Wild Rice River Watershed Monitoring and Assessment Report

Minnesota Pollution Control Agency

June 2017

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List of acronyms

AUID Assessment Unit Identification Determination

BMPs Best Management Practices

CI Confidence Intervals

CLMP Citizen Lake Monitoring Program

CSMP Citizen Stream Monitoring Program

CWA Clean Water Act

DNR Minnesota Department of Natural Resources

EQuIS Environmental Quality Information System

FIBI Fish Index of Biotic Intergrity

FWMC Flow Weighted Mean Concentration

HUC Hydrologic Unit Code

IBI Index of Biotic Integrity

LRVW Limited Resource Value Water

MCES Metropolitan Council Environmental Services

MCL Maximum Containment Level

MDA Minnesota Department of Agriculture

MDH Minnesota Department of Health

MIBI Macroinvertebrate Index of Biotic Integrity

MINLEAP Minnesota Lake Eutrophication Analysis Procedure

MPCA Minnesota Pollution Control Agency

MSHA Minnesota Stream Habitat Assessment

NHD National Hydrologic Dataset

PWI Protection Waters Inventory

SWAG Surface Water Assessment Grant

SWCD Soil and Water Conservation District

SWUD State Water Use Database

TALU Tiered Aquatic Life Uses

TMDL Total Maximum Daily Load

TP Total Phosphorous

TSS Total Suspended Solids

USGS United States Geological Survey

WIMN What's in My Neighborhood

WPLMN Water Pollutant Load Monitoring Network

Executive summary

The Wild Rice River Watershed lies within the Lake Agassiz Plain, North Central Hardwoods, and Northern Lakes and Forests Ecoregions within northwestern Minnesota. This watershed drains a total of 1,636 square miles, across six counties; Becker, Clay, Mahnomen, Norman, Clearwater, and Polk. Eighty percent of the lakes within the Wild Rice River Watershed, including Upper Rice Lake, Lower Rice Lake, Rockstad Lake, and Waptus Lake, occur within the headwaters portion of the watershed. As the Wild Rice River flows westward into the North Central Hardwoods Ecoregion, very few lakes are present. However, throughout the watershed, there are many streams and small tributaries flowing into the Wild Rice River. Some of the most notable streams include; the White Earth River, Wild Rice River-South Branch, Spring Creek, Felton Creek, and Coon Creek.

In 2014, the Minnesota Pollution Control Agency (MPCA) began an intensive watershed monitoring (IWM) effort of lakes, rivers, and streams within the Wild Rice River Watershed. After finishing the monitoring effort in the summer of 2016, the lakes, rivers, and streams were assessed to see if they supported aquatic life, aquatic recreation, and aquatic consumption. Throughout the watershed, 43 streams/rivers, and 16 lakes were assessed. The majority of these systems supported both aquatic life and aquatic recreation.

Sixteen lakes were reviewed during the 2016 assessment cycle, 11 of which were determined to support recreation. Only 2 lakes were determined to exceed ecoregion specific standards and did not support aquatic recreation (Tulaby Lake-previously listed in 2010; and Rockstad Lake-newly listed in 2016). Three other lake assessments had either insufficient or inconclusive data so were not assessed for aquatic recreation. Additionally, 12 lakes were surveyed by the Minnesota Department of Natural Resources (DNR) to assess aquatic life using fish communities. Ten of the assessed lakes fully supported aquatic life. The other 2 lakes had insufficient or inconclusive information to assess for aquatic life because there was evidence of historic winter fish kills, or there was difficulty in obtaining adequate sampling data (e.g. low effort).

Overall, only 22 (51%) of streams fully supported aquatic life. Thirteen stream reaches did not support aquatic life, based on biological or chemistry impairments. The main contributors to the aquatic life impairments included habitat degradation, inadequate flow, and Total Suspended Solids (TSS)/turbidity exceedances. Water control structures and drainage ditch networks impede fish passage from the Red River of the North and threaten the ability of these fishes to reach the Wild Rice River and its tributaries. Establishing ways to control flooding without the use of water control structures and creating buffers around all streams, rivers, and ditches would help protect and restore aquatic habitat and promote healthy and diverse aquatic assemblages.

Although several impairments were identified, the Wild Rice River Watershed still provides some of the best habitat for aquatic life within the Red River Basin. The good habitat is typically found in the headwater portions of the watershed that have remained natural. Most of the subwatersheds within this major watershed have been heavily altered, but the natural portions of the Wild Rice River Watershed still support a diverse biological community. The Wild Rice River Watershed is home to more than 62 fish species, and 300 macroinvertebrate species, yielding some of the highest biodiversity within the Red River Basin. This abundance of aquatic life is due in part to the rivers close connection to the Red River of the North; the smaller Wild Rice River provides critical habitat for larger riverine fish species to spawn.

Following this report, the stressor identification team will identify the aquatic life stressors, and release a report on their findings. This will aid in the production of the watershed restoration and protection strategies report, focusing on the implementation of best management practices (BMPs) to restore the impaired waters of the Wild Rice River Watershed.

Introduction

Water is one of Minnesota's most abundant and precious resources. The MPCA is charged under both federal and state law with the responsibility of protecting the water quality of Minnesota's water resources. The MPCA's water management efforts are tied to the 1972 Federal Clean Water Act (CWA), which requires states to adopt water quality standards to protect their water resources and the designated uses of those waters, such as for drinking water, recreation, fish consumption, and aquatic life. States are required to provide a summary of the status of their surface waters and develop a list of water bodies that do not meet established standards. Such waters are referred to as "impaired waters" and the state must make appropriate plans to restore these waters, including the development of Total Maximum Daily Loads (TMDLs). A TMDL is a comprehensive study that determines the assimilative capacity of a waterbody, identifies all pollution sources causing or contributing to impairment, and provides an estimation of the reductions needed to restore a water body so that it can once again support its designated use.

The MPCA currently conducts a variety of surface water monitoring activities that support our overall mission of helping Minnesotans protect the environment. To successfully prevent and address problems, decision makers need good information regarding the status of the resources, potential and actual threats, options for addressing the threats and data on the effectiveness of management actions. The MPCA's monitoring efforts are focused on providing that critical information. Overall, the MPCA is striving to provide information to assess, and ultimately, to restore or protect the integrity of Minnesota's waters.

The passage of Minnesota's Clean Water Legacy Act in 2006 provided a policy framework and the initial resources for state and local governments to accelerate efforts to monitor, assess, restore, and protect surface waters. This work is implemented on an on-going basis with funding from the Clean Water Fund created by the passage of the Clean Water, Land and Legacy Amendment to the state constitution. To facilitate the best use of agency and local resources, the MPCA has developed a watershed monitoring strategy, which uses an effective and efficient integration of agency and local water monitoring programs to assess the condition of Minnesota's surface waters, and to allow for coordinated development and implementation of water quality restoration and improvement projects.

The strategy behind the watershed monitoring approach is to intensively monitor streams and lakes within a major watershed to determine the overall health of water resources, identify impaired waters, and to identify waters in need of additional protection. The benefit of the approach is the opportunity to begin to address most, if not all, impairments through a coordinated TMDL process at the watershed scale, rather than the reach-by-reach and parameter-by-parameter approach often historically employed. The watershed approach will more effectively address multiple impairments resulting from the cumulative effects of point and non-point sources of pollution and further the CWA goal of protecting and restoring the quality of Minnesota's water resources.

This watershed-wide monitoring approach was implemented in the Wild Rice River Watershed beginning in the summer of 2014. This report provides a summary of all water quality assessment results in the Wild Rice River Watershed and incorporates all data available for the assessment process including watershed monitoring, volunteer monitoring, and monitoring conducted by local government units.

The watershed monitoring approach

The watershed approach is a 10-year rotation for monitoring and assessing waters of the state on the level of Minnesota's 80 major watersheds. The major benefit of this approach is the integration of monitoring resources to provide a more complete and systematic assessment of water quality at a geographic scale useful for the development and implementation of effective TMDLs, project planning, effectiveness monitoring, and protection strategies. The following paragraphs provide details on each of the four principal monitoring components of the watershed approach. For additional information see: Watershed Approach to Condition Monitoring and Assessment (MPCA, 2008) (http://www.pca.state.mn.us/publications/wq-s1-27.pdf).

Intensive watershed monitoring

The IWM strategy utilizes a nested watershed design allowing the sampling of streams within watersheds from a coarse to a fine scale (Figure 1). Each watershed scale is defined by a hydrologic unit code (HUC). These HUCs define watershed boundaries for water bodies within a similar geographic and hydrologic extent. The foundation of this approach is the 80 major watersheds (8-HUC) within Minnesota. Using this approach, many of the smaller headwaters and tributaries to the main stem river are sampled in a systematic way so that a more holistic assessment of the watershed can be conducted and problem areas identified without monitoring every stream reach. Each major watershed is the focus of attention for at least one year within the 10-year cycle.

River/stream sites are selected near the outlet of each of three watershed scales, 8-HUC, aggregated 12-HUC, and 14-HUC (Figure 2) is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use support. Within each aggregated 12-HUC, smaller watersheds (14-HUCs, typically 10-20 mi^2), are sampled at each outlet that flows into the major aggregated 12-HUC tributaries. Each of these minor subwatershed outlets is sampled for biology to assess aquatic life use support (red dots in Figure 2).

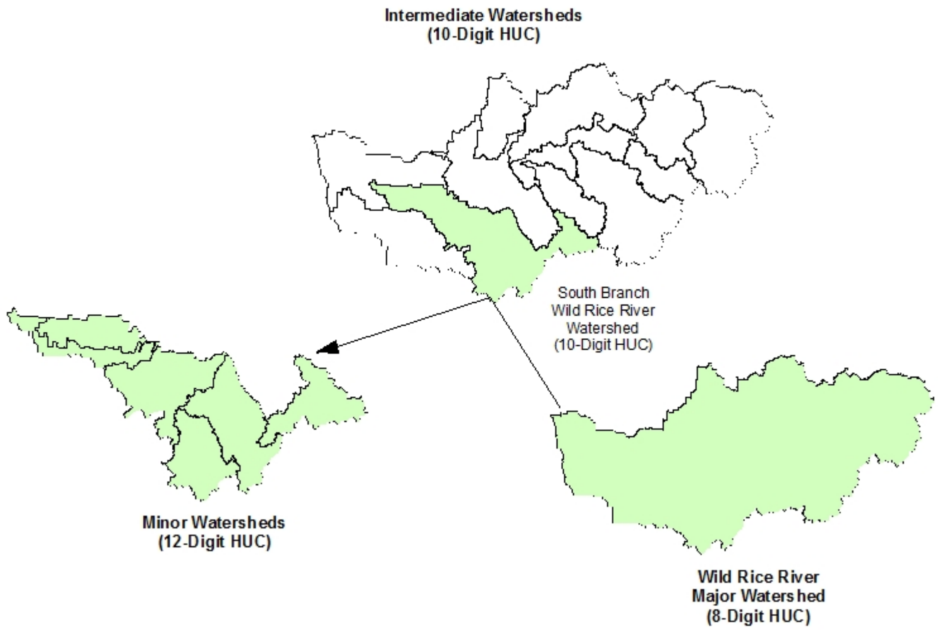

Figure 1. The intensive watershed monitoring design.

