-*a*, and 18 ppb TP based on a 10-year average of all summer samples.

According to the DNR's WHAF Tool for TP Sensitivity Significance Priority Class, Sand Lake has been rated high for phosphorus sensitivity, out of high, higher, and highest. The DNR's WHAF explains phosphorus sensitivity is "the predicted loss in lake clarity with additional phosphorus loading into the lake", and that Sand Lake would lose 0 inches in water clarity with an addition of 100 pounds of phosphorus to the lake (DNR 2024a).

***Turtle Lake* (31-0725-00)**

Turtle Lake is proposed as exceptional use for aquatic life, based on DNR's Fish IBI, this new classification is pending as part of future changes to Minnesota Rules. The FIBI scores of 64 from the recent survey was above the impairment threshold of 45 and equal to the exceptional threshold of 64. The FIBI scores of 75 and 66 from the supplemental historic surveys were above the impairment threshold and the exceptional threshold. Turtle Lake has a transparency of 5 meters, 2 ppb chl-*a*, and 10 ppb TP based on a 10-year average of all summer samples.

According to the DNR's WHAF Tool for TP Sensitivity Significance Priority Class, Turtle Lake has been rated highest for phosphorus sensitivity, out of high, higher, and highest. The DNR's WHAF explains phosphorus sensitivity is "the predicted loss in lake clarity with additional phosphorus loading into the lake", and that Turtle Lake would lose 12 inches in water clarity with an addition of 100 pounds of phosphorus to the lake (DNR 2024a).

***Grave Lake* (31-0624-00 which has been split into child WIDs 31-0624-01 and -02)**

Grave Lake is proposed as exceptional use for aquatic life, based on DNR's Fish IBI, this new classification is pending as part of future changes to Minnesota Rules. The FIBI score of 66 from the survey was above the impairment threshold of 45 and exceptional threshold of 64. Grave Lake has a transparency of 4.1 meters based on 28 measurements.

According to the DNR's WHAF Tool for TP Sensitivity Significance Priority Class, Grave Lake has been rated higher for phosphorus sensitivity, out of high, higher, and highest. The DNR's WHAF explains phosphorus sensitivity is "the predicted loss in lake clarity with additional phosphorus loading into the lake", and that Grave Lake would lose 28 inches in water clarity with an addition of 100 pounds of phosphorus to the lake. (DNR 2024a)

8.7 Other High Priority Lakes

***Larson Lake* (31-0317-00)**

Larson Lake did not get assessed for aquatic life; however, this lake is considered high priority for protection. Larson Lake has a transparency of 7 meters, 1 ppb chl-*a*, and 7 ppb TP based on a 10-Year average of all summer samples.

According to the DNR's WHAF Tool for TP Sensitivity Significance Priority Class, Larson Lake has been rated highest for phosphorus sensitivity, out of high, higher, and highest. The DNR's WHAF explains phosphorus sensitivity is "the predicted loss in lake clarity with additional phosphorus loading into the lake", and that Larson Lake would lose 130 inches in water clarity with an addition of 100 pounds of phosphorus to the lake (DNR 2024a).

Caribou Lake (***31-0620-00)***

Caribou Lake did not get assessed for aquatic life; however, this lake is considered high priority for protection. Caribou Lake has a transparency of 10 meters based on a 10-year average of all summer samples.

According to the DNR's WHAF Tool for TP Sensitivity Significance Priority Class, Caribou Lake has been rated highest for phosphorus sensitivity, out of high, higher, and highest. The DNR's WHAF explains phosphorus sensitivity is "the predicted loss in lake clarity with additional phosphorus loading into the lake", and that Caribou Lake would lose 163 inches in water clarity with an addition of 100 pounds of phosphorus to the lake (DNR 2024a).

Nickel Lake (31-0470-00)

Nickel Lake did not get assessed for aquatic life; however, this lake is considered high priority for protection. Nickel Lake has a transparency of 4 meters, 5 ppb chl-*a*, and 11 ppb TP based on a 10-year average of all summer samples.

According to the DNR's WHAF Tool for TP Sensitivity Significance Priority Class, Nickel Lake has been rated higher for phosphorus sensitivity, out of high, higher, and highest. The DNR's WHAF explains phosphorus sensitivity is "the predicted loss in lake clarity with additional phosphorus loading into the lake", and that Nickel Lake would lose 191 inches in water clarity with an addition of 100 pounds of phosphorus to the lake (DNR 2024a*).*

Three Island Lake (31-0542-00)

Three Island Lake did not get assessed for aquatic life; however, this lake is considered high priority for protection. Three Island Lake has a transparency of 8 meters based on a 10-Year average of all summer samples.

According to the DNR's WHAF Tool for TP Sensitivity Significance Priority Class, Three Island Lake has been rated highest for phosphorus sensitivity, out of high, higher, and highest. The DNR's WHAF explains phosphorus sensitivity is "the predicted loss in lake clarity with additional phosphorus loading into the lake", and that Three Island Lake would lose 87 inches in water clarity with an addition of 100 pounds of phosphorus to the lake (DNR 2024a).

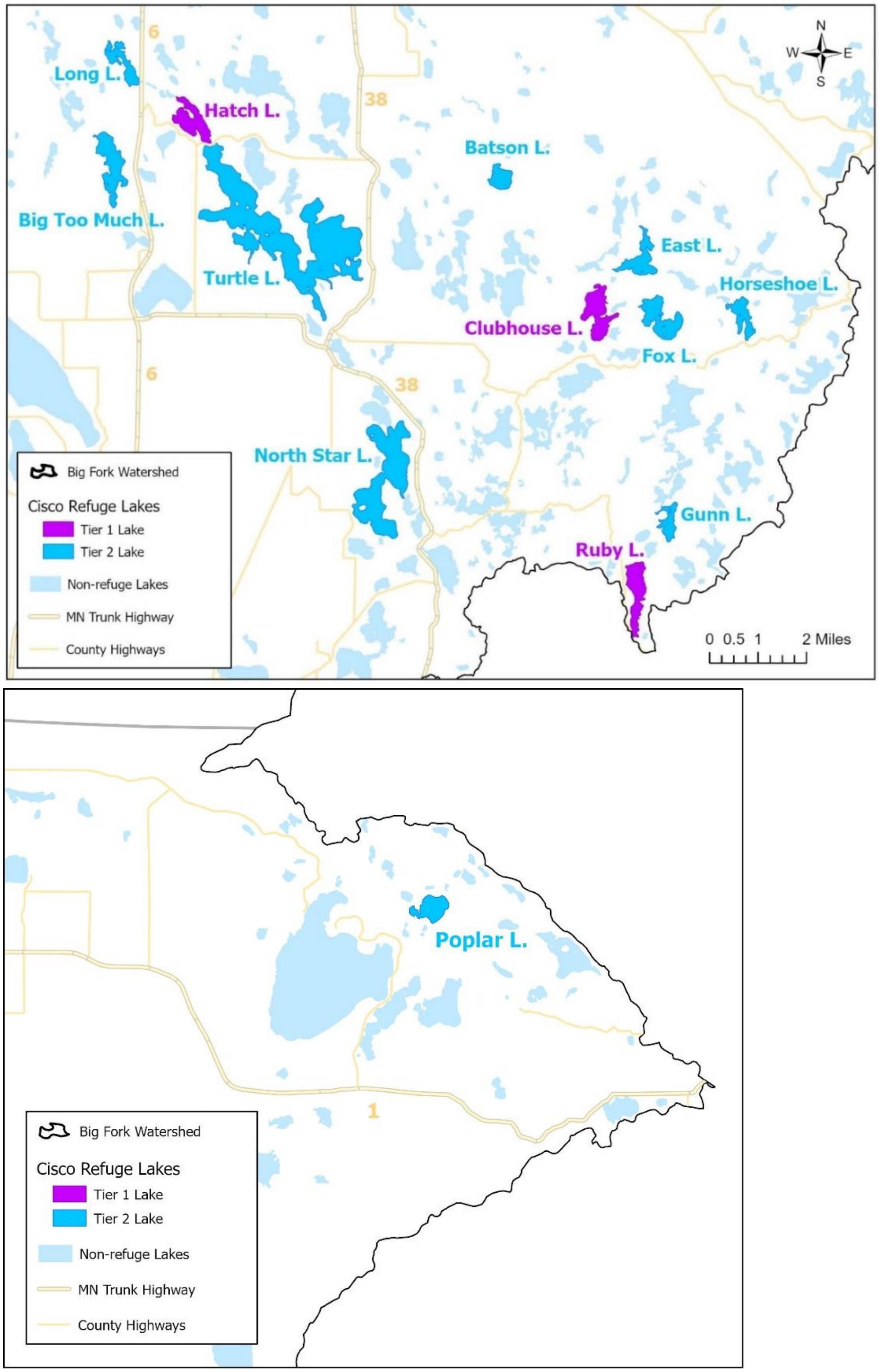
8.8 Cisco Refuge Lakes

Table 17. Table of Big Fork River Watershed Cisco refuge lakes.

Lake Name	Lake ID	Tier 1 or Tier 2
Hatch Lake	31-0771-00	Tier 1
Clubhouse Lake	31-0540-00	Tier 1
Ruby Lake	31-0422-00	Tier 1
Long Lake	31-0781-00	Tier 2
Big Too Much Lake	31-0793-00	Tier 2
Turtle Lake	31-0725-00	Tier 2
North Star Lake	31-0653-00	Tier 2
Batson Lake	31-0704-00	Tier 2
East Lake	31-0460-00	Tier 2
Horseshoe Lake	31-0466-00	Tier 2
Fox Lake	31-0463-00	Tier 2
Gunn Lake	31-0452-00	Tier 2
Poplar Lake	31-0196-00	Tier 2

DNR has recently identified lakes within the BFRW with very high-quality habitat for Cisco, a cold-water fish species. Protecting these identified lakes from water quality degradation is a great way to protect the species. Cisco is an important dietary food for walleye, muskellunge, northern pike, lake trout and common loons. These identified lakes have good, cold, oxygenated water quality and have been predicted to continue to have good habitat under future climate scenarios. These lakes are broken up into Tier 1 and Tier 2 lakes. The Tier 1 lakes are identified as expecting to have good habitat well into the future and Tier 2 lakes are expected to continue to have some habitat into the future but not as much as Tier 1 is expected. Table 17 is a list of the Cisco Refuge Lakes and Figure 63 is a map showing the Tier 1 and Tier 2 Cisco refuge lakes that are within the BFRW.

Figure 63. Big Fork River Watershed cisco refuge lakes.



For more information on these cisco refuge lakes, the DNR presentation, https://www.youtube.com/watch?v=DQxF4ij1agM, explains how the warming climate is putting a "summer squeeze" on the areas that these fish can survive in the summer months. When there is a long ice-free season and hot summer temperatures, this puts thermal stress on cold-water fish species because they must move out of the cold water to seek oxygen. Oxygen can get depleted in the cold-water part of the lake (bottom) in the summer months because the warm layer on top that has the oxygen from the surface does not mix with cold water on the bottom. The more nutrients (like phosphorus) that enters the lake, the more algae blooms there are, and the more algae blooms there are, there more algae that dies and sinks to the bottom using up the Cisco's oxygen in the decomposition process. It's going to be ever so important to reduce the amount of phosphorus entering the lake and protect cold-water sources to the lake in order to protect these cold-water fish species. (DNR 2024c).

There is also a report titled Simulations of Cisco Fish Habitat in Minnesota Lakes under Future Climate Scenarios: https://files.dnr.state.mn.us/fish_wildlife/fisheries/slice/slice-sim-cisco.pdf. This report explains that these cisco refuge lakes are exceptional,

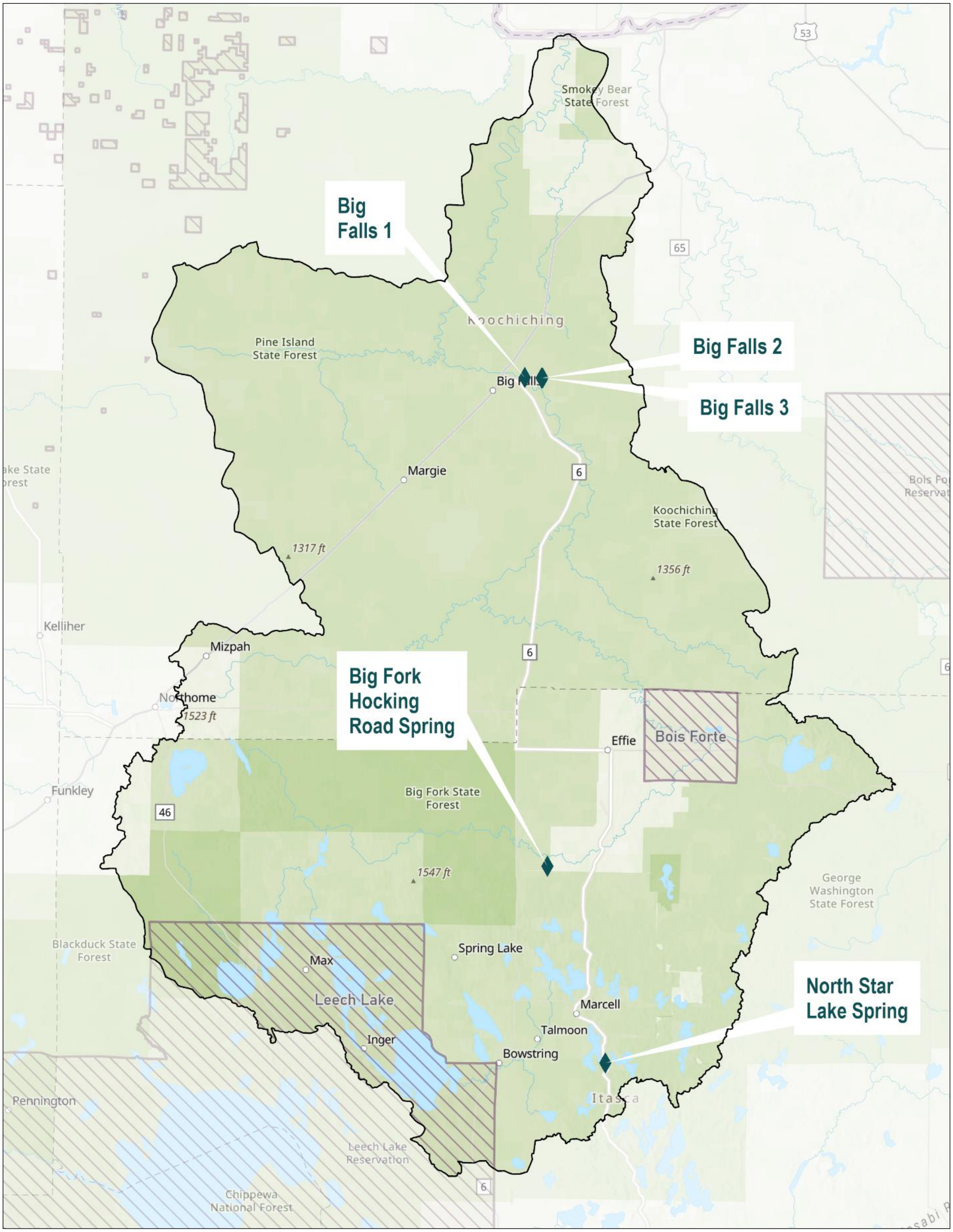
> "It can be concluded that the cisco refuge lakes (Tier 1 and Tier 2) identified in this report have bathymetric and transparency characteristics that are different from the ensemble of 620 cisco lakes in Minnesota. In the first project report of this study (Fang et al. 2009) it was shown that the 620 cisco lakes in Minnesota are substantially different from the bulk of Minnesota's lakes. In this third project report of the study it has been shown that refuge lakes are even more exceptional" (Fang et. Al 2010).

8.9 Groundwater Springs

The DNR defines a spring as "*a focused, natural discharge where water emerges from the ground"* (DNR 2024b*).* A spring survey was conducted within the BFRW in Cycle 2. Figure 64 shows the locations where springs were found.

It is important to protect groundwater springs for several reasons. Springs are a cold, oxygen-rich water source to streams and lakes, and springs provide refuge to fish species who require cold water with abundant oxygen. Cold-water fish species in the BFRW include, lake trout, stream trout, cisco (tullibee), and whitefish; furthermore, cisco is an important species in the food chain for walleye, pike, and other sustenance fish species. Springs also provide a sustaining water source to lakes and streams, especially in hot summer months and throughout drought conditions. It's also important to protect springs from becoming contaminated as they are interconnected with the groundwater table. The springs listed below have been field verified by MPCA, Koochiching SWCD, and Itasca SWCD and entered into the DNR Spring Inventory, Minnesota Spring Inventory | Minnesota DNR. Continuing to locate and protect more groundwater springs within the BFRW would be beneficial in the future.

Figure 64. Big Fork River Watershed field verified springs.



North Star Lake Springs: 47.543929°, -93.647234°

North Star Lake groundwater springs. This is a series of springs running North to South located just off the East side of highway 38 near Marcell, Minnesota. These springs flow from the ground with noticeable discharge areas, vibrant areas of moss in the flow area, with bright copper colored staining of iron mineral precipitate in other areas. The springs flow from numerous areas of the base of a hill at approximately 5 gallons per minute (GPM) in approximately 250ft length, flow north/south along the ditch of the highway and then into culverts, which run under Hwy 38 and deposit into North Star Lake. The temperature of the springs are from 5.70 to 6.10 degrees Celsius, the conductivity is 333.7-338.7 microsiemens per centimeter (µS/cm), the DO is 0.29-4.93 mg/L, and there is iron deposition and sulfur odor. North Star Lake has an average Secchi depth of approx. 13ft, chl-*a* of about 2.5, and TP mean of about 11.

Figure 65. North Star Lake Springs.

Big Fork Hocking Road Spring: 47.729722°, -93.730720°

This spring is located on Itasca County land near the town of Bigfork, Minnesota. The groundwater bubbles to the surface and flows North (generally) about ¾ of a mile and then making its way into the Big Fork River. This area has a significant amount of moss vegetation, is lined with cedar trees, and the spring is quickly noticed through the winter snow. This spring has an estimated flow of 1 gallon per minute (GPM). The temperature is 0.6 degrees Celsius, the conductivity is 209 µS/cm, the DO is 7.44 mg/L, and there are marsh marigolds growing in the spring water.

Figure 66. Big Fork Hocking Road Spring.

Big Falls Spring 1: 48.192057°, -93.769316°

Big Falls 1 is a spring located east of the town of Big Falls and on the north side of the Big Fork River. This spring is off County Road 31 and located in a freshwater forested/shrub wetland. This spring is roughly 700 ft from the Big Fork River and provides a source of coldwater to the river. This spring is located on state land with low risk of disturbance. The highest risk to this stream would be logging and equipment use in the vicinity of the spring. This spring has an estimated flow of 1 GPM. The temperature is 8.80 degrees Celsius, the conductivity is 384.5 µS/cm, the DO is 5.96 mg/L, and there is moss growing near the spring.

Figure 67. Big Falls 1 spring.

Big Falls Spring 2: 48.191782°, -93.745468°

Big Falls 2 is a spring located east of the town of Big Falls and at the headwaters of Trout Brook. Trout Brook is a DNR designated trout stream. This spring is located in a freshwater forested/shrub wetland and located at the base of a ridge line that runs east to west. This area has a significant amount of moss vegetation lined with cedar trees. This spring is located on state land with low risk of disturbance. The highest risk to this stream would be logging and equipment use in the vicinity of the spring. This spring has an estimated flow of 1 GPM. The temperature is 6.70 degrees Celsius, the conductivity is 301.8 µS/cm, the DO is 4.74 mg/L, and there is moss growing near the spring.

Figure 68. Big Falls 2 spring.

Big Falls Spring 3: 48.191764°, -93.744109°

Big Falls 3 is a spring located east of the town of Big Falls and at the headwaters of Trout Brook. This spring is roughly 300 ft east of Big Falls 2. Trout Brook is a DNR designated trout stream. This spring is located in a freshwater forested/shrub wetland and located at the base of a ridge line that runs east to west. This area has a significant amount of moss vegetation lined with cedar trees. This spring is located on state land with low risk of disturbance. The highest risk to this stream would be logging and equipment use in the vicinity of the spring. This spring has an estimated flow of 2 GPM. The temperature is 7.60 degrees Celsius, the conductivity is 365.10 µS/cm, the DO is 5.52 mg/L, and there is moss growing near the spring.

8.10 Culvert Inventory

Stream crossings are an essential part of water connectivity throughout the watershed. The design of a stream crossing can have a significant impact on the connectivity, geomorphology, biology, hydrology, and water quality aspects of water bodies. While culverts have historically been utilized as a relatively cost-effective way to address stream crossings, a poorly designed crossing can have significant negative impacts to the watershed. Culverts can create barriers to fish that may have negative consequences on fish populations. Some of the issues that can cause this are flow conditions, drop at outlets, and improper alignment that creates damming.

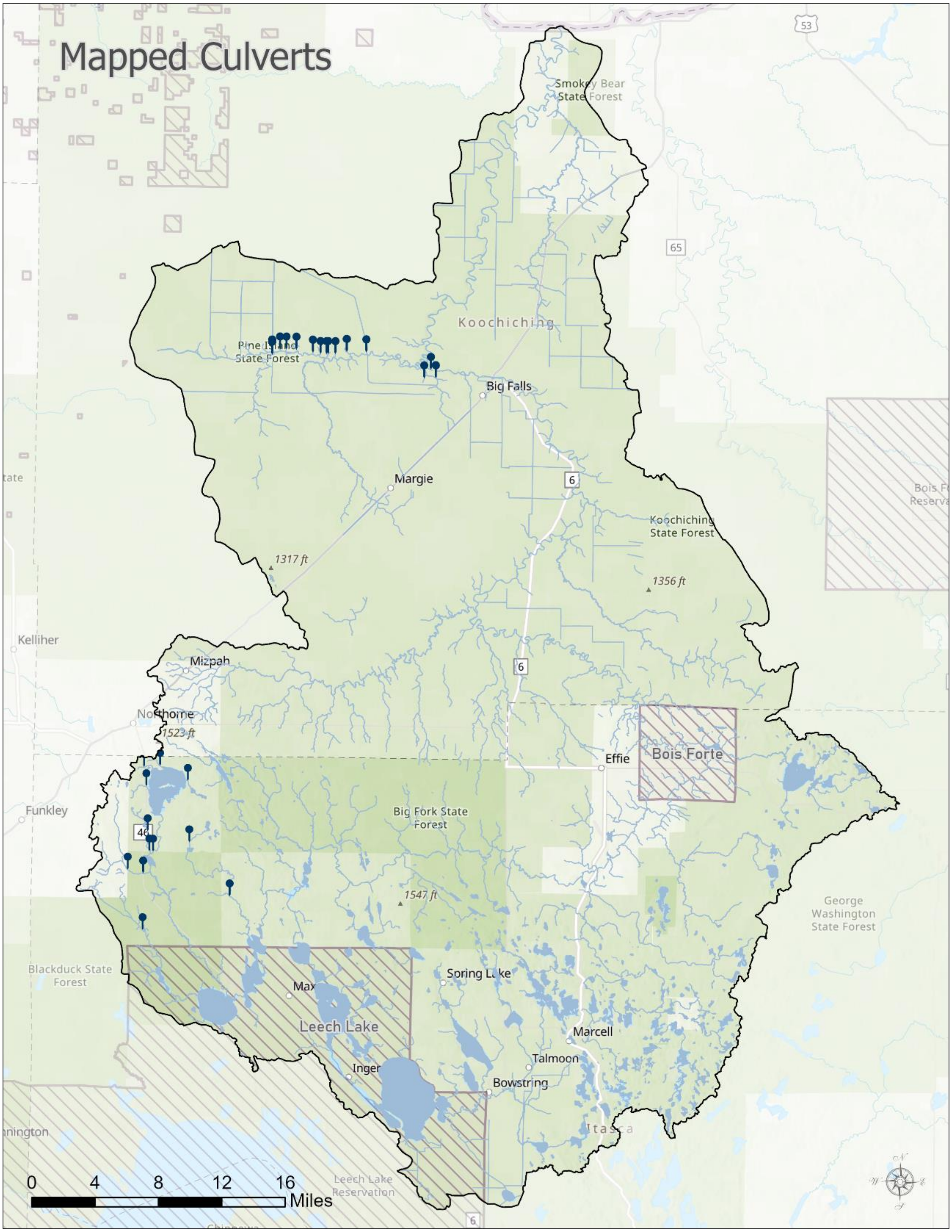
DNR provides training and surveys designed to assess culverts for these potential issues. DNR assessments were used to look at culverts in the Big Fork Watershed to determine a priority for culvert replacement. The culvert inventory was conducted around Island Lake and Shallow Pond in Itasca County in the Popple River HUC-10 Subwatershed (0903000602, and it the Sturgeon River HUC-10 Subwatershed (090300060) in Koochiching County. Figure 69 is a map of the culvert inventory sites.

In Itasca County, stream crossings were assessed for culvert conditions that may impact stream connectivity and pollutant levels. Generally, many of the stream crossings indicated undersized culverts, showing signs of upstream pooling and downstream scouring, which likely contributes to bank erosion and increased sediment and phosphorus levels in the water bodies. While none of the culverts inventoried showed immediate signs of failure, it may be beneficial that road authorities review the culvert inventory assessment and work with local agencies to replace culverts with appropriate designs as road construction projects occur.

In Koochiching County, 15 culverts were assessed for culvert conditions that may impact stream connectivity and pollutant levels. Two culverts were considered high priority due to not being properly aligned, a barrier to fish passage at some flow, and having no substrate in the culvert. Three culverts were considered medium to high priority due to not being properly aligned. Two culverts were considered low-medium priority, one due to not being properly aligned and the other culvert being highly impacted by beaver activity. Eight culverts were considered low priority because they are properly aligned. Appendix C contains more information on the culvert inventory in the Sturgeon River HUC-10.

For more information on the culvert results, please see the Big Fork River Watershed SID Report.

Figure 69. Big Fork River Watershed culvert inventory.



8.11 Big Fork River Streambank Assessment

A streambank erosion assessment was conducted at the public access sites along the Big Fork River. This assessment was a recommendation in the Big Fork River cycle 1 WRAPS report. This assessment was a targeted approach focusing on boat landings and campgrounds along the Big Fork River. Itasca SWCD surveyed 10 access sites along the Big Fork River in Itasca County and Koochiching SWCD surveyed 12 access sites along the Big Fork River in Koochiching County for site erosion. The survey was conducted during the 2020 field season. Access sites along the Big Fork River were assessed with an Erosion Assessment Form, marked by GPS waypoints, and photos were taken to identify erosion. Once the site assessments were completed, Itasca SWCD and Koochiching SWCD rated these sites based on survey data to help identify areas of concerns along the Big Fork River. A score was given for all sites based on erosion observed, vegetation abundance, and bank slope. The lower the score the better rating for the site. These scores, along with other observations, will rank the sites overall sensitivity to erosion (Table 18). Figure 71 shows a map of the prioritized assessment results. Appendix B contains photos of each site and county specific prioritization results and maps.

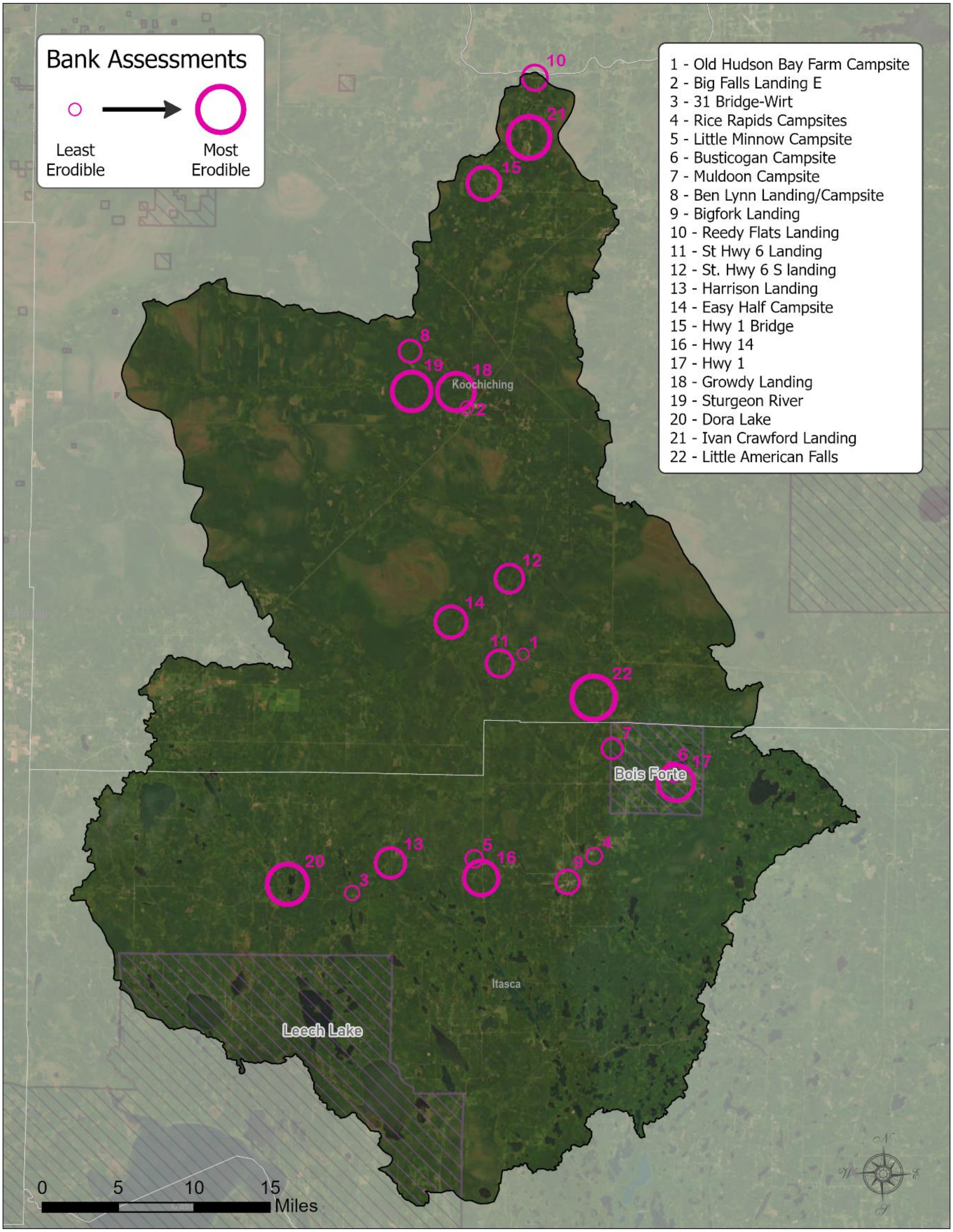
Figure 70. Streambank erosion at Little American Falls campsite.