Lakes most heavily used for recreation (all those greater than 500 acres and at least 25% of lakes 100-499 acres) are monitored for water chemistry to determine if recreational uses, such as swimming and wading, are being supported and where applicable, where fish community health can be determined. Lakes are prioritized by size, accessibility (can the public access the lakes), and presence of recreational use.

Specific locations for sites sampled as part of the intensive monitoring effort in the Wild Rice River Watershed are shown in Figure 2 and are listed in Appendices 2.1 and 2.2.

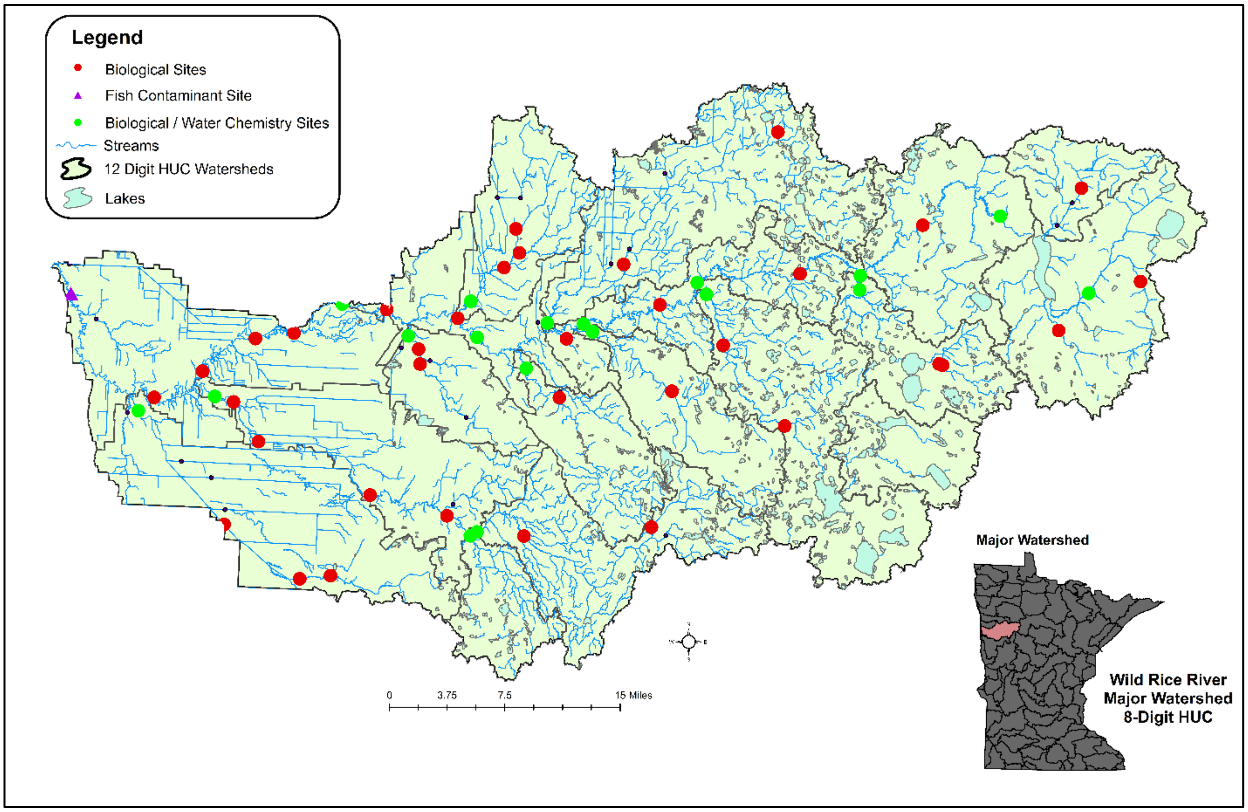

Figure 2. Intensive watershed monitoring sites for streams in the Wild Rice River Watershed.

Citizen and local monitoring

Citizen and local monitoring is an important component of the watershed approach. The MPCA and its local partners jointly select the stream sites and lakes to be included in the IWM process. Funding passes from MPCA through Surface Water Assessment Grants (SWAGs) to local groups such as counties, soil and water conservation districts (SWCDs), watershed districts, nonprofits, and educational institutions to support lake and stream water chemistry monitoring. Local partners use the same monitoring protocols as the MPCA, and all monitoring data from SWAG projects are combined with the MPCA's to assess the condition of Minnesota lakes and streams. Preplanning and coordination of sampling with local citizens and governments helps focus monitoring where it will be most effective for assessment and observing long-term trends. This allows citizens/governments the ability to see how their efforts are used to inform water quality decisions and track how management efforts affect change. Many SWAG grantees invite citizen participation in their monitoring projects and their combined participation greatly expands our overall capacity to conduct sampling.

The MPCA also coordinates two programs aimed at encouraging long term citizen surface water monitoring: the Citizen Lake Monitoring Program (CLMP) and the Citizen Stream Monitoring Program (CSMP). Like the permanent load monitoring network, having citizen volunteers monitor a given lake or stream site monthly and from year to year can provide the long-term picture needed to help evaluate the current status and trends. Citizen monitoring is especially effective at helping to track water quality changes that occur in the years between intensive monitoring years. Figure 3 provides an illustration of the locations where citizen monitoring data were used for assessment in the Wild Rice River Watershed.

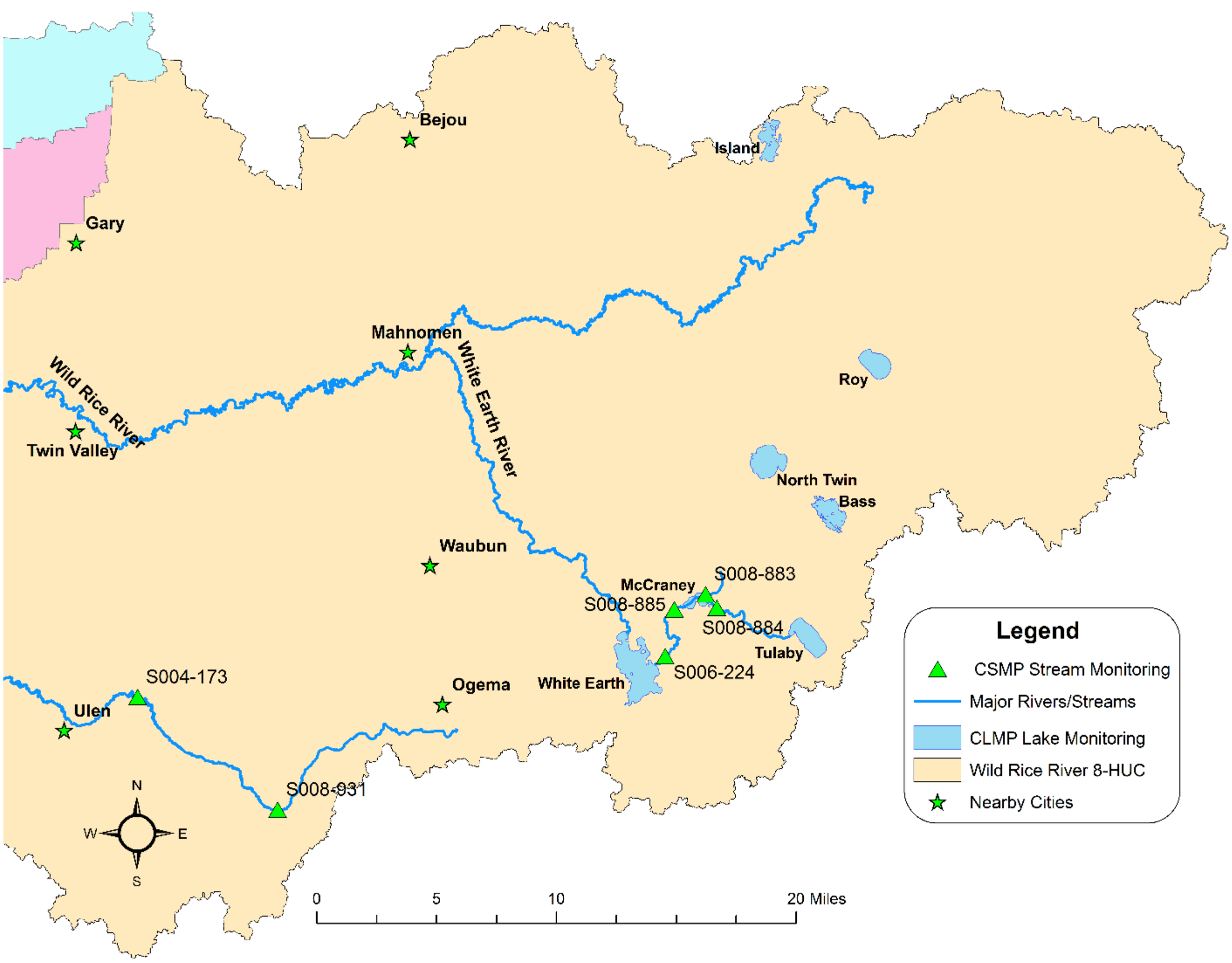

Figure 3. Monitoring locations of local groups and citizen monitors in the Wild Rice River Watershed.

Assessment methodology

The CWA requires states to report on the condition of the waters of the state every two years. This biennial report to Congress contains an updated list of surface waters that are determined to be supporting or non-supporting of their designated uses as evaluated by the comparison of monitoring data to criteria specified by Minnesota Water Quality Standards (Minn. R. ch. 7050 2008; https://www.revisor.leg.state.mn.us/rules/?id=7050). The assessment and listing process involves dozens of MPCA staff, other state agencies and local partners. The goal of this effort is to use the best data and best science available to assess the condition of Minnesota's water resources. For a thorough review of the assessment, methodologies see: Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List (MPCA, 2016). https://www.pca.state.mn.us/sites/default/files/wq-iw1-04.pdf.

Water quality standards

Water quality standards are the fundamental benchmarks by which the quality of surface waters are measured and used to determine impairment. These standards can be numeric or narrative in nature and define the concentrations or conditions of surface waters that allow them to meet their designated beneficial uses, such as for fishing (aquatic life), swimming (aquatic recreation), or human consumption (aquatic consumption). All surface waters in Minnesota, including lakes, rivers, streams, and wetlands are protected for aquatic life and recreation where these uses are attainable. Numeric water quality standards represent concentrations of specific pollutants in water that protect a specific designated use. Narrative standards are statements of conditions in and on the water, such as biological condition, that protect their designated uses.