Table 18. Assessment results for the Big Fork River. Ranked very erodible (1) to least erodible (20).

Big Fork River Assessment in Itasca County and Koochiching County			
Rank:	***Site:***	***Score:***	***Notes:***
1	Little American Falls	50	Steep banks throughout the campsite/landing. Highest amount of erosion observed at all sites. Slumping, gullies, and exposed soil observed throughout the site. See photos to show extent of erosion.
2	Ivan Crawford Landing	37	Little/no vegetation on banks close to river. Some erosion due to boat landing and what looks to be runoff.
3	Dora Lake	34	Federal boat launch that has gully erosion leading into Dora Lake. Sediment has overflowed concert ramp.
4	Sturgeon River Landing	33	Erosion on bank next to stairs and on bank. Overall, the site is in good condition.
5	Gowdy Landing	26	Little/no erosion on site. Buffer of vegetation on shoreline. Grass area next to shoreline does not show any signs of erosion.

Big Fork River Assessment in Itasca County and Koochiching County			
Rank:	***Site:***	***Score:***	***Notes:***
6	Hwy 1	26	State site with gully erosion leading down into river from road.
7	Hwy 14	25	State access site for canoe launch. The water bars need to be replaced, and sediment removed. Lack of maintenance has allowed erosion to occur. Replace sediment control bars.
8	Hwy 1 Bridge	23	Some bare soils on shore where entry and exit of river is happening. Low slope and vegetation along shoreline.
9	Easy Half Campsite	23	Some bare soils on shore where entry and exit of river is happening. Vegetation present throughout the site and no erosion present.
10	Harrison Landing	23	State access campsite and boat launch. Campsite well vegetated. Boat launch is channelized, but slope is relatively flat.
11	St Hwy 6 S Landing	22	Some bare soils on shore where entry and exit of river is happening. Vegetation present throughout the site and no erosion present.
12	St Hwy 6 Landing	21	Some bare soils on shore where entry and exit of river is happening. Minimal erosion present on shoreline next to steps.
13	Reedy Flats Landing	20	Vegetation present throughout shoreline at landing. No erosion present.
14	Bigfork Landing	19	City access site with paved parking lot. Banks are well vegetated.
15	Ben Lynn Landing/Campsite	19	Minimal erosion/bare soils at rivers edge next to steps. Vegetation present throughout site.
16	Muldoon Campsite	17	State site with campsite above Big Fork River, also has a canoe portage that is poorly marked while floating river. Better signage needed for portage.
17	Busticogan Campsite	17	State site with campsite. Site is well vegetative, and single access point to river.
18	Little Minnow Campsite	17	State site with campsite. Single access point is vegetated.
19	Rice Rapids Campsite	17	State site with campsite. Access point from river is vegetated.
20	31 Bridge-Wirt	17	Right-of-way access point off county road.
21	Big Falls Landing E	17	Some bare soil/erosion next to boat launch. Vegetation present throughout site.
22	Old Hudson Bay Farm Campsite	17	Fully vegetated and no bare soil present at site.

Figure 71. Streambank Erosion Assessment results for the Big Fork River.



9. Strategies

The following pages are a list of restoration and protection strategies laid out by HUC-12 subwatersheds, as well as watershed wide. Table 19 is a list of measures to be applied across lakes and streams. During stakeholder discussions, these strategies were deemed valuable to the priority focus areas.

Table 19. Strategies and actions proposed for the Big Fork River Watershed lakes and streams.

Strategy Table for Priority Focus Lakes							
HUC-12 Subwatershed	Water Body (ID)	Water Quality				Strategy Type	Strategy Description
		Topic of Focus	Current Conditions:	Goals/Targets	Estimated Reduction		
Island Lake – Popple River	Island Lake (31-0913-00)	Nutrients	Mean TP 31.7 µg/L Mean chl-*a* 13.1 µg/L Mean Transparency 3.0 m	Mean TP 30.0 µg/L Mean chl-*a* 9.0 µg/L Mean Transparency 2.0 m	Mean TP 1.7 µg/L Mean chl-*a* 4.1 µg/L Mean Transparency 0 m	Enhance forestry management	Protect forested lands within the priority lakeshed and protect coldwater springs entering the lake by doing the following: • Encourage eligible landowners to enroll in the Sustainable Forestry Incentive Act (SFIA) to receive annual payments for keeping their wooded areas undeveloped and converting pasture/hay lands back to forested. This is also important for coldwater springs protection. • Develop and implement forest stewardship plans in the lakeshed. • Encourage Reinvest in Minnesota (RIM) activities (e.g., conservation easements) in forested areas. This is also important for coldwater springs protection. • Increase compliance with the Forest Management Guidelines from the Minnesota Forest Resources Council. According to the 2018 implementation results report called Timber Harvesting and Forest Management Guidelines on Public and Private Forest Land in Forested Watersheds in Minnesota, "watershed outreach is needed on the importance of riparian management zones to all landowners in the Rainy River, Little Fork and Big Fork Watershed sample unit where Riparian Management Zone compliance was lowest at 50%" (DNR 2018). The guidelines explain to maintain a filter strip between the water body and the forest disturbance can protect surface water. Filter strips are areas adjacent to perennial and intermittent streams, lakes, open water wetlands, nonopen water wetlands, seasonal ponds, seeps and springs that help minimize the runoff of sediment, debris, nutrients and pesticides into these water bodies. Filter strips provide a zone of infiltration that protects surface water by 1) allowing remaining vegetation to remain essentially undisturbed, and 2) allowing the forest floor to trap sediment from adjacent land areas. The guidelines also go into details on wetlands and water bodies, riparian management zones, steam crossings, and other implementation efforts to protect water while logging (DNR 2018). • Provide education, outreach and training (ex., Big Fork Forest Day) to forest land planners and logging operators. • Continue to map springs in the DNR Spring 123 App. Mapping springs will allow foresters to know their locations and abide by the filter.
						Address failing septic systems	• Identify and upgrade 100% of failing septic systems in riparian areas around the lake and lake tributaries • Conduct a public outreach and information campaign in septic system upgrade funding opportunities (e.g. grants, low-interest loan programs)

Strategy Table for Priority Focus Lakes							
HUC-12 Subwatershed	Water Body (ID)	Water Quality				Strategy Type	Strategy Description
		Topic of Focus	Current Conditions:	Goals/Targets	Estimated Reduction		
						Shoreline improvement	• Connect with and encourage real estate professionals to modify their conversations with clients about lakeshore and lawn management to encourage native plants and explain shoreline regulations. • Connect with and educate landowners about lakeshore and lawn management BMPs practices. Explain shoreline regulations. Reduce lawncare fertilizer use in lakeshore lawns. Promote natural wooded and herbaceous ground cover. Install rain gardens to filter pollutants before entering lake. Promote native shoreline buffers. Promote a grant and funding opportunity such as the Lawns to Legumes program. • Maintain or improve natural shoreline buffers by planting perennials, and instead of mowing all the way to the lake, let the vegetation grow. According to the MN Natural Shoreline Partnership, "shorelines of mowed turf to the lake allow 7 to 9 times more pollutants to enter the water than those with natural vegetation. Pollutants accumulate, causing water quality issues, promoting algal blooms, and leading to the growth of excessive aquatic vegetation" (MN Lakes and Rivers Advocates 2025). For more information see The MN Natural Shoreline Partnership – Minnesota Lakes & Rivers Advocates. • Encourage plant growth and limit weeding of aquatic vegetation. According to MN Natural Shoreline Partnership, "aquatic plants play a vital role in maintaining the health of Minnesota's lakes and rivers by providing habitat and food for various fish and wildlife species. They help improve water quality by absorbing excess nutrients and stabilizing sediments, which reduces erosion and prevents algal blooms" (MN Lakes and Rivers Advocates 2025).
						Reduce watershed nutrient loading	• Further assess sources of watershed loading (e.g., wetlands, land disturbance), mitigate anthropogenic sources of nutrients.
						Restore altered hydrology	• Assess lakeshed for ditched wetlands, if found, plug, backfill and restore wetland to natural state, where possible.
						Public outreach on shoreline protection	• Public outreach targeting lakeshore landowners and contractors on the importance of shoreline protection.
						Culvert and road management	• Mitigate erosion at all road crossings, where feasible. Replace undersized culverts and culverts that are causing erosion.
	Shallow Pond (31-0910-00)	Nutrients	Mean TP 52.0 µg/L Mean chl-*a* 22.4 µg/L Mean Transparency 1.5 m	Mean TP 30.0 µg/L Mean chl-*a* 9.0 µg/L Mean Transparency 2.0 m	Mean TP 22.0 µg/L Mean chl-*a* 13.4 µg/L Mean Transparency 0.5 m	Refer to lake strategies above	Refer to lake strategies above Note: A TMDL study is being deferred until the shallow lake standards are approved.
Round Lake	Round Lake (31-0896-00)	Nutrients	Mean TP 53.3 µg/L Mean chl-*a* 27.4 µg/L	Mean TP 20 µg/L Mean chl-*a* 9.0 µg/L Mean Transparency 1.8 m	Mean TP 33.3 µg/L Mean chl-*a* 18.4 µg/L	Refer to lake strategies above	Refer to lake strategies above Note: A protection study is planned to be conducted in partnership with MPCA and LLBO on Round Lake in the near future. The report will be published to the MPCA Watersheds website under BFRW. Please refer to the Round Lake Protection Study report for restoration strategies.

Strategy Table for Priority Focus Lakes							
HUC-12 Subwatershed	Water Body (ID)	Water Quality				Strategy Type	Strategy Description
		Topic of Focus	Current Conditions:	Goals/Targets	Estimated Reduction		
			Mean Transparency 1.8 m		Mean Transparency 0 m		Leech Lake Band of Ojibwe Water Quality Standards Act
Dunbar River	Dunbar Lake (31-0904-00)	Nutrients	Mean TP 37.1 µg/L Mean chl-*a* 14.0 µg/L Mean Transparency 1.6 m	Mean TP 20 µg/L Mean chl-*a* 9.0 µg/L Mean Transparency 1.8 m	Mean TP 17.1 µg/L Mean chl-*a* 5.0 µg/L Mean Transparency 0.2 m	Refer to lake strategies above	Refer to lake strategies above Leech Lake Band of Ojibwe Water Quality Standards Act
Bowstring Lake	Bowstring Lake (31-0813-00)	Nutrients	Mean TP 31.1 µg/L Mean chl-*a* 11.2 µg/L Mean Transparency 2.6 m	Mean TP 20 µg/L Mean chl-*a* 9.0 µg/L Mean Transparency 1.8 m	Mean TP 11.1 µg/L Mean chl-*a* 2.2 µg/L Mean Transparency 0 m	Refer to lake strategies above	Refer to lake strategies above Note: A protection study is planned to be conducted in partnership with MPCA and LLBO on Bowstring Lake in the near future. The report will be published to the MPCA Watersheds website under BFRW. Please refer to the Round Lake Protection Study report for restoration strategies. Leech Lake Band of Ojibwe Water Quality Standards Act
Jessie Lake	Jessie Lake (31-0786-00)	Nutrients	Mean TP 52.0 µg/L Mean chl-*a* 17.0 µg/L Mean Transparency 2.9 m	Mean TP 30.0 µg/L Mean chl-*a* 9.0 µg/L Mean Transparency 2.0 m	Mean TP 22.0 µg/L Mean chl-*a* 8.0 µg/L Mean Transparency 0 m	Refer to lake strategies above	Refer to lake strategies above Note: A TMDL study was completed on Jessie Lake in 2011, Lake Nutrient TMDL for Jessie Lake
	Little Spring (31-0797-00)	Nutrients	Mean TP 40.0 µg/L Mean chl-*a* 12.0 µg/L Mean Transparency 2.0 m	Mean TP 30.0 µg/L Mean chl-*a* 9.0 µg/L Mean Transparency 2.0 m	Mean TP 10.0 µg/L Mean chl-*a* 3.0 µg/L Mean Transparency 0 m	Refer to lake strategies above	Refer to lake strategies above Note: A TMDL study is being deferred until the shallow lake standards are approved.
All	Watershed Wide	Nutrients	--	--	--	Refer to Lake Strategies above. Protecting coldwater fish species by limiting excess nutrients	Refer to all lake strategies above to reduce nutrients focusing on cisco refuge lakes, coldwtaer lakes, exceptional lakes, and lakes vulnerable to impairment.
All	Watershed Wide	Wild Rice Protection	--	--	--	Voluntary measures for protecting wild rice stands in Lakes	• Mechanical removal of invasive plants and/or weeds is a better solution than the use of pesticides. • Removing the minimum amount of plant species as necessary when installing boat docks is preferred to protect wild rice stands. • Avoid driving through wild rice stands with a motorboat.

Strategy Table for Priority Focus Lakes							
HUC-12 Subwatershed	Water Body (ID)	Water Quality				Strategy Type	Strategy Description
		Topic of Focus	Current Conditions:	Goals/Targets	Estimated Reduction		
All	Watershed Wide	Mercury in fish tissue	--	--	--	Public outreach for fish consumption advisories	• Share awareness on fish consumption guidelines and share how to access lake specific fish consumption advisories. Fish Consumption Guidance - MN Dept. of Health

Strategy Table for Priority Focus Streams				
HUC-12 Subwatershed	**Water Body (ID)**	**Topic of Focus**	**Strategy Type**	**Strategy Description**
Headwaters Bowstring River	Bowstring River (09030006-575)	*E. coli*	Address septic systems, feedlot and livestock management	• Identify and upgrade 100% of failing septic systems. • Complete livestock and feedlot inventories. Ensure pasture management does not contribute to erosion or sediment loading. Ensure there's an adequate vegetative buffer between feeding area and stream. Develop a plan if needed to address feedlots and livestock at the county level. • Continue to monitor and evaluate *E. coli* sources and patterns in the watershed, taking into consideration growth and die-off of pathogens.
Upper, Middle, Lower Bear River	Bear River (09030006-516*)*	*E. coli*	Refer to strategy types above, address septic systems, feedlot and livestock management	Refer to strategies for Headwaters Bowstring River Subwatershed above.
Upper Caldwell Brook, Pancake Creek, and Middle Caldwell Brook	Caldwell Brook (09030006-510)	TSS	Enhance forestry management	Protect forested lands near the priority stream and protect coldwater springs entering the stream by doing the following: • Encourage eligible landowners to enroll in the Sustainable Forestry Incentive Act (SFIA) to receive annual payments for keeping their wooded areas undeveloped and converting pasture/hay lands back to forested. • Develop and implement forest stewardship plans. • Encourage Reinvest in Minnesota (RIM) activities (e.g., conservation easements) in forested areas. • Increase compliance with the Forest Management Guidelines from the Minnesota Forest Resources Council (MFRC). According to the 2018 implementation results report called Timber Harvesting and Forest Management Guidelines on Public and Private Forest Land in Forested Watersheds in Minnesota, "watershed outreach is needed on the importance of riparian management zones to all landowners in the Rainy River, Little Fork and Big Fork watershed sample unit where Riparian Management Zone compliance was lowest at 50%" (DNR 2018). The guidelines explain to maintain a filter strip between the water body and the forest disturbance can protect surface water. Filter strips are areas adjacent to perennial and intermittent streams, lakes, open water wetlands, nonopen water wetlands, seasonal ponds, seeps and springs that help minimize the runoff of sediment, debris, nutrients and pesticides into these water bodies. Filter strips provide a zone of infiltration that protects surface water by 1) allowing remaining vegetation to remain essentially undisturbed, and 2) allowing the forest floor to trap sediment from adjacent land areas. The guidelines also go into details on wetlands and water bodies, riparian management zones, steam crossings, and other implementation efforts to protect water while logging (DNR 2018). • Provide education, outreach and training (ex., Big Fork Forest Day) to forest land planners and logging operators. Continue to map springs in the DNR Spring 123 App. Mapping springs will allow foresters to know their locations for better compliance with the MFRC guidelines.
			Restore incised channels	• This requires geomorphological expertise, such as exists in DNR. ○ Please refer to the BFRW SID Report for more details specific to Caldwell Brook located in the Improving Caldwell Brook section.
			Increase water storage	• Increase water storage to reduce peak flows in the river and tributaries by incorporating Water and Sediment Control Basins (WASCOBs) and other BMPs in agricultural areas or other high runoff areas. ○ Please refer to the BFRW SID Report for more details specific to Caldwell Brook located in the Improving Caldwell Brook section.
			Log jam removal	• Removal of large log jams may have some benefit to improving the health of Caldwell Brook. ○ Please refer to the BFRW SID Report for more details specific to Caldwell Brook located in the Improving Caldwell Brook section.
		TSS	Increase water storage	• Increase water storage to reduce peak flows in the river and tributaries by incorporating Water and Sediment Control Basins (WASCOBs) and other BMPs in agricultural areas or other high runoff areas.