Protection of aquatic recreation means the maintenance of conditions safe and suitable for swimming and other forms of water recreation. In streams, aquatic recreation is assessed by measuring the concentration of *E. coli* bacteria in the water. To determine if a lake supports aquatic recreational activities, its trophic status is evaluated, using total phosphorus, Secchi depth and chlorophyll-a as indicators. Lakes that are enriched with nutrients and have abundant algal growth are eutrophic and do not support aquatic recreation.

Protection of consumption means protecting citizens who eat fish from Minnesota waters or receive their drinking water from waterbodies protected for this beneficial use. The concentrations of mercury and polychlorinated biphenyls (PCBs) in fish tissue are used to evaluate whether or not fish are safe to eat in a lake or stream and to issue recommendations regarding the frequency that fish from a particular water body can be safely consumed. For lakes, rivers, and streams that are protected as a source of drinking water, the MPCA primarily measures the concentration of nitrate in the water column to assess this designated use.

Protection of aquatic life means the maintenance of a healthy aquatic community, including fish, invertebrates, and plants. Biological monitoring, the sampling of aquatic organisms, is a direct means to assess aquatic life use support, as the aquatic community tends to integrate the effects of all pollutants and stressors over time. To effectively use biological indicators, the MPCA employs the Index of Biotic Integrity (IBI). This index is a scientifically validated combination of measurements of the biological community (called metrics). An IBI is comprised of multiple metrics that measure different aspects of aquatic communities (e.g., dominance by pollution tolerant species, loss of habitat specialists). Metric scores are summed together and the resulting index score characterizes the biological integrity or "health" of a site. The MPCA has developed stream IBIs for fish and macroinvertebrates since these communities can respond differently to various types of pollution. The MPCA also uses a lake fish IBI developed by the DNR to determine if lakes are meeting aquatic life use. Because the lakes, rivers, and streams in Minnesota are physically, chemically, and biologically diverse, IBI's are developed separately for different stream classes and lake class groups to account for this natural variation. Further interpretation of biological community data is provided by an assessment threshold or biocriteria against which an IBI score can be compared within a given stream class. In general, an IBI score above this threshold is indicative of aquatic life use support, while a score below this threshold is indicative of non-support. Additionally, chemical parameters are measured and assessed against numeric standards developed to be protective of aquatic life. For streams, these include pH, dissolved oxygen (DO), un-ionized ammonia nitrogen, chloride, total suspended solids, pesticides, and river eutrophication. For lakes, pesticides and chlorides contribute to the overall aquatic life use assessment.

Protection for aquatic life uses in streams and rivers are divided into three tiers: Exceptional, General, and Modified. Exceptional Use waters support fish and macroinvertebrate communities that have minimal changes in structure and function from the natural condition. General Use waters harbor "good" assemblages of fish and macroinvertebrates that can be characterized as having an overall balanced distribution of the assemblages and with the ecosystem functions largely maintained through redundant attributes. Modified Use waters have been extensively altered through legal physical modifications, which limit the ability of the biological communities to attain the General Use. Currently the Modified Use is only applied to streams with channels that have been directly altered by humans (e.g., maintained for drainage). These tiered uses are determined before assessment based on the attainment of the applicable biological criteria and/or an assessment of the habitat. For additional information, see: http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-rulemaking/tiered-aquatic-life-use-talu-framework.html).

Table 1. Table of proposed tiered aquatic life use standards.

Proposed Tiered Aquatic Life Use	Acronym	Proposed Use Class Code	Description
Warm water General	WWg	2Bg	Warm water Stream protected for aquatic life and recreation, capable of supporting and maintaining a balanced, integrated, adaptive community of warm or cool water aquatic organisms that meet or exceed the General Use biological criteria.
Warm water Modified	WWm	2Bm	Warm water Stream protected for aquatic life and recreation, physically altered watercourses (e.g., channelized streams) capable of supporting and maintaining a balanced, integrated, adaptive community of warm or cool water aquatic organisms that meet or exceed the Modified Use biological criteria, but are incapable of meeting the General Use biological criteria as determined by a Use Attainability Analysis
Warm water Exceptional	WWe	2Be	Warm water Stream protected for aquatic life and recreation, capable of supporting and maintaining an exceptional and balanced, integrated, adaptive community of warm or cool water aquatic organisms that meet or exceed the Exceptional Use biological criteria.
Coldwater General	CWg	2Ag	Coldwater Stream protected for aquatic life and recreation, capable of supporting and maintaining a balanced, integrated, adaptive community of cold water aquatic organisms that meet or exceed the General Use biological criteria.

A small percentage of stream miles in the state (~1% of 92,000 miles) have been individually evaluated and re-classified as a Class 7 Limited Resource Value Water (LRVW). These streams have previously demonstrated that the existing and potential aquatic community is severely limited and cannot achieve aquatic life standards either by: a) natural conditions as exhibited by poor water quality characteristics, lack of habitat or lack of water; b) the quality of the resource has been significantly altered by human activity and the effect is essentially irreversible; or c) there are limited recreational opportunities (such as fishing, swimming, wading or boating) in and on the water resource. While not being protective of aquatic life, LRVWs are still protected for industrial, agricultural, navigation and other uses. Class 7 waters are also protected for aesthetic qualities (e.g., odor), secondary body contact, and groundwater for use as a potable water supply. To protect these uses, Class 7 waters have standards for bacteria, pH, DO, and toxic pollutants.

Assessment units

Assessments of use support in Minnesota are made for individual waterbodies. The waterbody unit used for river systems, lakes, and wetlands is called the "assessment unit". A stream or river assessment unit usually extends from one significant tributary stream to another or from the headwaters to the first tributary. A stream "reach" may be further divided into two or more assessment reaches when there is a change in use classification (as defined in Minn. R. ch. 7050) or when there is a significant morphological feature, such as a dam or lake, within the reach. Therefore, a stream or river is often segmented into multiple assessment units that are variable in length. The MPCA is using the 1:24,000 scale high resolution National Hydrologic Dataset (NHD) to define and index stream, lake, and wetland assessment units. Each river or stream reach is identified by a unique waterbody identifier (known as its AUID), comprised of the USGS eight-digit hydrologic unit code (8-HUC) plus a three-character code that is unique within each HUC. Lake and wetland identifiers are assigned by the DNR. The Protected Waters Inventory (PWI) provides the identification numbers for lake, reservoirs and wetlands. These identification numbers serve as the AUID and are composed of an eight-digit number indicating county, lake, and bay for each basin.

It is for these specific stream reaches or lakes that the data are evaluated for potential use impairment. Therefore, any assessment of use support would be limited to the individual assessment unit. The major exception to this is the listing of rivers for contaminants in fish tissue (aquatic consumption). Over the course of time it takes fish, particularly game fish, to grow to "catchable" size and accumulate unacceptable levels of pollutants, there is a good chance they have traveled a considerable distance. The impaired reach is defined by the location of significant barriers to fish movement such as dams upstream and downstream of the sampled reach and thus often includes several assessment units.

Determining use attainment

For beneficial uses related to human health, such as drinking water or aquatic recreation, the relationship is well understood and thus the assessment process is a relatively simple comparison of monitoring data to numeric standards. In contrast, assessing whether a waterbody supports a healthy aquatic community is not as straightforward and often requires multiple lines of evidence to make use attainment decisions with a high degree of certainty. Incorporating a multiple lines of evidence approach into MPCA's assessment process has been evolving over the past few years. The current process used to assess the aquatic life use of rivers and streams is outlined below and in Figure 4.

The first step in the aquatic life assessment process is largely an automated process performed by logic programmed into a database application where all data from the 10-year assessment window is gathered; the results are referred to as 'Pre-Assessments'. Data filtered into the "Pre-Assessment" process is then reviewed to insure that data is valid and appropriate for assessment purposes. Tiered use designations are determined before data is assessed based on the attainment of the applicable biological criteria and/or an assessment of the habitat. Stream reaches are assigned the highest aquatic life use attained by both biological assemblages on or after November 28, 1975. Streams that do not attain the Exceptional or General Use for both assemblages undergo a Use Attainability Analysis (UAA) to determine if a lower use is appropriate. A Modified Use can be proposed if the UAA demonstrates that the General Use is not attainable as a result of legal human activities (e.g., drainage maintenance, channel stabilization) which are limiting the biological assemblages through altered habitat. Decisions to propose a new use are made through UAA workgroups, which include watershed project managers and biology leads. The final approval to change a designated use is through formal rulemaking.

The next step in the aquatic life assessment process is a comparison of the monitoring data to water quality standards. Pre-assessments are then reviewed by either a biologist or water quality professional, depending on whether the parameter is biological or chemical in nature. These reviews are conducted at the workstation of each reviewer (i.e., desktop) using computer applications to analyze the data for potential temporal or spatial trends as well as gain a better understanding of any extenuating circumstances that should be considered (e.g., flow, time/date of data collection, or habitat).

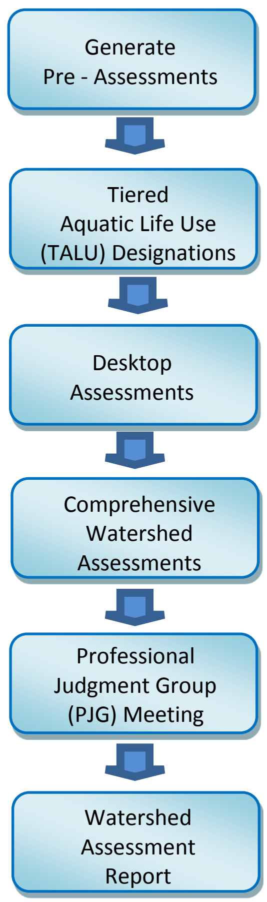

Figure 4. Flowchart of aquatic life use assessment process.

The next step in the process is a comprehensive watershed assessment meeting where reviewers convene to discuss the results of their desktop assessments for each individual waterbody. Implementing a comprehensive approach to water quality assessment requires a means of organizing and evaluating information to formulate a conclusion utilizing multiple lines of evidence. Occasionally, the evidence stemming from individual parameters are not in agreement and would result in discrepant assessments if the parameters were evaluated independently. However, the overall assessment considers each piece of evidence to make a use attainment determination based on the preponderance of information available. See the *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List* (MPCA, 2016) https://www.pca.state.mn.us/sites/default/files/wq-iw1-04i.pdf for guidelines and factors considered when making such determinations.

The last step in the assessment process is the Professional Judgment Group meeting. At this meeting, results are shared and discussed with entities outside of the MPCA that may have been involved in data collection or that might be responsible for local watershed reports and project planning. Information obtained during this meeting may be used to revise previous use attainment decisions (e.g., sampling events that may have been uncharacteristic due to annual climate or flow variation, local factors such as impoundments that do not represent the majority of conditions on the stream reach). Waterbodies that do not meet standards and therefore do not attain one or more of their designated uses are considered impaired waters and are placed on the draft 303(d) Impaired Waters List. Assessment results are also included in watershed monitoring and assessment reports.

Watershed overview

Located within the northwestern portion of Minnesota, the Wild Rice River Watershed is comprised of lakes, wetlands, and rich soils. The eastern portion of the watershed is located solely within the White Earth Band of Ojibwe Reservation.

The Wild Rice River Watershed has a total drainage of 1,636 square miles (Offelen et al. 2002), spanning across six counties: Becker, Clay, Mahnomen, Norman, Clearwater, and Polk. The Wild Rice River starts at Upper Rice Lake, about 32 miles northeast of Mahnomen in Clearwater County, and flows westward for 168 miles, until it reaches its confluence with the Red River of the North, approximately three miles south of Halstad, Minnesota.

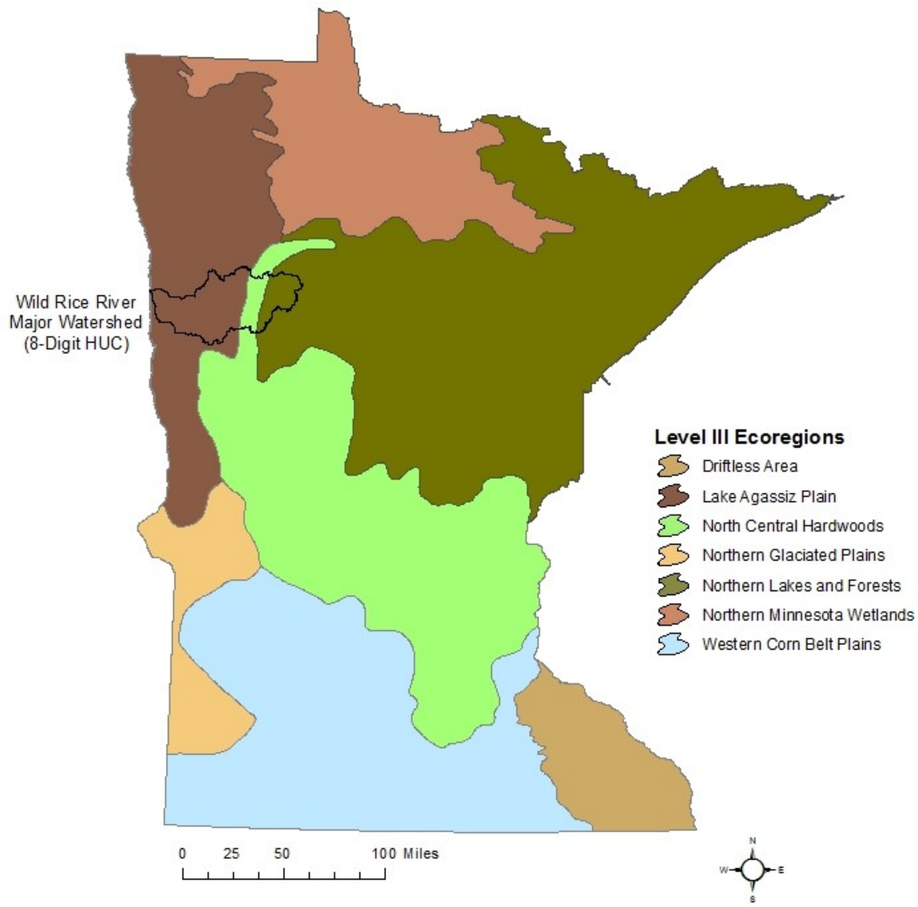

Figure 5. The Wild Rice River Watershed within the Lake Agassiz, North Central Hardwoods, and Northern Lakes and Forests ecoregions of Northern Minnesota.

This watershed lies within three Omernick level III Ecoregions (Omernik & Gallant, 1988) (Figure 5). The largest portion of the watershed lies within the Lake Agassiz Plains Ecoregion, covering most of the western half of the watershed. This area is largely utilized for agriculture, as it features rich soils (Figure 6) that originated from historic glacial Lake Agassiz. Following the last ice age, Lake Agassiz was a large glacial lake covering 200,000 square miles within North America (Waters, 1977). Larger than all of the Great Lakes combined, Lake Agassiz covered 17,000 square miles of Minnesota along the North Dakota-Minnesota border. As glaciers melted and formed Lake Agassiz, clay soils were spread throughout the lake bottom, forming the Red River of the North and creating large flat plains of fertile soil (Waters, 1977). The next ecoregion, North Central Hardwood Forests in the central portion of the watershed, is dominated by hardwood and coniferous forests. The soils within this ecoregion have generally poor fertility, compared to the Lake Agassiz Plains Ecoregion. The last ecoregion within the Wild Rice River Watershed is the Northern Lakes and Forests Ecoregion, located to the eastern portion of the watershed. This ecoregion is heavily forested, with a variety of lakes and wetlands. Agricultural activities are slightly hindered within this ecoregion due to the nature of the hilly topography, and the generally poor soils.

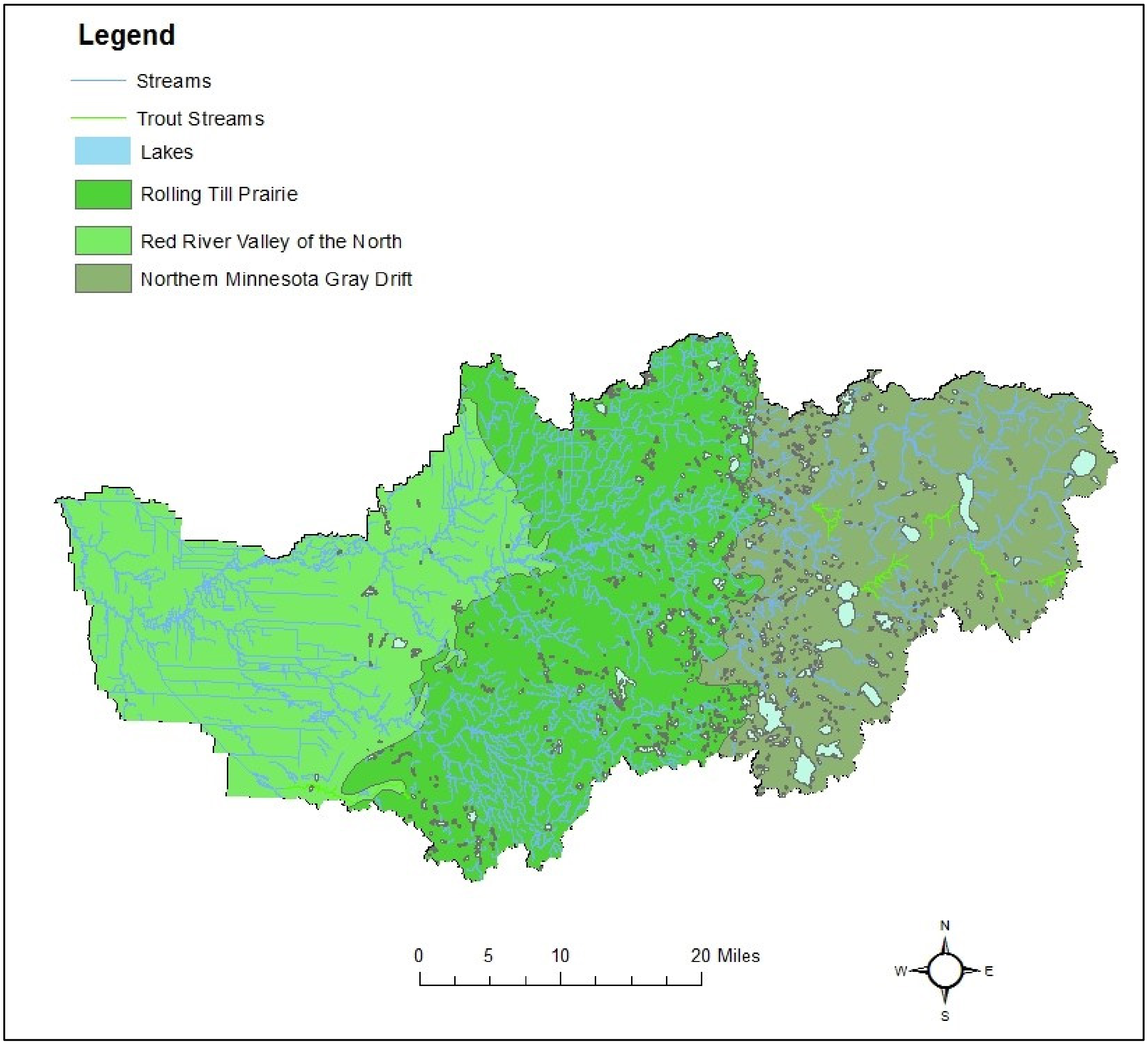

Figure 6. Major Land Resource Areas (MLRA) and springs in the Wild Rice River Watershed.

Land use summary

Starting in the early 1900s, the Wild Rice River Watershed has been managed for optimal agricultural production (Offelen et al. 2002). During settlement in the area, flood management has been an area of concern. Early flood management practices included modifying natural stream channels to develop vast drainage systems. This watershed wide alteration changed the natural hydrology of the entire watershed, causing an abrupt change within the whole ecosystem (Offelen et al. 2002). According to the NRCS (2007), there are 1,168 farms within the watershed as of 2007. A total of 572,372 acres within the watershed are utilized for farming activities (Figure 7), with each farm averaging at 195 acres per farm.

Historically, logging practices also dominated the landscape. Part of the alteration within the Wild Rice River Watershed, included the connection of the Marsh River with the Wild Rice River. This connection allowed for logs to be floated down the Wild Rice River and then shifted to flow down the Marsh River, meeting up with a sawmill just east of Ada. This connection is now used for flood management purposes; during high flow events, when the Wild Rice River reaches 95% flow, it runs over the dike at the connection, allowing the excess water to flow down the Marsh River before reaching its confluence with the Red River of the North.

The Wild Rice River Watershed is sparsely populated as 13,564 people live within the watershed. Land ownership is dominated by private ownership as 76% of the watershed is privately owned, 18% is publicly owned, and 6% is tribal land (NRCS, 2007).