Strategy Table for Priority Focus Streams				
HUC-12 Subwatershed	**Water Body (ID)**	**Topic of Focus**	**Strategy Type**	**Strategy Description**
Beaver Brook – Big Fork and Town of Craigville – Big Fork.	Big Fork River – Deer Creek to Caldwell Brook (09030006-504)		Stream channel restoration - stabilize ravines, banks, headcuts, and shoreland	• Evaluate and explore the feasibility of streambank restoration opportunities, such as opportunities to restore riparian areas at Little American Falls campground. Little American Falls scored as the highest priority during the Big Fork River Streambank Assessment study (see Appendix B for details). Streambank erosion was primarily caused by human trampling of sensitive banks, due to the camping, picnicking, and swimming from recreational traffic. Feasibility for streambank restoration is high at this location because there is easy access for equipment and workers. It would also be a great educational setting, as restoration signs could be put up regarding the project and for protection after restoration is finished.
			Restore altered hydrology	• Restore altered hydrology by exploring legacy peatland ditching and determining where ditching could be restored (plugged/filled). A starting project could be to determine which ditches would be easiest and/or most cost effective to restore. Some factors to consider: ○ Are the ditches on public land or private (public could be easier), would anyone upstream be affected by plugging them, how difficult are they to access for restoration equipment, are there ditches that the county would like to have removed, and are there some that would provide the best scenario for "multiple benefits". For more information on peatland restoration, please refer to the BFRW SID Report .
			Enhance forestry management	Protect forested lands near the priority stream and protect coldwater springs entering the stream by doing the following: • Encourage eligible landowners to enroll in the Sustainable Forestry Incentive Act (SFIA) to receive annual payments for keeping their wooded areas undeveloped and converting pasture/hay lands back to forested. • Develop and implement forest stewardship plans. • Encourage Reinvest in Minnesota (RIM) activities (e.g., conservation easements) in forested areas. • Increase compliance with the Forest Management Guidelines from the Minnesota Forest Resources Council (MFRC). According to the 2018 implementation results report called Timber Harvesting and Forest Management Guidelines on Public and Private Forest Land in Forested Watersheds in Minnesota, "watershed outreach is needed on the importance of riparian management zones to all landowners in the Rainy River, Little Fork and Big Fork watershed sample unit where Riparian Management Zone compliance was lowest at 50%" (DNR 2018). The guidelines explain to maintain a filter strip between the water body and the forest disturbance can protect surface water. Filter strips are areas adjacent to perennial and intermittent streams, lakes, open water wetlands, nonopen water wetlands, seasonal ponds, seeps and springs that help minimize the runoff of sediment, debris, nutrients and pesticides into these water bodies. Filter strips provide a zone of infiltration that protects surface water by 1) allowing remaining vegetation to remain essentially undisturbed, and 2) allowing the forest floor to trap sediment from adjacent land areas. The guidelines also go into details on wetlands and water bodies, riparian management zones, steam crossings, and other implementation efforts to protect water while logging (DNR 2018). • Provide education, outreach and training (ex., Big Fork Forest Day) to forest land planners and logging operators. • Continue to map springs in the DNR Spring 123 App. Mapping springs will allow foresters to know their locations for better compliance with the MFRC guidelines.
Macaffee Brook – Big Fork River and City of Big Falls – Big Fork River	Big Fork River – Reilly Brook to Sturgeon River (09030006-503)	TSS	Refer to increase water storage, restore altered hydrology, and increase forestry management strategies above.	Refer to strategies for Beaver Brook – Big Fork River and Town of Craigville – Big Fork River subwatersheds above.

Strategy Table for Priority Focus Streams				
HUC-12 Subwatershed	**Water Body (ID)**	**Topic of Focus**	**Strategy Type**	**Strategy Description**
Upper Caldwell Brook, Pancake Creek, and Middle Caldwell Brook	Caldwell Brook (09030006-510)	TSS, TP	Refer to increase water storage and enhance forestry management strategies above.	Refer to strategies for Beaver Brook – Big Fork River and Town of Craigville – Big Fork River subwatersheds above. • Increasing water storage to reduce peak flows, strategies such as installing WASCOBS (and other Ag BMPs) in the headwaters of Caldwell Brook where there is farmland would be beneficial to slow the flow of water and reduce erosion on the streambanks of Caldwell Brook. • Removing log jams could help with reducing flow deflection into the banks that cause streambank erosion.
All	Watershed-wide	Altered hydrology	Peatland Restoration	Locations: • Peatland ditch system between the Big Fork River and Reilly Brook, which drains to the Big Fork River. • Incoming bog ditches from the north into the headwaters of the Sturgeon River. • Peatland ditches to the Big Fork River southeast of Big Falls. • Peatland ditches to the Bear River northeast of Big Falls. For details on specific locations and maps, please refer to the BFRW SID Report. For more strategy ideas on peatland restoration, please see the BFRW SID report and also the Nature Conservancy's Protecting and Restoring Minnesota's Peatlands: PeatlandPlaybook-Jan25.pdf

10. Priorities

Priority water bodies are discussed in Section 4 Watershed Condition and Section 8 Protection and Restoration.

11. Public participation/Public notice

Public participation and outreach for the BFRW WRAPS was extensive to reach as many people as possible in a large, sparsely populated watershed. MPCA partnered with Koochiching and Itasca SWCDs in all the public participation efforts. It began with the WRAPS cycle 2 kickoff event in December 2020. This was an online only event due to Covid restrictions. The online meeting gave the public a brief cycle 1 overview, cycle 2 monitoring locations with an overview on the monitoring process, blue-green algae public outreach, and information on citizen stream, spring, and lake monitoring opportunities. Following this, a social media campaign titled "Watershed Wednesdays" was developed during the spring of 2021 and launched in the summer of 2021. Itasca and Koochiching SWCDs collaborated with MPCA to develop interactive social media posts to engage the public about the BFRW. Ten weekly posts were created with consistent public engagement. Figure 72 shows two posts during the series and Figure 73 and Figure 74 show graphs of the engagement.

Figure 72. Clips from the social media campaign titled "Watershed Wednesdays".

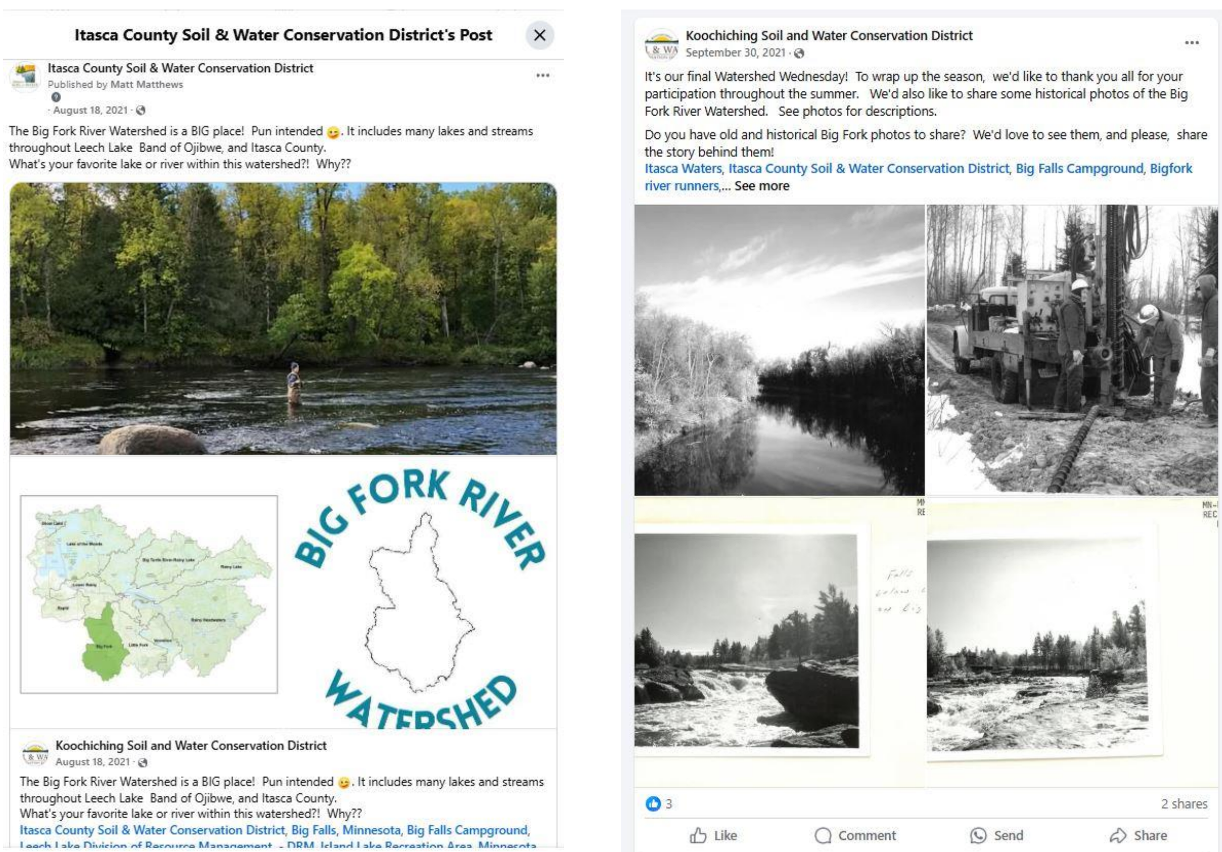


Figure 73. Public engagement results from the social media campaign titled "Watershed Wednesdays".

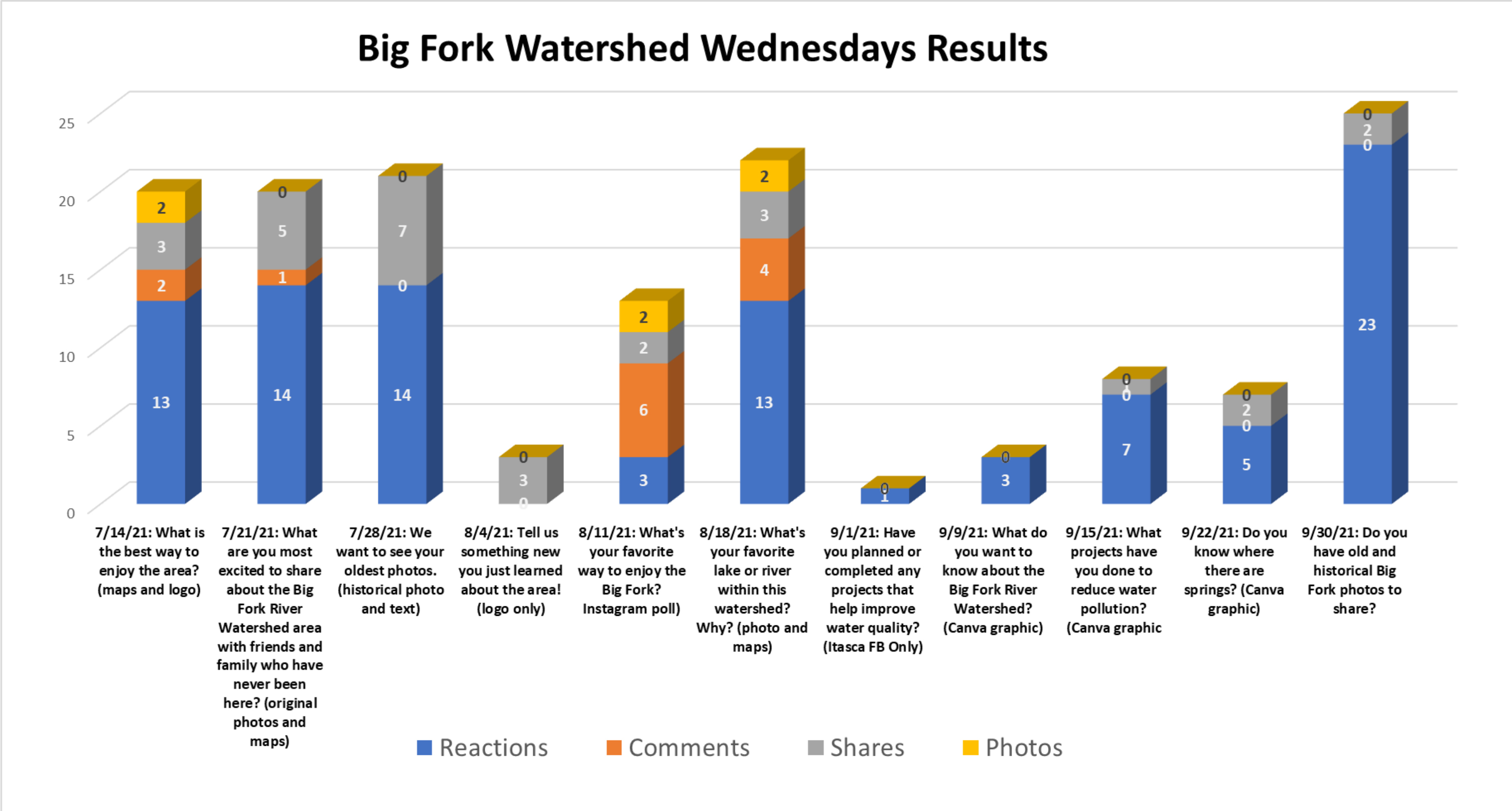
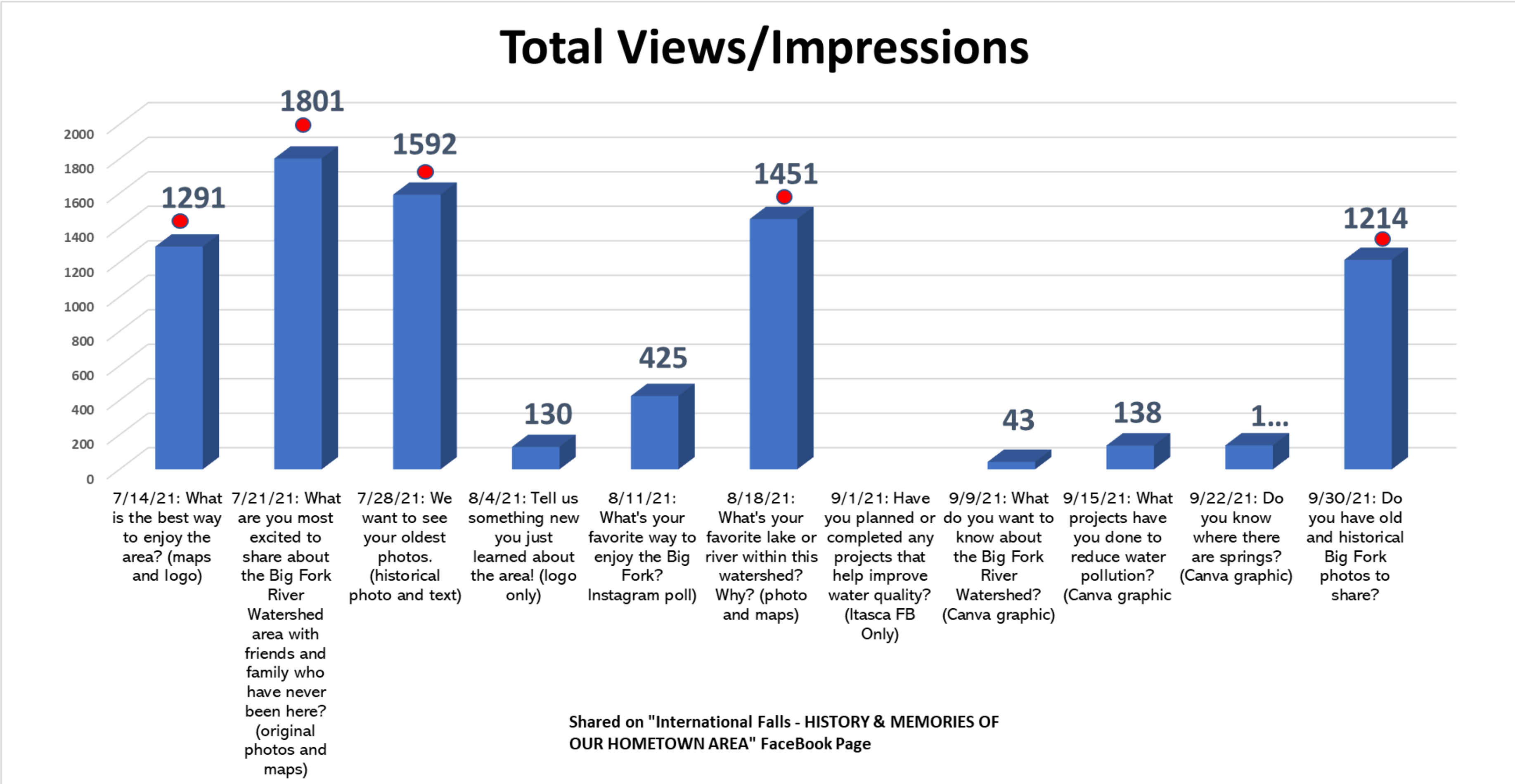


Figure 74. Total views and impressions from the social media campaign titled “Watershed Wednesdays”.



Following some initial public outreach events, WRAPS cycle 2 planning partners brainstormed ideas that might help showcase the gathered data and information to a wide range of people throughout this large watershed. This brainstorming created the idea for a traveling exhibit that could be utilized during events but also could be setup at locations for a period of time where people in the watershed might not otherwise interact with this watershed information.

The display was used at several interactive outreach events including the Bigfork Wilderness Days in Bigfork, Minnesota (June 2024), Bigfork 4H Club meeting in Big Fork, Minnesota (September 2023), Big Fork Elementary School education event in Bigfork, Minnesota (April 2022), and LLBO Earth Day events in Cass Lake, Minnesota (April 2023 and April 2024) where over 300 students attended each year. The outreach events included the traveling display along with an interactive watershed model, groundwater model, and other interactive games.

Figure 75. The traveling display at the LLBO Earth Day event in Cass Lake, MN.

The display was set up for longer periods of time at the Koochiching County fair in Northome, Minnesota (August 2022, 2023, 2024), Itasca County Fair in Grand Rapids, Minnesota (August 2021, 2022, 2023, 2024), Edge of the Wilderness Discovery Center in Marcell, Minnesota (winter 2023/2024), and city of Big Falls Municipal Building in Big Falls, Minnesota (April – June 2024). The display shared lists of impaired water bodies, exceptional and vulnerable water bodies, maps of the watershed, spring locations, restoration and protection strategies, ideas of how people can adjust their actions to benefit water quality, “Get the Lead Out” brochures with sample lead-free tackle and Minnesota Fish Consumption Advisory brochures with magnets. These traveling exhibits allowed folks that live and visit the area to learn about the health of the BFRW and provided contact information if they wanted to learn more. Figure 76 is photos of the traveling exhibit at different locations throughout WRAPS cycle 2.

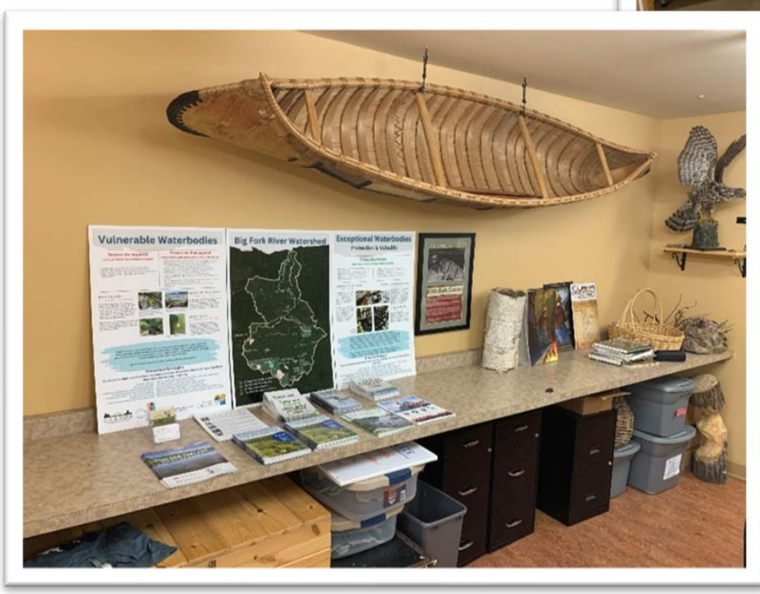


Figure 76. The traveling display at the Koochiching County Fair, Itasca County Fair, and Wilderness Discovery Center.

Public notice for comments

An opportunity for public comment on this draft WRAPS update report was provided via a public notice in the *State Register* from June 2, 2025, through July 2, 2025. There were no comments received and responded to as a result of the public comment period.

12. References

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Appendix A: Impaired and Vulnerable Lake Analysis

Big Fork River Lake Protection Water Quality Criteria

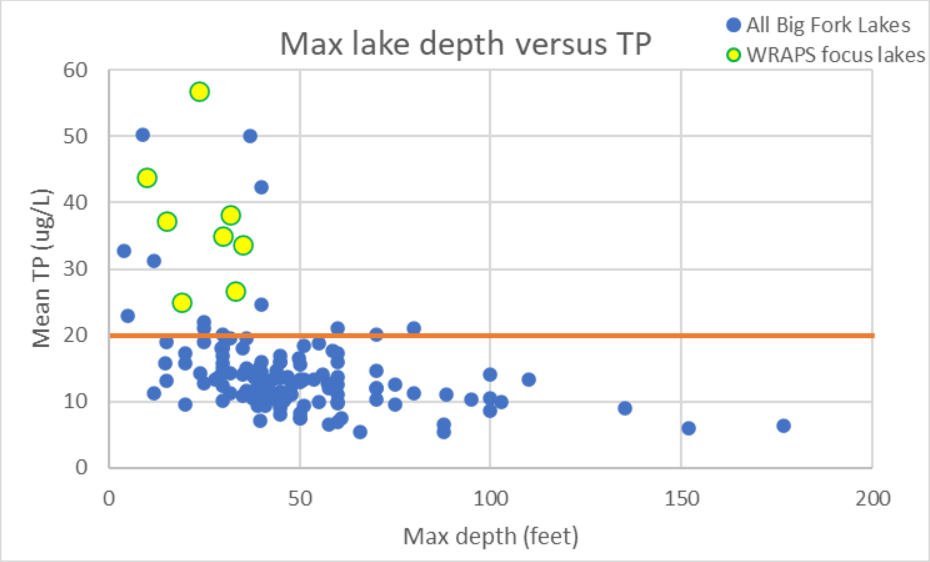
Total Phosphorus (TP) = 20 ug/L (mean in WHAF; N=135)

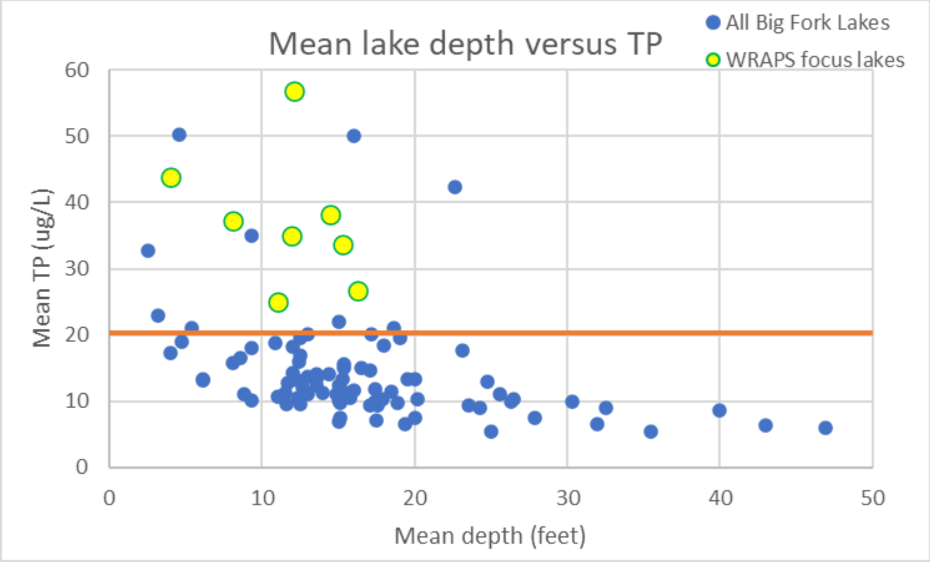
- 22 (16%) of Big Fork lakes >=20 ug/L mean TP
- All 8 Big Fork WRAPS focus lakes >=20 ug/L mean TP

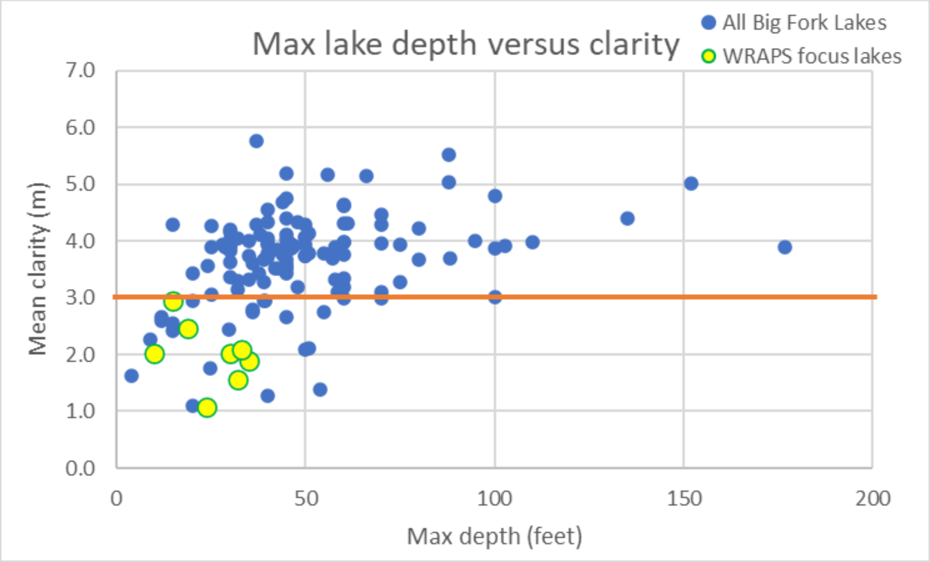
Secchi Depth = 3.0 m (mean in WHAF; N=132)

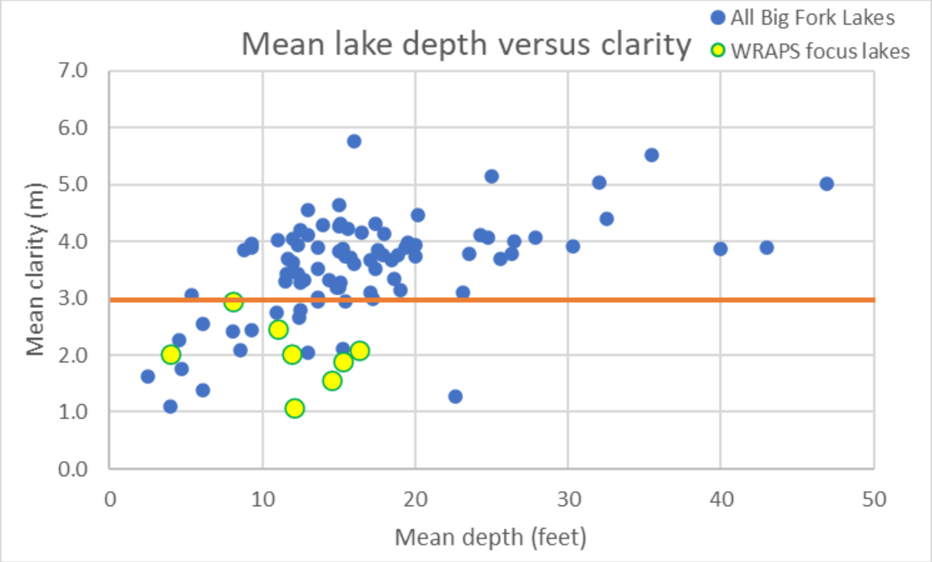
- 33 (25%) of Big Fork lakes <=3.0 m mean Secchi
- All 8 Big Fork WRAPS focus lakes <=3.0 m mean Secchi