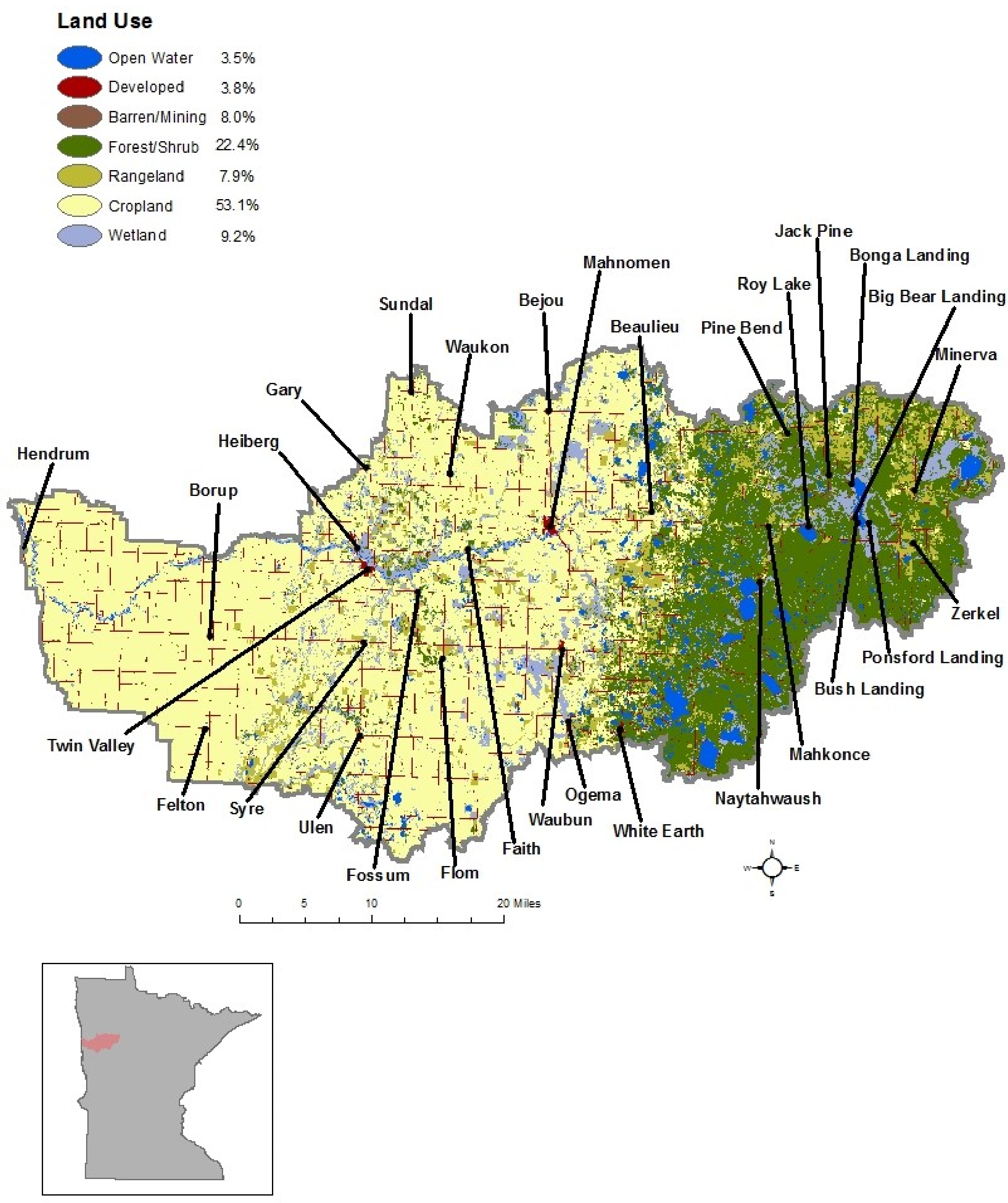

Figure 7. Land use in the Wild Rice River Watershed.

Surface water hydrology

The Wild Rice River flows from east to west, draining approximately 1,636 square miles (NRCS 2007). The headwaters of the Wild Rice River Watershed originate within Upper Rice Lake in the White Earth State Forest and flows for 200 miles before reaching its confluence with the Red River of the North, 3 miles south of Halstad. As the Wild Rice River flows from east to west throughout the watershed, from the headwaters to the confluence with the Red River of the North, approximately 19 major tributaries flow into the Wild Rice River. Identified from upstream to downstream, the major tributaries to the Wild Rice River include the following: Mosquito Creek (5.5 miles NW of Minerva), Twin Lake Creek (7 miles NW of Naytahwaush), White Earth River (1.5 miles E of Mahnomen), Spring Creek (6.9 miles E of Twin Valley), Marsh Creek (1.3 miles SW of Fossum), Mashaug Creek (2 miles NW of Twin Valley) Coon Creek (4 miles NW of Twin Valley), Unnamed Creek (Trib. to Wild Rice River, 3 miles W of Twin Valley), Wild Rice River, South Branch (8.3 miles NE or Perley), and Felton Creek (4 miles E of Perley).

Historically, the downstream portion (western side) of the watershed was inundated by a portion of glacial Lake Agassiz with smaller lakes and forests in the headwaters portion. Although 8,500 years have passed since Lake Agassiz receded, the effects of massive lake are still evident today. The lakes presence contributed to the formation of rich soils within the ancient lake bottom that have given rise to modern agricultural opportunities.

The headwaters of the Wild Rice River have not been historically channelized however, as the river flows west and enters the Lake Agassiz Plain, approximately 17 stream miles of the mainstem near the outlet has been channelized to aid drainage. The tributaries follow the same pattern. In the headwaters of the watershed, most of the tributaries are natural, but the central to western portions of the watershed have been channelized (Figure 8, and Figure 9). The channelization was done to aid drainage, and aid flood management practices. Flood management is an issue that has impacted this region since settlement.

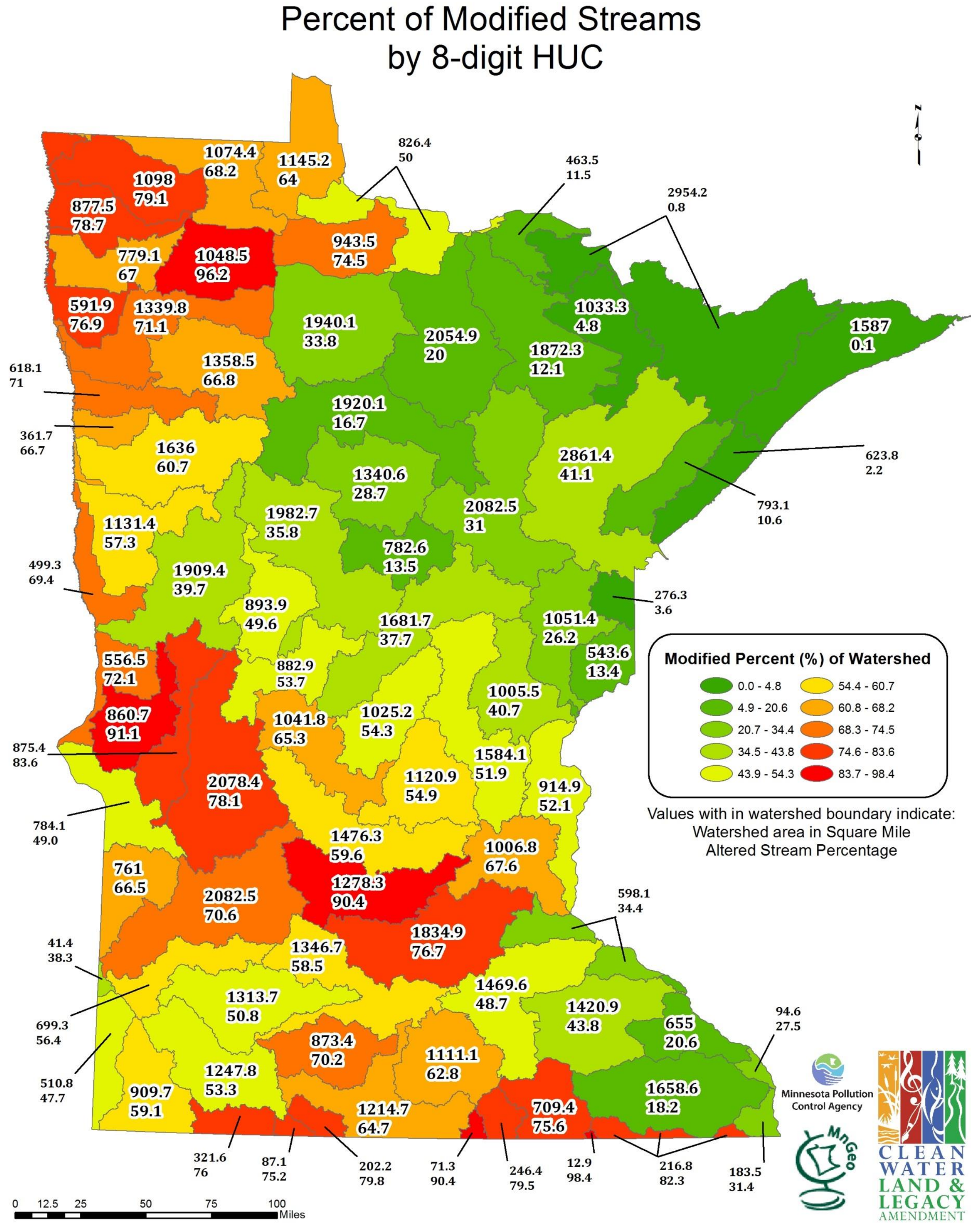

Figure 8. Map of percent modified streams by major watershed (8-HUC).

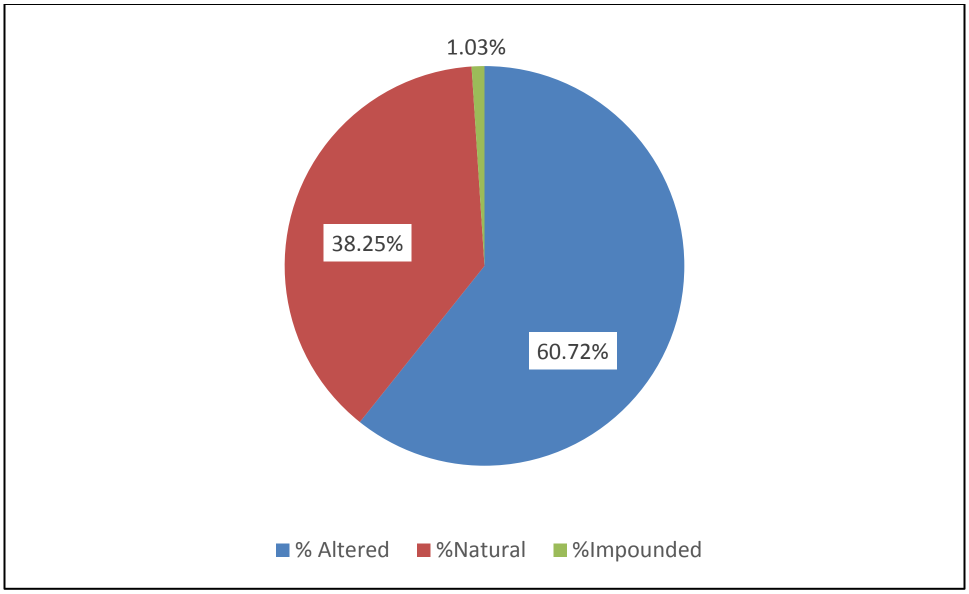

Figure 9. Comparison of natural to altered streams in the Wild Rice River Watershed (percentages derived from the Statewide Altered Water Course project).

Climate and precipitation

Minnesota has a continental climate, marked by warm summers and cold winters. The mean annual temperature for Minnesota is 4.6˚C (NOAA, 2016); the mean summer (June-August) temperature for the Wild Rice River Watershed is 18.3˚C and the mean winter (December-February) temperature is -13.3˚C (MDNR: Minnesota State Climatology Office, 2003).

Precipitation is an important source of water input to a watershed. Figure 10 displays two representations of precipitation for calendar year 2014. On the left is total precipitation, showing the typical pattern of increasing precipitation toward the eastern portion of the state. According to this figure, the Wild Rice River Watershed area received 16 to 24 inches of precipitation in 2014. The display on the right shows the amount that precipitation levels departed from normal. The Wild Rice River Watershed area primarily experienced precipitation that ranged from 2 to 6 inches below normal in 2014.

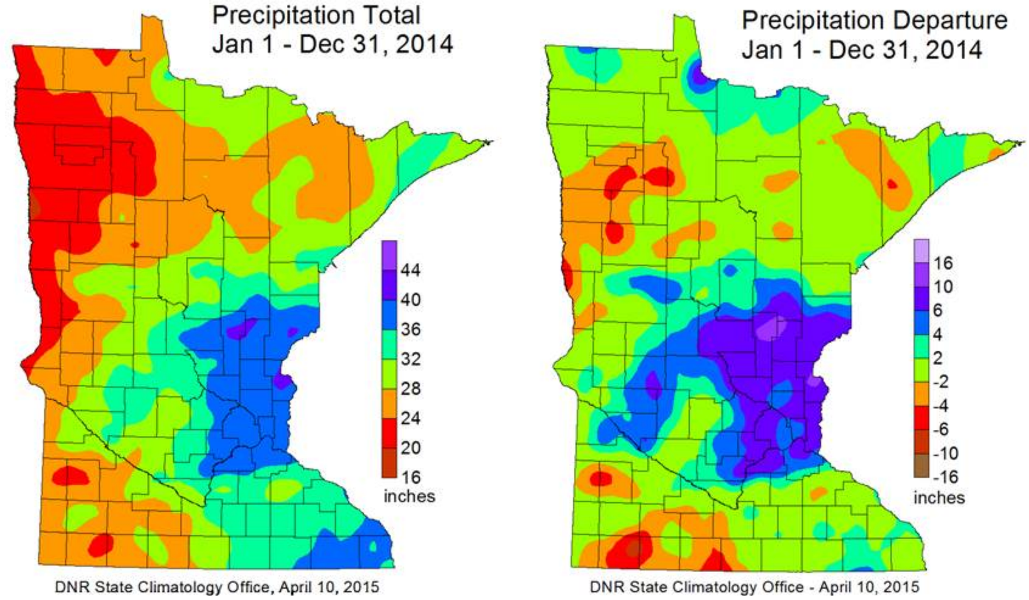

Figure 10. Statewide precipitation total (left) and precipitation departure (right) during 2014. (Source MDNR State Climatology Office, 2015)

The Wild Rice River Watershed is located within the northwest precipitation region. Figure 11 and Figure 12 display the areal average representation of precipitation in northwest Minnesota for 20 and 100 years, respectively. An areal average is a spatial average of all the precipitation data collected within a certain area presented as a single dataset. Though rainfall can vary in intensity and time of year, rainfall totals in the northwest region display no significant trend over the last 20 years. However, precipitation in northwest Minnesota exhibits a significant rising trend over the past 100 years ($p<0.01$). This is a strong trend and matches similar trends throughout Minnesota.

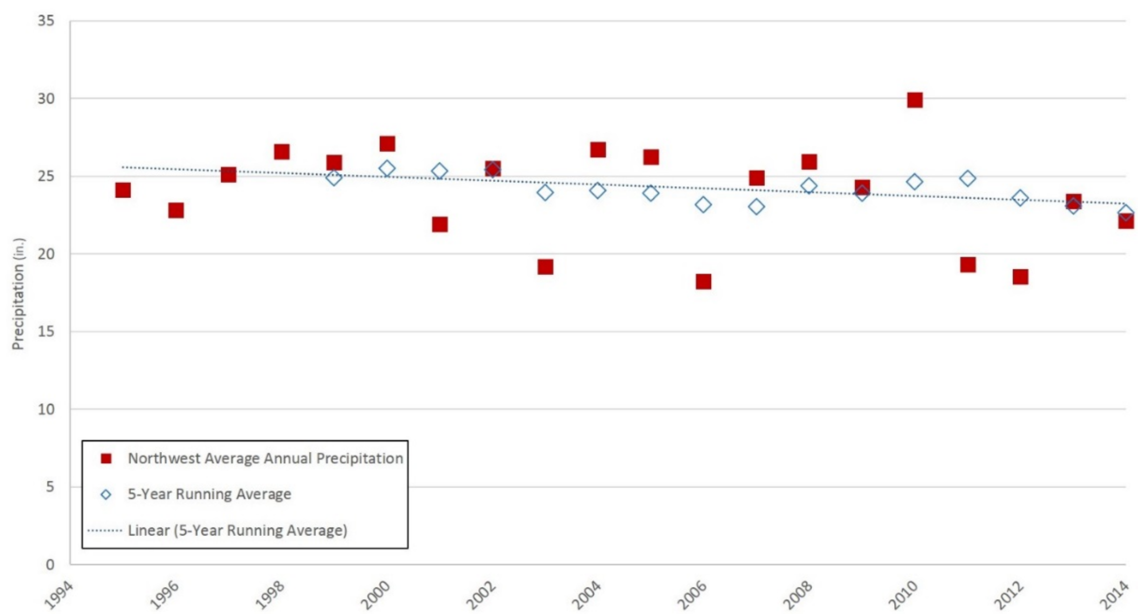

Figure 11. Precipitation trends in Northwest Minnesota (1995-2014) with five-year running average. (Source: WRCC, 2016)

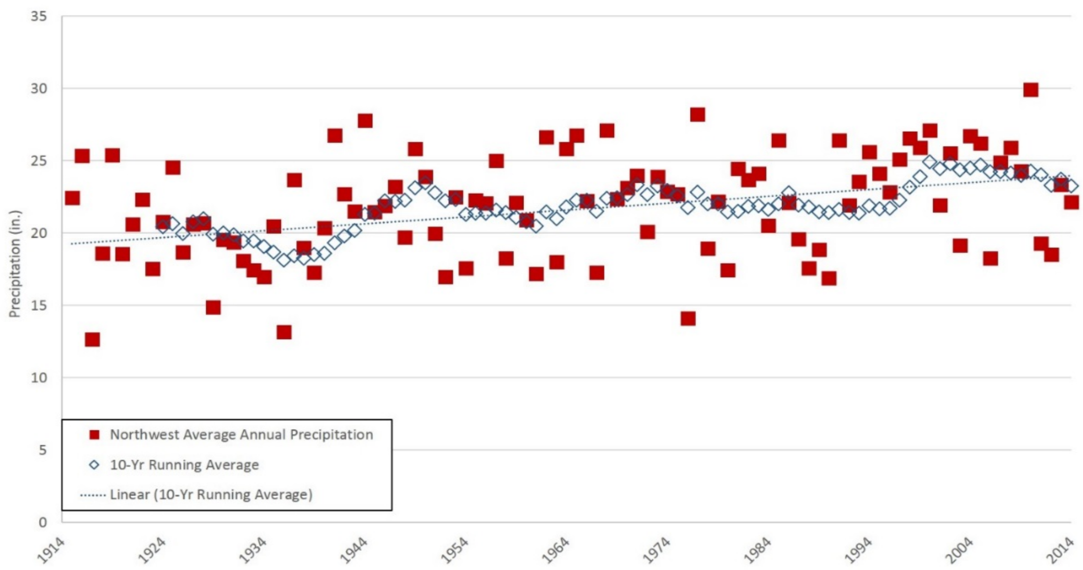

Figure 12. Precipitation trends in northwest Minnesota (1915-2014) with ten-year running average. (Source: WRCC, 2016)

Hydrogeology and groundwater quality and quantity

Hydrogeology

Hydrogeology is the study of the interaction, distribution, and movement of groundwater through the rocks and soil of the earth. The geology of a region strongly influences the quantity of groundwater available, the quality of the water, the sensitivity of the water to pollution, and how quickly the water will be able to recharge and replenish the source aquifer. This branch of geology is important to understand as it indicates how to manage groundwater withdrawal and land use and can determine if mitigation is necessary.

Surficial and bedrock geology

Surficial geology is identified as the earth material located below the topsoil and overlying the bedrock. Glacial sediment is at the surface over much of the Wild Rice River Watershed and is the parent material for the soils that have developed since glaciation. The depth to bedrock ranges from 125 to over 1,040 feet. The bedrock is buried by deposits from the various ice lobes that reached this watershed during the last glacial period, as well as during previous glaciations in the last 2.58 million years. The deposits at the surface are associated with the Des Moines and Wadena glacial lobes and post-glacial alterations to that sediment, including soil formation and peat accumulation. The geomorphology includes glacial lake sediment, end, ground, and stagnation moraines (Wadena Lobe-Itasca Moraine, Des Moines Lobe-Erskine Moraine, and Des Moines Lobe-Big Stone Moraine), lake modified till, outwash, peat, and alluvium (Holocene) (Figure 13, *left*) (Hobbs & Goebel, 1982). The glacial sediment consists of sand, gravel, clay, and silt glacial lake sediment, clayey and gravelly outwash, clayey lake modified till, and silty calcareous till with a predominantly clayey texture (Hobbs & Goebel, 1982).

Bedrock is the main mass of rocks that form the Earth, located underneath the surficial geology and can only be seen in only a few places where weathering has exposed the bedrock. Precambrian bedrock lies under the extent of the Wild Rice River Watershed, displaying evidence of volcanic activity. The main terrane groups include the Wawa Subprovince (mafic metavolcanic, calc-alkalic volcanic, volcaniclastic rocks, hypabyssal intrusions) and the Wawa and Wabigoon Subprovince (mafic metavolcanic, volcaniclastic rocks, hypabyssal intrussions) (Jirsa et al., 2011). Massive to weakly foliated metamorphic rocks and mafic plug-like intrusions are also found throughout the watershed (Jirsa et al., 2011). The rock types that are found in the uppermost bedrock include basalt, gabbro, granite, greywacke, mafic metavolcanic rock and monzonite (Figure 13, *right*) (Morey & Meints, 2000).