Lake characteristics - depth

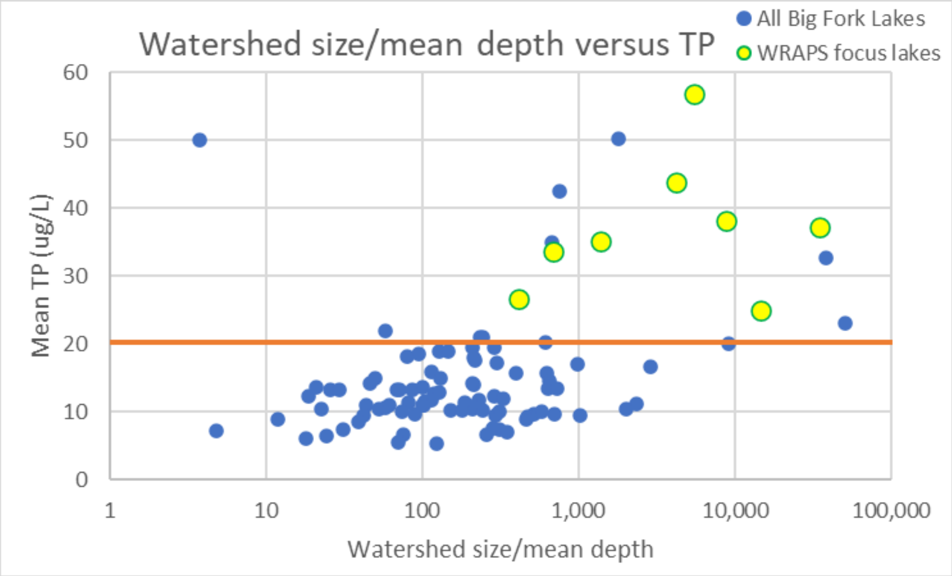


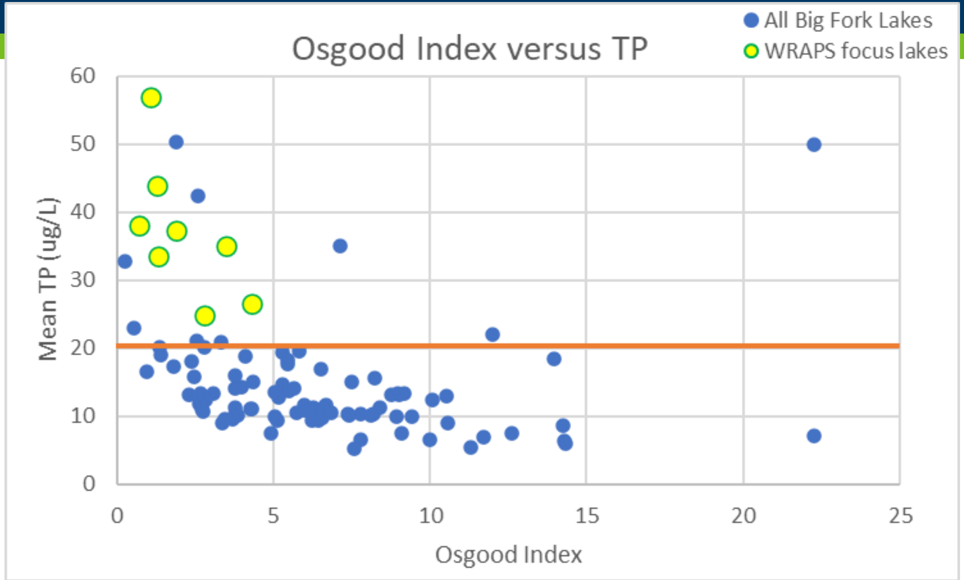


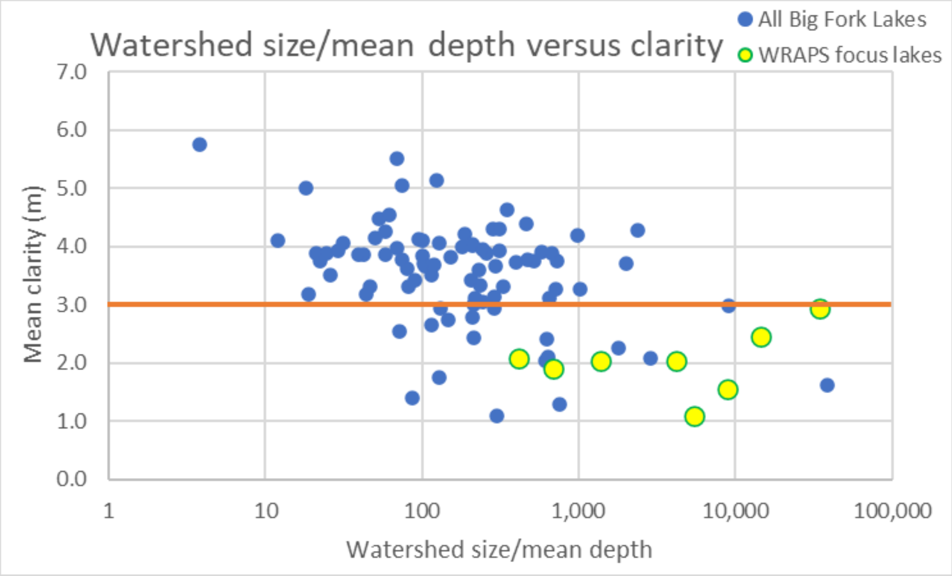


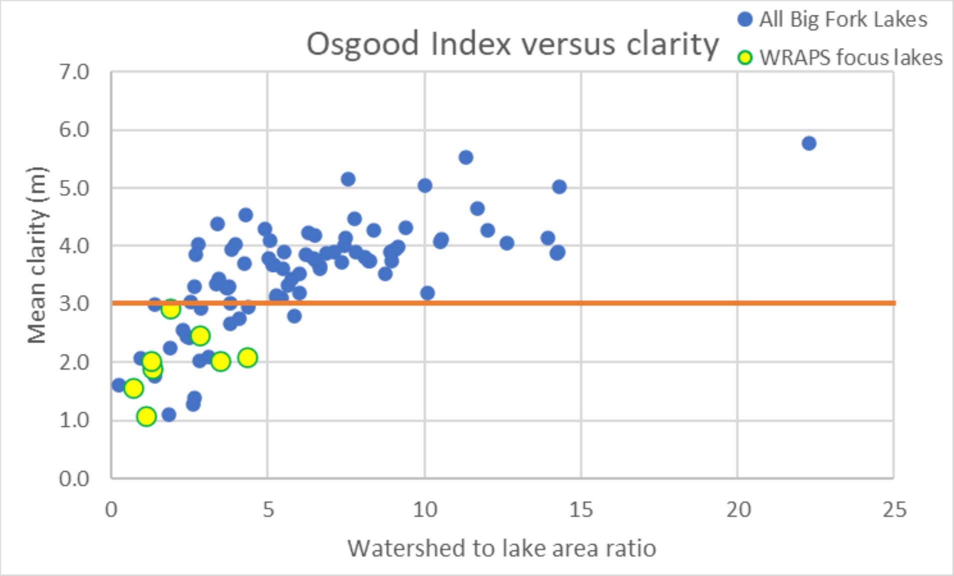


Lake characteristics - morphology

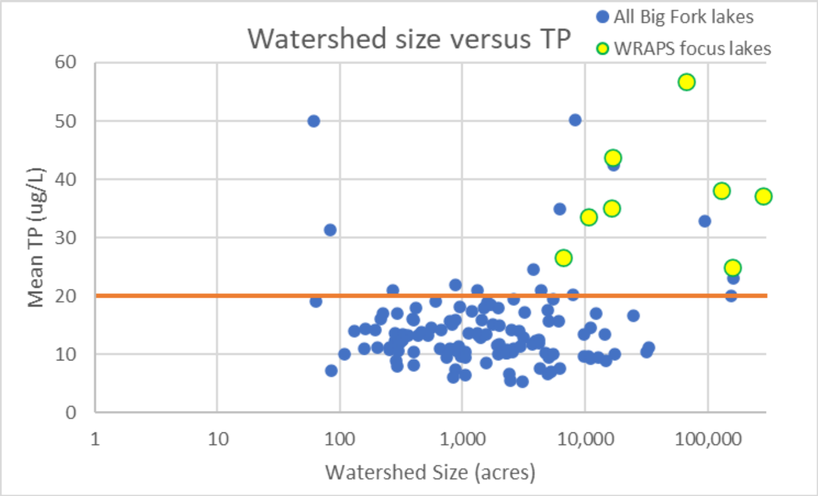


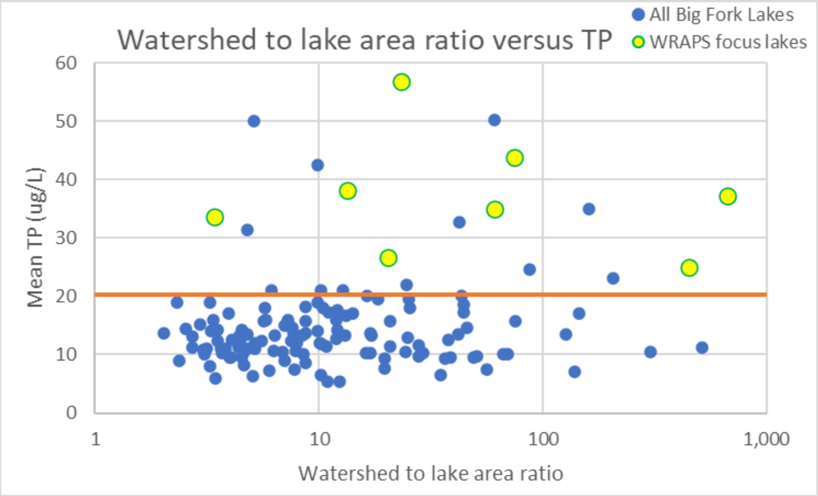


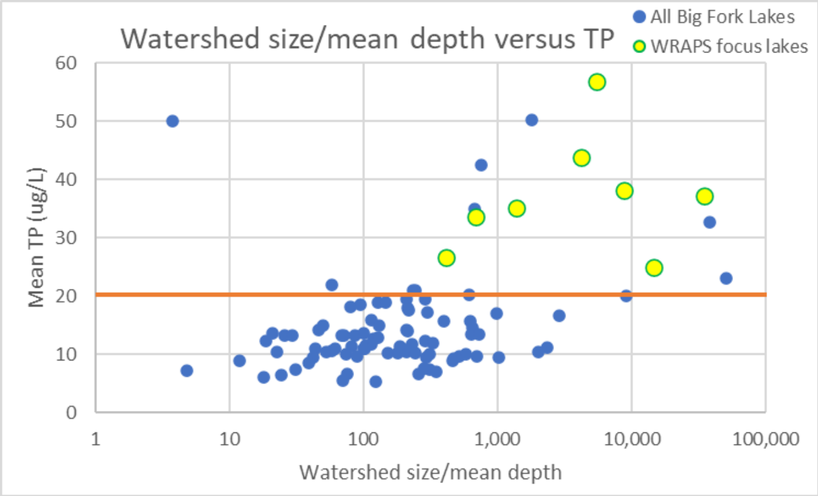


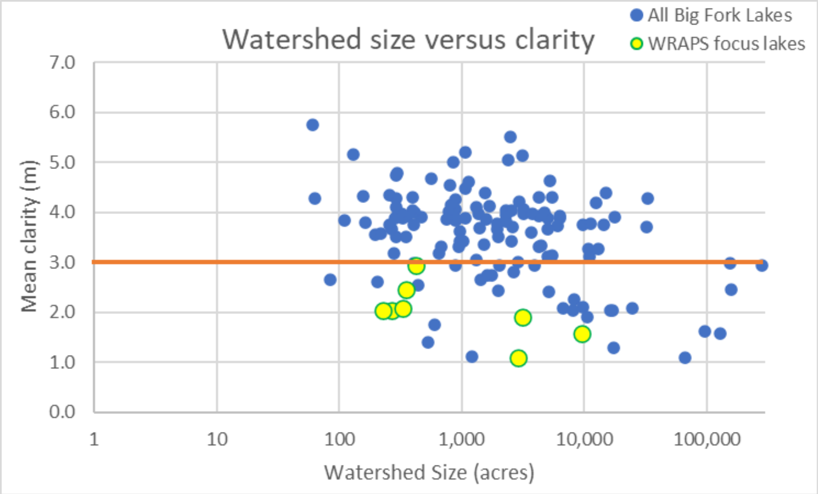


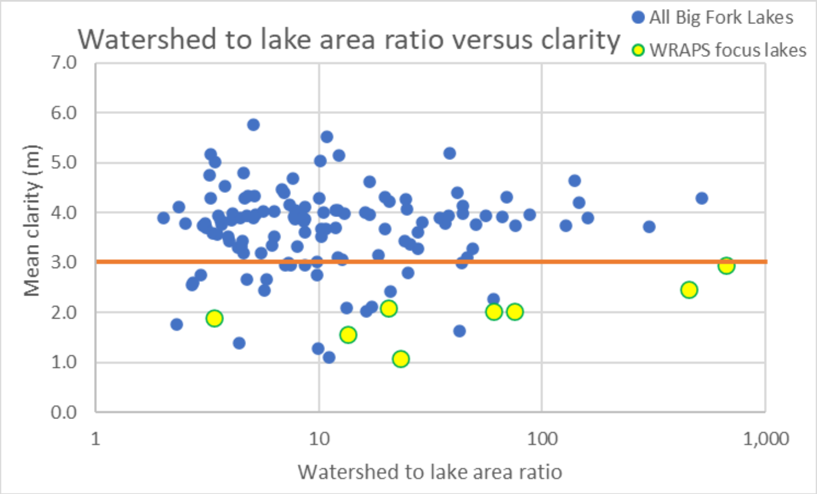
Lake characteristics – watershed

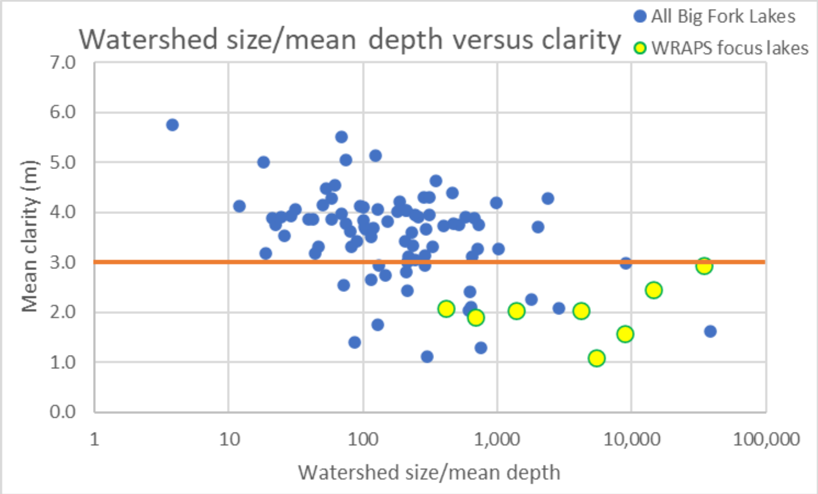




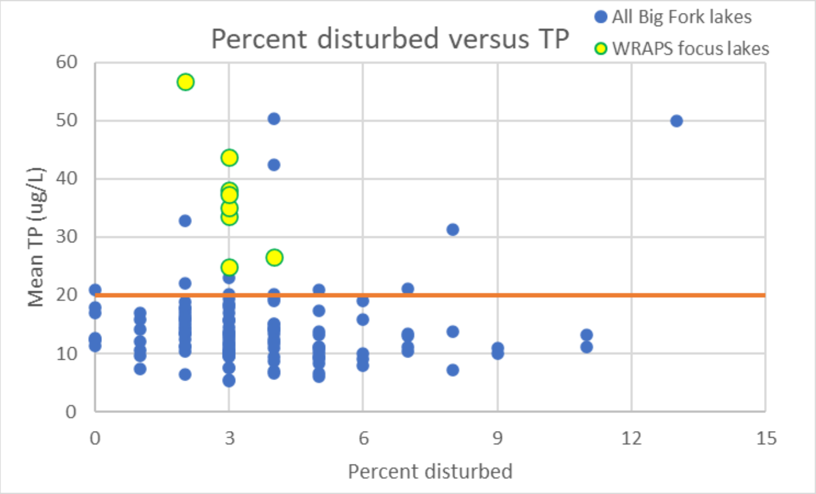


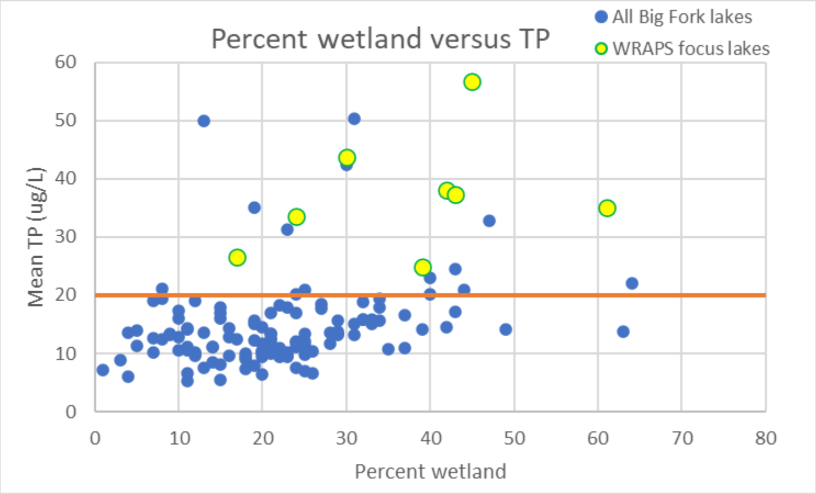


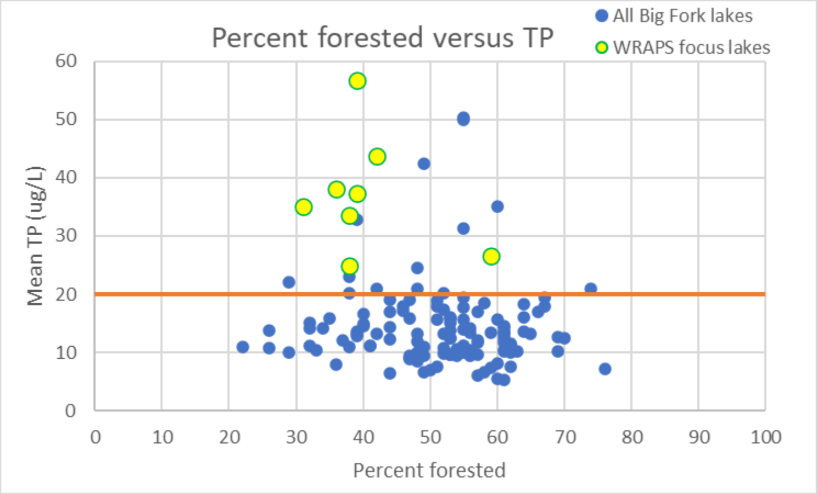


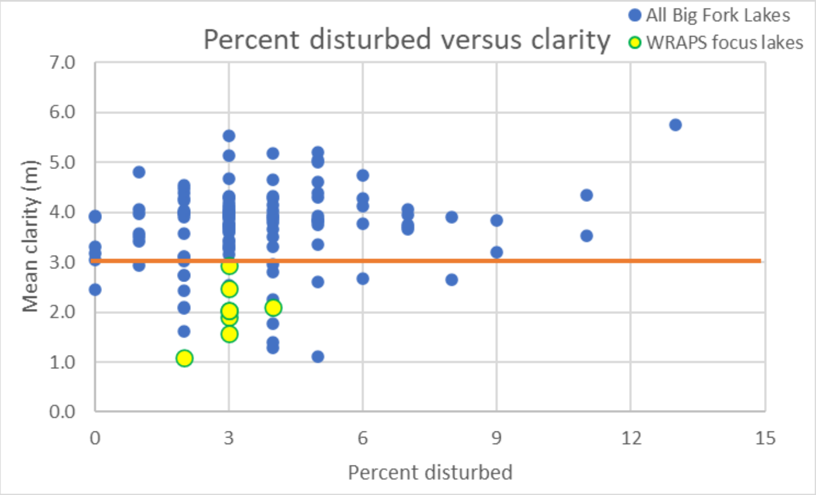


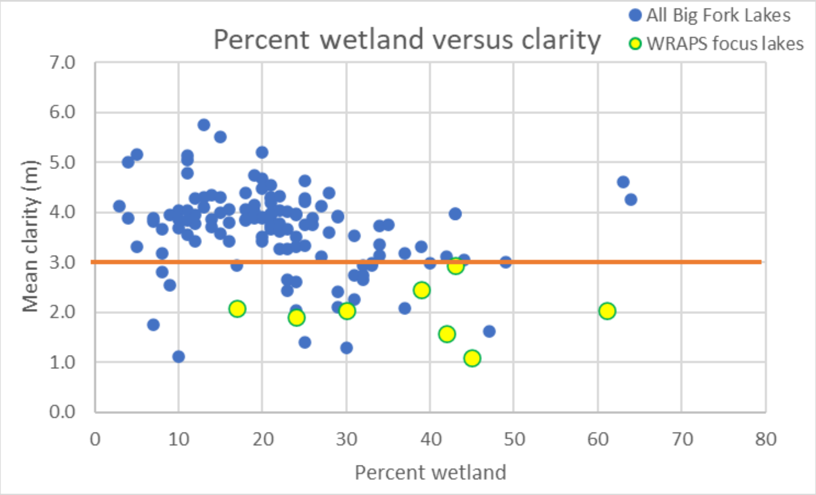
Lake characteristics – land cover

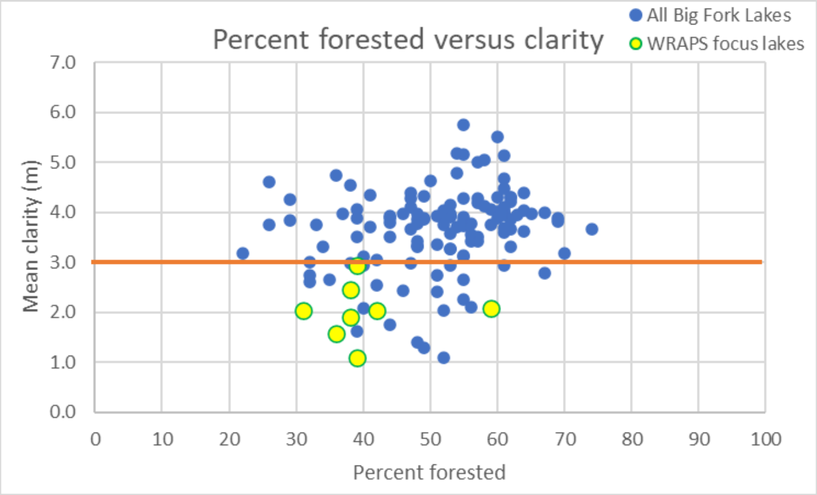












Lake characteristic summary

Characteristic (approximate "breakpoint")	All Big Fork Lakes (N=135)	Big Fork Lakes meeting criteria (N=96)	Big Fork Lakes not meeting criteria (N=39)*	Big Fork WRAPS focus lakes (N=8)
Max depth (<=40 ft)	46%	35%	**77%**	**100%**
Mean depth (<=15 ft)	50%	38%	**75%**	**88%**
Watershed size (>=2,500 acres)	40%	33%	**56%**	**100%**
Watershed to lake area ratio (>=10)	50%	47%	56%	**88%**
Watershed size/mean depth (>=200)	53%	42%	**75%**	**100%**
Osgood Index (<=5)	44%	22%	**88%**	**100%**
Fetch/max depth (>=100)	58%	41%	**87%**	**100%**
Watershed % disturbed (>=5)	24%	26%	18%	**0%**
Watershed % wetland (>=20)	60%	54%	**77%**	**88%**
Watershed % forested (<50)	42%	33%	**64%**	**88%**

Red = denotes significant difference (i.e., >25%) from lakes meeting criteria in the Big Fork Watershed

*meeting/not meeting TP criteria of 20 ug/L criteria, Secchi criteria of 3.0 m, or both

Appendix B: Big Fork River Streambank Assessment

SID Assessment Report

Overview:

Itasca Soil & Water surveyed 10 access sites along the Big Fork River in Itasca county for site erosion. Survey was conducted during the fall of 2020. Access sites along the Bigfork River were assessed with Erosion Assessment Form, marked by GPS waypoints, and photos were taken to identify erosion. Once the site assessments were completed, Itasca Soil & Water ranked these sites based on survey data to help identify areas of concerns along the Big Fork River. These scores, along with other observations, will determine the overall ranking of the sites.

Ranked: very erodible to least erodible (1-10)

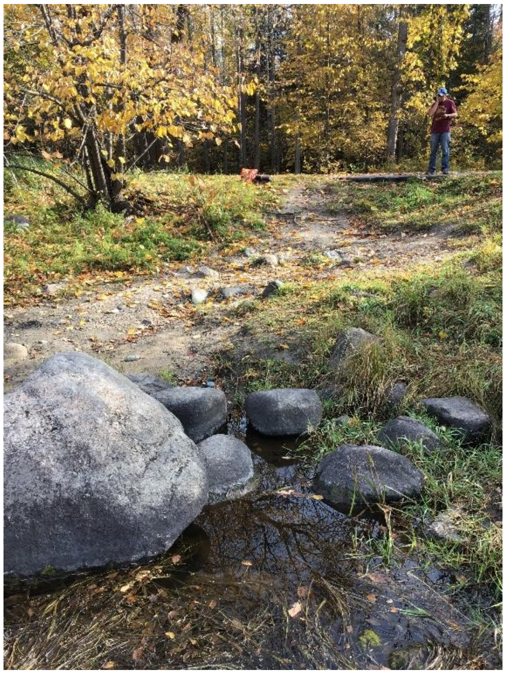
Rank:	*Site:*	*Score:*	*Notes:*
1.	*Dora Lake*	*34*	*Sediment has overflowed concert ramp*
2.	*Hwy 1*	*26*	
3.	*Hwy 14*	*25*	*Replace sediment control bars*
4.	*Harrison Landing*	*23*	
5.	*Bigfork Landing*	*19*	
6.	*Muldoon Campsite*	*17*	*Better signage needed for portage*
7.	*Busticogan Campsite*	*17*	
8.	*Little Minnow Campsite*	*17*	
9.	*Rice River Campsite*	*17*	
10.	*31 Bridge-Wirt*	*17*	

Dora Lake summary:

Federal boat launch that has gully erosion leading into Dora Lake.

Hwy 1 summary:

State site with gully erosion leading down into river from road.



Hwy 14 summary:

State access site for canoe launch, water bars need to be replaced and sediment removed. Lack of maintenance has allowed erosion to occur.

Harrison Landing summary:

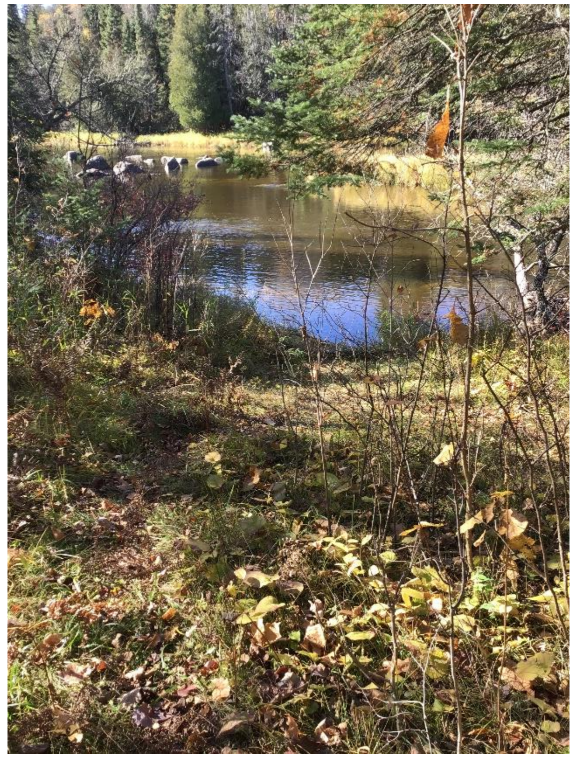
State access campsite and boat launch. Campsite well vegetated. Boat launch is channelized, but slope is relatively flat.

Bigfork Landing summary:

City access site with paved parking lot. Banks are well vegetated.

Muldoon Campsite summary:

State site with campsite above Big Fork River, also has a canoe portage that is poorly marked while floating river.



Busticogan Campsite summary:

State site with campsite. Site is well vegetative, and single access point to river.

Little Minnow Campsite summary:

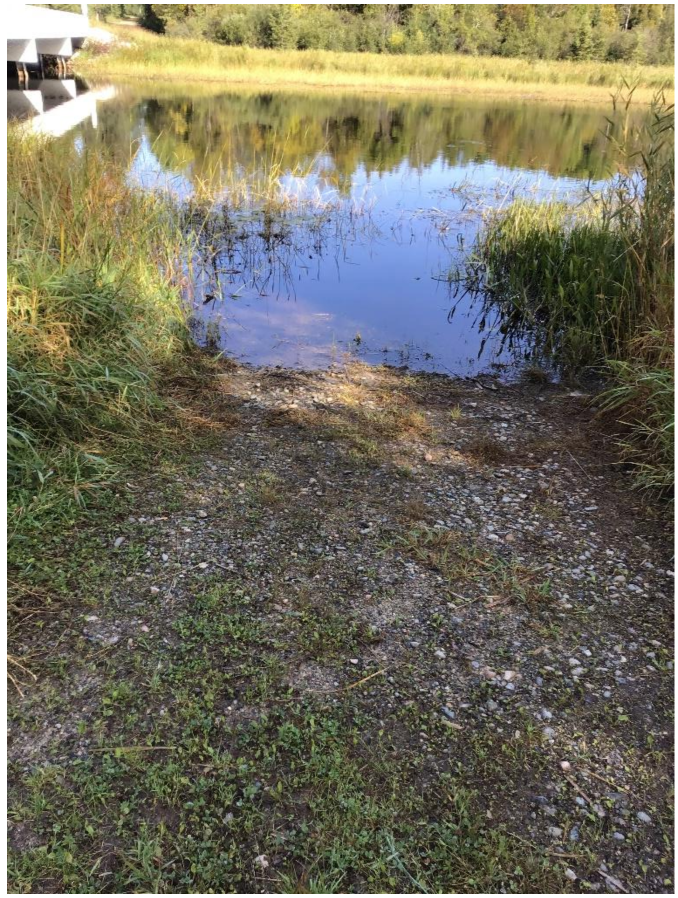
State site with campsite. Single access point is vegetated.

Rice River Campsite summary:

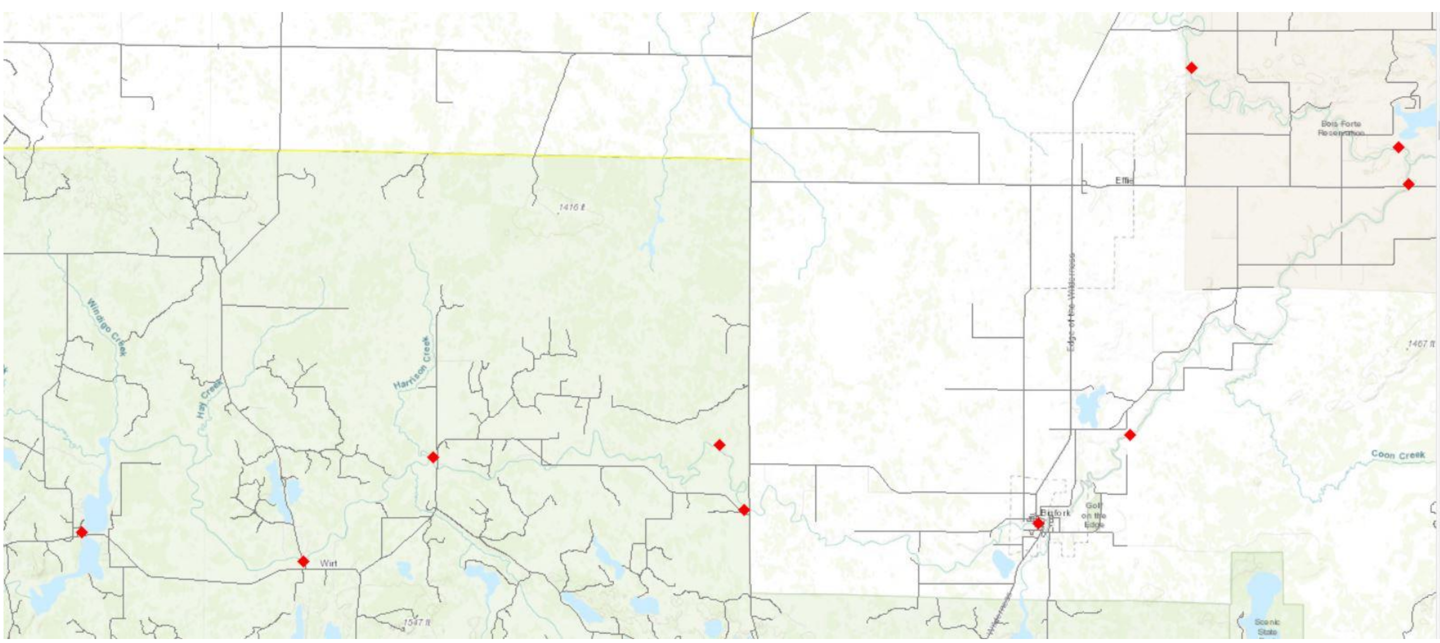
State site with campsite. Access point from river is vegetated.

County Rd. 31 bridge summary:

Right-of-way access point off county road.



Map:



Bigfork River canoe access campsite GPS locations Decimal Degrees

Little Minnow

Lat 47.766763N, Long -93.787940W

Rice Rapids

47.770632N, -93.618307W

Busticogan Campsite

47.851157N, -93.507567W

Muldoon Campsite

47.873077N, -93.594000W

Erosion Assessment Results

Overview:

In the summer of 2020, field staff from Koochiching Soil and Water Conservation District assessed access/campsite locations along the Big Fork River for Erosion. Field staff also took GPS locations and pictures of localized bank erosion along stretches of the river that they floated. An Erosion Assessment Form was filled out for 12 sites on the portion of the Big Fork River located in Koochiching County. This data was collected to help identify areas of concern for remediation or protection to keep the river in its pristine state. The ranking of these sites from worst to best is based on the erosion assessment form and the professional judgement of the SWCD staff. A score will be given for each site based on erosion observed, vegetation abundance, and bank slope. The lower the score the better rating for the site. These scores, along with other observations, will determine the overall ranking of sites.

Ranking: Worst to Best (1-12)

Rank:	Site:	Score:	Notes:
1.	**Little American Falls**	**50**	**Steep banks throughout the campsite/landing. Highest amount of erosion observed at all sites. Slumping, gullies, and exposed soil observed throughout the site. See photos to show extent of erosion.**
2.	**Ivan Crawford Landing**	**37**	**Little/no vegetation on banks close to river. Some erosion due to boat landing and what looks to be runoff.**
3.	**Sturgeon River Landing**	**33**	**Erosion on bank next to stairs and on bank. Overall the site is in good condition.**
4.	**Gowdy Landing**	**26**	**Little/no erosion on site. Buffer of vegetation on shoreline. Grass area next to shoreline does not show any signs of erosion.**
5.	**Hwy 1 Bridge**	**23**	**Some bare soils on shore where entry and exit of river is happening. Low slope and vegetation along shoreline.**
6.	**Easy Half Campsite**	**23**	**Some bare soils on shore where entry and exit of river is happening. Vegetation present throughout the site and no erosion present.**
7.	**St Hwy 6 S Landing**	**22**	**Some bare soils on shore where entry and exit of river is happening.**

			Vegetation present throughout the site and no erosion present.
8.	**St Hwy 6 Landing**	**21**	**Some bare soils on shore where entry and exit of river is happening. Minimal erosion present on shoreline next to steps.**
9.	**Reedy Flats Landing**	**20**	**Vegetation present throughout shoreline at landing. No erosion present.**
10.	**Ben Lynn Landing/Campsite**	**19**	**Minimal erosion/bare soils at rivers edge next to steps. Vegetation present throughout site.**
11.	**Big Falls Landing E**	**17**	**Some bare soil/erosion next to boat launch. Vegetation present throughout site.**
12.	**Old Hudson Bay Farm Campsite**	**17**	**Fully vegetated and no bare soil present at site.**

Maps:

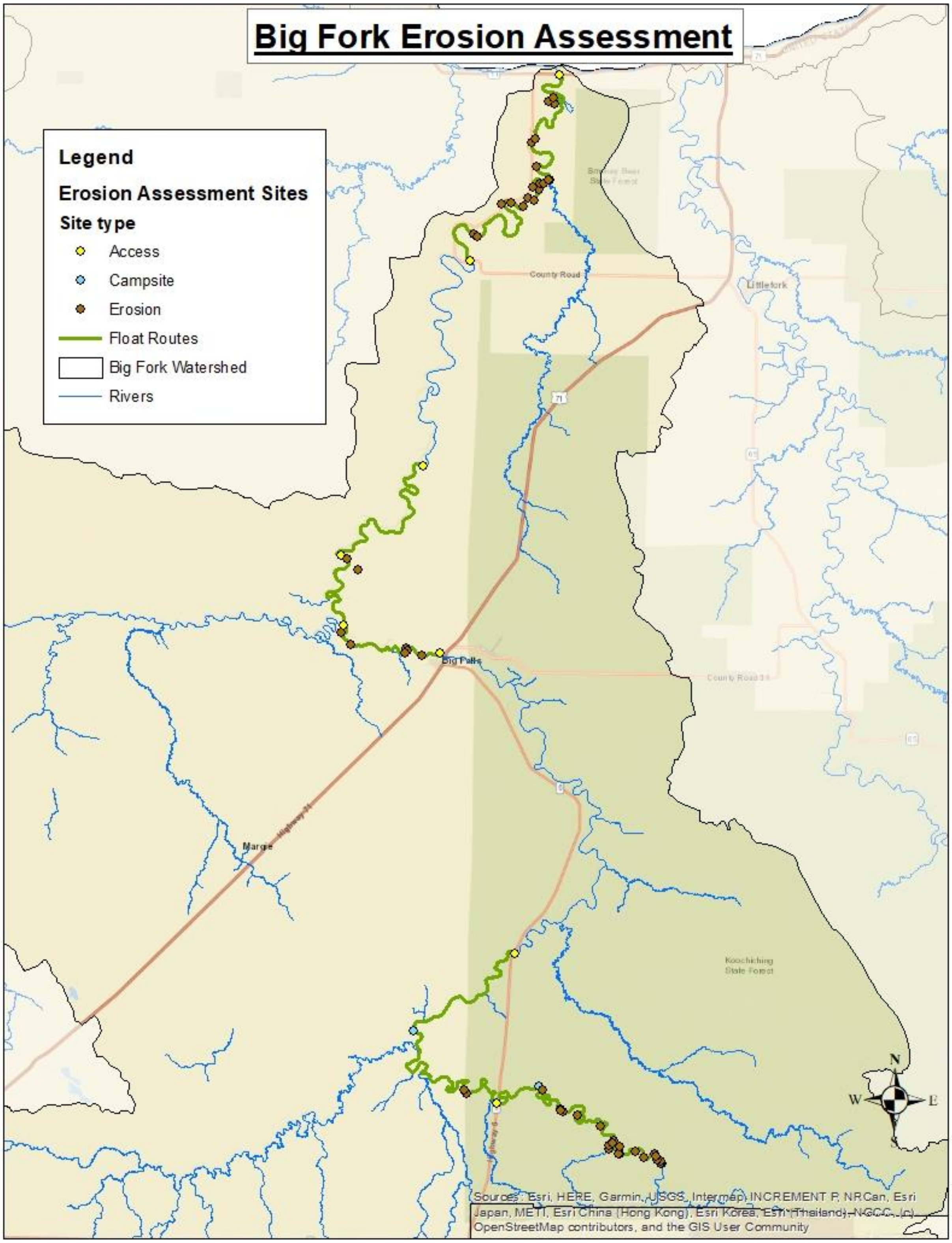


Figure 1. Map showing locations of campsites, accesses, and observed erosion on the Big Fork River.

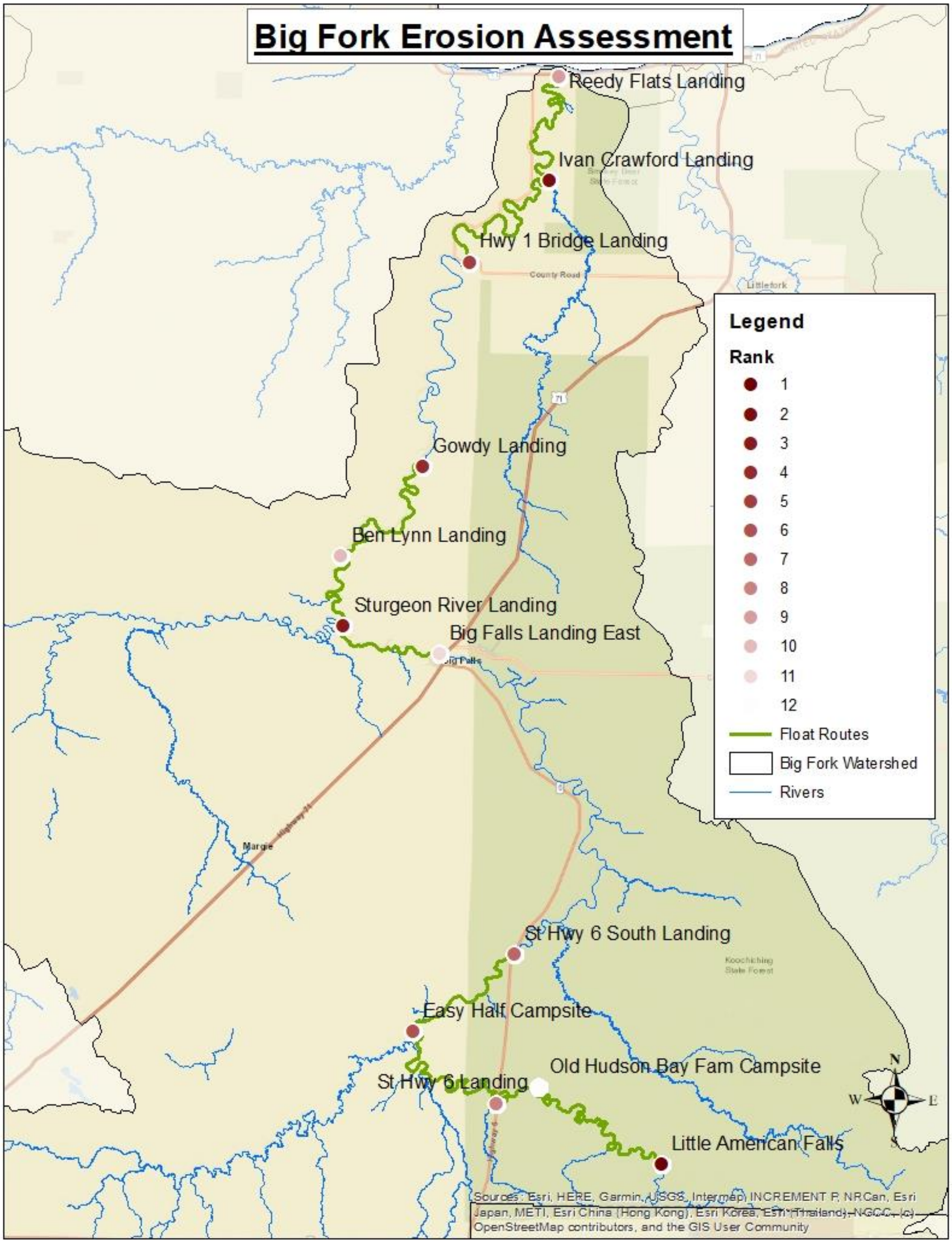


Figure 2. Map showing the sites ranked from worst to best (1-12).

Streambank Erosion Photos:

Little American Falls:

Little American Falls is situated in the upper half of the Big Fork watershed. It consists of multiple campsites and multiple trails leading down to the river. The shoreline is steep with sparce vegetation. Erosion is present throughout the shoreline which is the reason why this site tops the ranking system. This site would benefit the most from implementing BMP’s to mitigate and mange erosion issues present at the site.

Ivan Crawford Landing:

Ivan Crawford Landing is situated 7 miles from the mouth of the Big Fork River. The landscape has much lower banks with a widespread flood plain. This landing has sparsely vegetated shoreline with potential for erosion. Some erosion present on the shoreline and throughout the landing/campsite. Shoreline BMP’s would benefit this site to establish vegetation and eliminate erosion.

Sturgeon River Landing:

Sturgeon River Landing is just downstream of Big Falls at the confluence of the Sturgeon River and Big Fork River. This site is a campsite/canoe carry-down access point. This site had good vegetation present along the shoreline with the exception of some bar soils next to the stairs and rivers edge.

Gowdy Landing:

Gowdy Landing is situated in the bottom fourth of the watershed. This site is a carry-down canoe access with no steps or launch present. The shoreline is fully vegetated with low slopes. The parking lot is grassed/gravel with no signs of erosion. There is a crib present in the river to ease access in and out of the river. This site has low potential for erosion.

Hwy 1 Bridge:

Hwy 1 Bridge Landing is in the lower fourth of the watershed roughly 20 miles upstream from the mouth of the Big Fork. Vegetation is present along the shoreline except for an area where traffic is entering and exiting the river. This site has low slopes and is situated under the bridge. The parking lot if a grass/gravel mixture with no signs of erosion. This site has low potential for erosion.

Easy Half Campsite:


Easy Half Campsite is in the middle of the Big Fork watershed and only accessible by boat. The shoreline is vegetated with the exception of a portion of the rivers edge where entry and exit of the river is taking place. There is a portion of exposed soil due to foot traffic near the campfire and picnic table but shows a low potential for erosion.

St Hwy 6 S Landing:

State hwy 6 South landing is in the middle of the watershed. This shoreline is vegetated except for a path next to the stairs where entry and exit of the river is happening. The parking lot consists of gravel and has low potential for erosion.

St Hwy 6 Landing:

State hwy 6 landing is in the middle of the watershed. This shoreline is vegetated except for a path next to the stairs where entry and exit of the river is happening. The parking lot consists of gravel and has low potential for erosion.

Reedy Flats Landing:

Reedy Flats is just upstream from the mouth of the Big Fork River. This site has vegetated shorelines with little to no erosion present. A concrete landing is in place at the site. The parking lot is gravel and shows no signs of erosion.

Ben Lynn Landing/Campsite:

Ben Lynn Landing/campsite is in the lower third of the watershed. The shoreline has great vegetation with some bare soils at the end of the stairs leading down to the waters edge. The parking lot and path towards the water has some erosion potential with minor rill erosion.

Big Falls Landing E:

Big Falls Landing East is in Big Falls downstream of the rapids. This site is vegetated with a gravel parking lot. There is a boat ramp present with some erosion and exposed soils next to it. This site has low potential for erosion.

Old Hudson Bay Farm Campsite:

Old Hudson Bay Farm Campsite is in the middle of the watershed and only accessible by boat. This site is fully vegetated with no signs of erosion. There is a firepit and picnic table on site. This site has little to no potential for erosion.