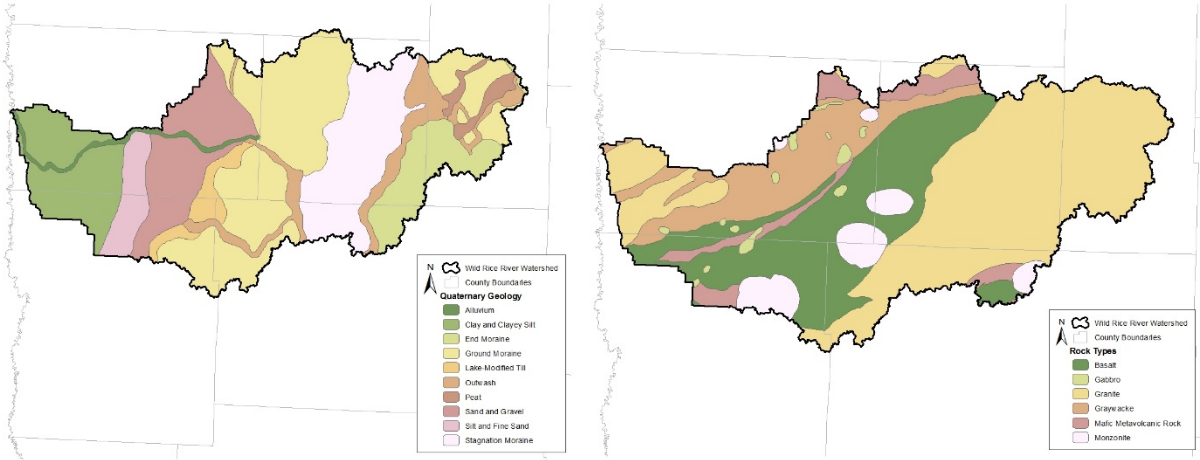

Figure 13. Quaternary geology (*left*) and bedrock geology rock types (*right*) within the Wild Rice River Watershed. (GIS Source: Hobbs & Goebel, 1982; Morey & Meints, 2000)

Aquifers

Groundwater aquifers are layers of water-bearing units that readily transmit water to wells and springs (USGS, 2016a). As precipitation hits the surface, it infiltrates through the soil zone and into the void spaces within the geologic materials underneath the surface, saturating the material and becoming groundwater (Zhang, 1998). The water table is the uppermost portion of the saturated zone, where the pore-water pressure is equal to local atmospheric pressure. The geologic material determines the permeability and availability of water within the aquifer. Minnesota's groundwater system is comprised of three types of aquifers: 1) igneous and metamorphic bedrock aquifers, 2) sedimentary rock aquifers, and 3) glacial sand and gravel aquifers (MPCA, 2005). The Wild Rice River Watershed has fractured igneous and metamorphic bedrock aquifers lying deep beneath clayey and sandy unconsolidated sediments (MDNR, 2016a). The central and eastern regions of the watershed contain thick buried sand and gravel aquifers, with the Quaternary Buried Artesian Aquifer as the primary source for groundwater withdrawals, while the western region of the watershed is typically clayey and limited in surficial and buried sand aquifers (MDNR, 2016a). The general availability of groundwater for this watershed can be categorized as good to moderate in the surficial sands, moderate to limited in the buried sands, and limited in the bedrock (MDNR, 2016a).

Groundwater pollution sensitivity

Bedrock aquifers are typically covered with thick till, indicating that they would normally be better protected from contaminant releases at the land surface. It is also less likely that withdrawals from wells would have a direct and significant impact on local surface water bodies. In contrast, surficial aquifers are typically more likely to 1) be vulnerable to contamination, 2) have direct hydrologic connections to local surface water, and 3) influence the quality and quantity of local surface water. The DNR is working on a hydrogeological atlas focused on the pollution sensitivity of the bedrock surface. It is being produced county-by-county and awaiting completion for those counties within the Wild Rice River Watershed. Until the hydrogeological atlas is finished, a 2016 statewide evaluation of pollution sensitivity of near-surface materials completed by the DNR is utilized to estimate pollution vulnerability up to ten feet from the land surface. This display is not intended to be used on a local scale, but as a coarse-scale planning tool. According to this data, the Wild Rice River Watershed is estimated to be categorized as ultra low in the west, predominately low in the central area, and a range from very low too high in the east (Figure 14) (DNR, 2016b). The areas with a high rating are scattered throughout the watershed, most likely due to the presence of sand and gravel Quaternary geology.

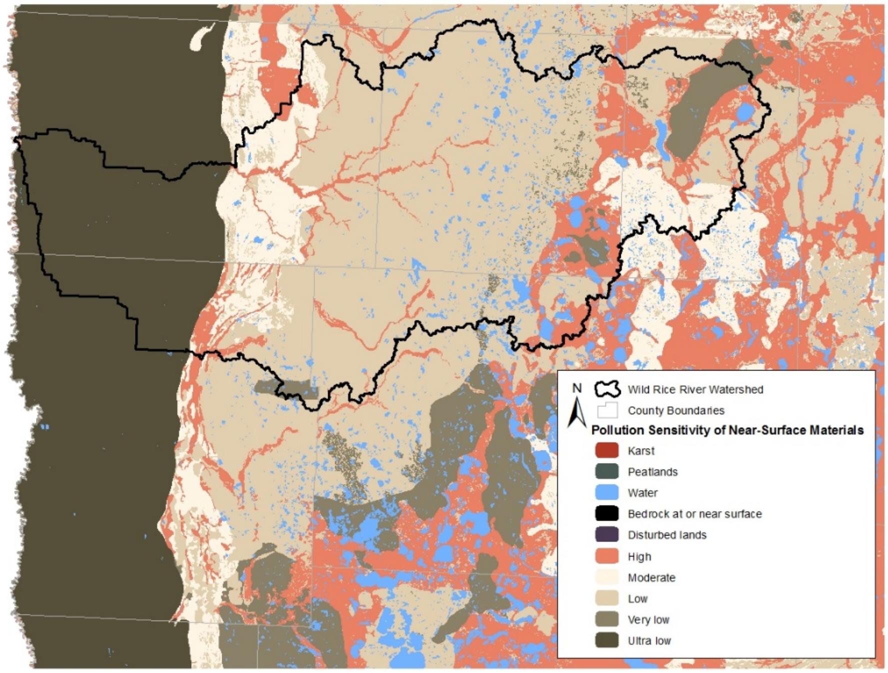

Figure 14. Pollution sensitivity of near-surface materials for the Wild Rice River Watershed. (GIS Source: MDNR, 2016b)

Groundwater potential recharge

Groundwater recharge is one of the most important parameters in the calculation of water budgets, which are used in general hydrologic assessments, aquifer recharge studies, groundwater models, and water quality protection. Recharge is a highly variable parameter, both spatially and temporally, making accurate estimates at a regional scale difficult to produce. The MPCA contracted the U.S. Geological Survey to develop a statewide estimate of recharge using the SWB – Soil-Water-Balance Code. The result is a gridded data structure of spatially distributed recharge estimates that can be easily integrated into regional groundwater studies. The full report of the project as well as the gridded data files are available at: https://gisdata.mn.gov/dataset/geos-gw-recharge-1996-2010-mean.

Recharge of these aquifers is important and limited to areas located at topographic highs, those with surficial sand and gravel deposits, and those along the bedrock-surficial deposit interface (Figure 15). Typically, recharge rates in unconfined aquifers are estimated at 20 to 25% of precipitation received, but can be less than 10% of precipitation where glacial clays or till are present (USGS, 2007). For the Wild Rice River Watershed, the average annual potential recharge rate to surficial materials ranges from 0.3 to 8.7 inches per year, with an average of 3.7 inches per year (Figure 16). The statewide average potential recharge is estimated to be 4 inches per year with 85% of all recharge ranging from 3 to 8 inches per year (Figure 17). When compared to the statewide average potential recharge, the Wild Rice River Watershed receives slightly less than the average potential recharge.

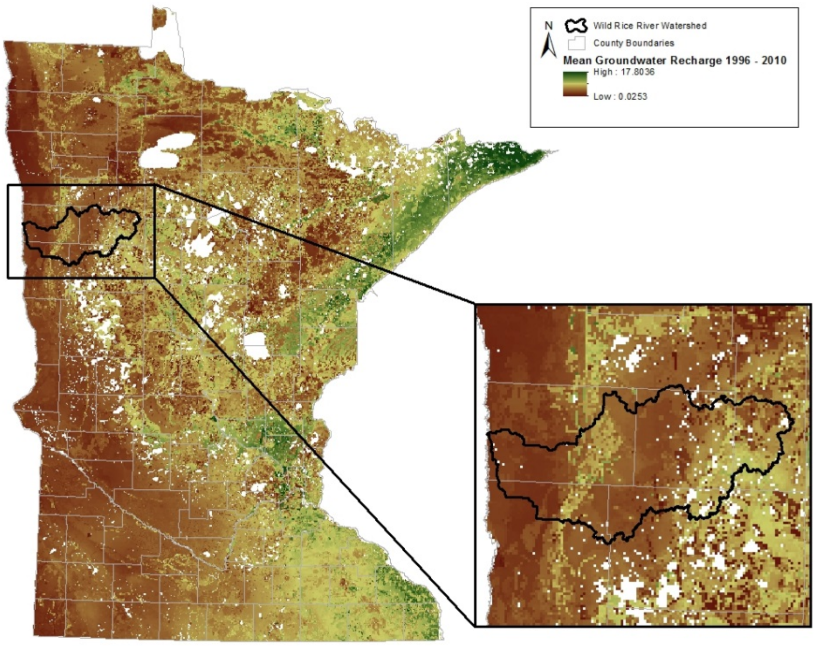

Figure 15. Average annual potential recharge rate to surficial materials in Wild Rice River Watershed. (1996-2010) (GIS Source: USGS, 2015)

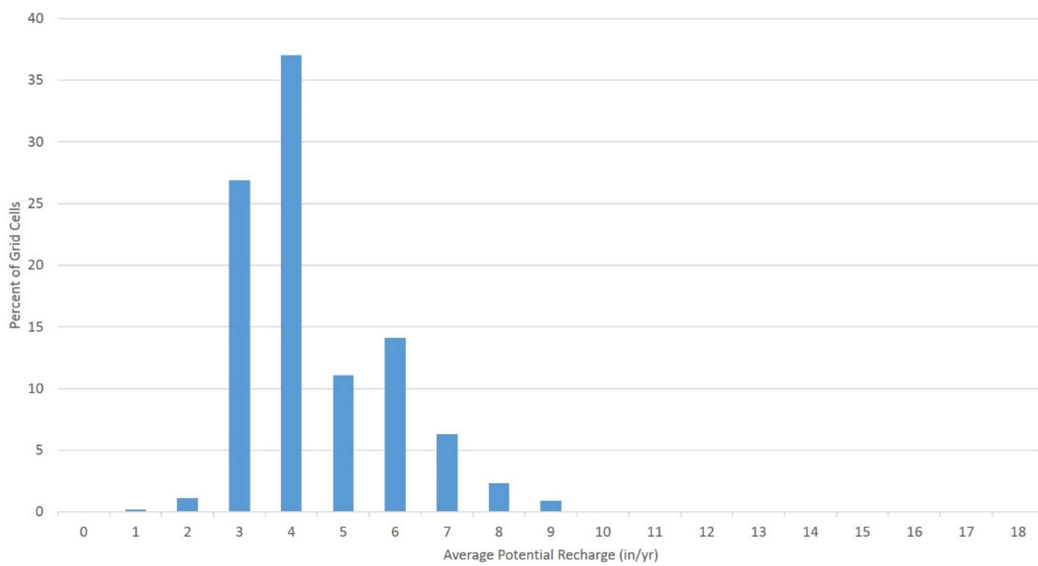

Figure 16. Average annual potential recharge rate percent of grid cells in the Wild Rice River Watershed. (1996-2010)

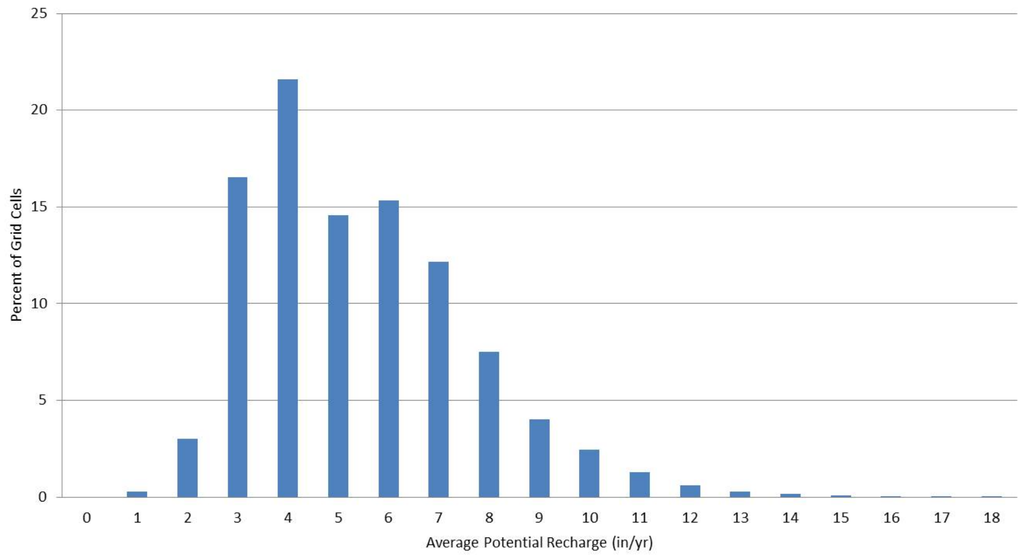

Figure 17. Average annual potential recharge rate percent of grid cells statewide. (1996-2010)

Groundwater quality

Approximately 75% of Minnesota's population receives their drinking water from groundwater, undoubtedly indicating that clean groundwater is essential to the health of its residents. The MPCA's Ambient Groundwater Monitoring Program monitors trends in statewide groundwater quality by sampling for a comprehensive suite of chemicals including nutrients, metals, and volatile organic compounds. These ambient groundwater wells represent a mix of deeper domestic wells and shallow monitoring wells. The shallow wells interact with surface waters and exhibit impacts from human activities more rapidly. Available data from federal, state and local partners are used to supplement reviews of groundwater quality in the region.

There are currently no MPCA ambient groundwater monitoring wells within the Wild Rice River Watershed. Figure 18 displays the locations of the closest ambient groundwater wells around the specified watershed. Due to the lack of data available, no ambient groundwater quality analysis was completed for the Wild Rice River Watershed.

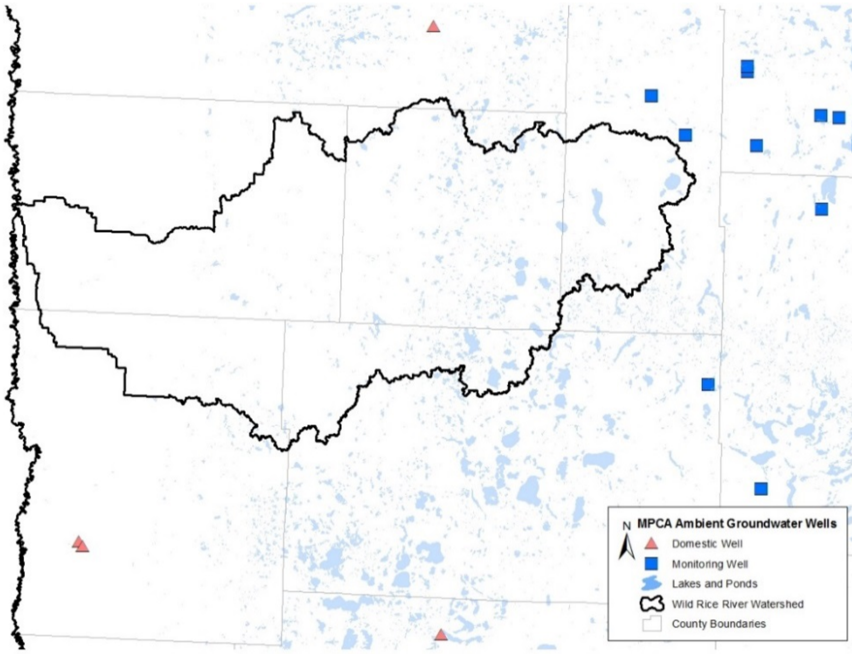

Figure 18. MPCA ambient groundwater monitoring well locations within the Wild Rice River Watershed.

Regional groundwater quality

From 1992 to 1996, the MPCA conducted baseline water quality sampling and analysis of Minnesota's principal aquifers. The Wild Rice River Watershed lies entirely within the Northwest Region, which was identified as having higher concentrations of chemicals in the sand and gravel aquifers when compared to other areas with similar aquifers. However, the greatest indicator of poor water quality in this region was the presence of Cretaceous bedrock, which is not present in this watershed. The number of exceedances of drinking criteria for arsenic, barium, boron, manganese, nitrate, and selenium ranged from one to twelve, depending on the aquifer (MPCA, 1999). Nitrate was identified as the chemical of greatest concern in this hydrogeologic region, with probable anthropogenic sources contributing to the elevated concentrations. Volatile organic compounds were also detected with chloroform as the most commonly detected compound, which is correlated with well disinfection (MPCA, 1999).

Another source of information on groundwater quality comes from the Minnesota Department of Health (MDH). Mandatory testing for arsenic, a naturally occurring but potentially harmful contaminant for humans, of all newly constructed wells has found that 10.7% of all wells installed from 2008 to 2015 have arsenic levels above 10 micrograms per liter, the maximum contaminant level (MCL) for drinking water (MDH, 2016a). In the Wild Rice River Watershed, the majority of new wells are within the water quality standards for arsenic levels, but there are exceedances to the MCL. When observing concentrations of arsenic by percentage of wells that exceed the MCL per county, the watershed lies within counties that range from over 10 to 42% exceedances. High levels of arsenic can sometimes be linked to anthropogenic causes, but most are likely related to the clay-rich material left behind by the Des Moines glacial lobe till (MDH, 2016a). By county, the percentages of wells identified with concentrations exceeding the MCL are as follows: Norman (42.1%), Clay (38.0%), Mahnomen (37.8%), Becker (26.1%), and Clearwater (12.4%) (MDH, 2016b) (Figure 19). It is important to reiterate that the percentages of arsenic concentration exceedances are per county, not specifically for the Wild Rice River Watershed. For more information on arsenic in private wells, please refer to the MDH's website: https://apps.health.state.mn.us/mndata/arsenic_wells.

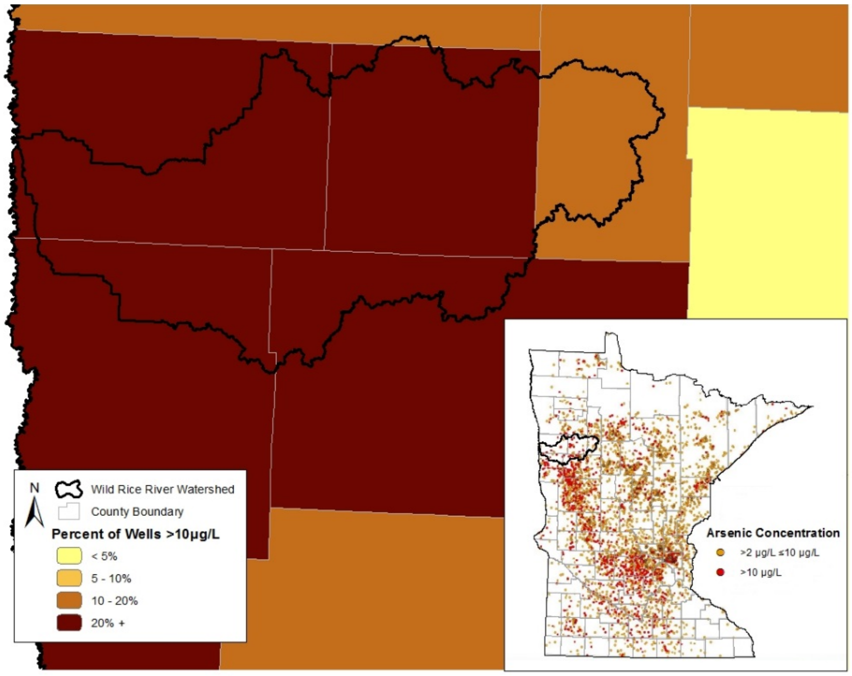

Figure 19. Percent wells with arsenic occurrence greater than the MCL for the Wild Rice River Watershed. (2008-2015) (Source: MDH, 2016b)

A statewide dataset of potentially contaminated sites and facilities with environmental permits and registrations is available at the MPCA's website, through a web-based application called, "What's In My Neighborhood" (WIMN). This MPCA resource provides the public with a method to access a wide variety of environmental information about communities across the state. The data is divided into two groups. The first is potentially contaminated sites, and includes contaminated properties, formerly contaminated sites, and those that are being investigated for suspicion of being contaminated. The second category is made up of businesses that have applied for and received different types of environmental permits and registrations from the MPCA. An example of an environmental permit would be for a business acquiring a permit for a storm water or wastewater discharge, requiring it to operate within limits established by the MPCA. In the Wild Rice River Watershed, there are currently 333 active sites identified by WIMN: 143 feedlots, 95 tanks and leaks, 52 water quality (construction and industrial stormwater, wastewater discharger), 34 hazardous waste, 5 air quality, 3 solid waste, and 1 investigation and cleanup site (Figure 20). For more information regarding "What's in My Neighborhood", refer to the MPCA webpage at http://www.pca.state.mn.us/index.php/data/wimn-whats-in-my-neighborhood/whats-in-my-neighborhood.html.

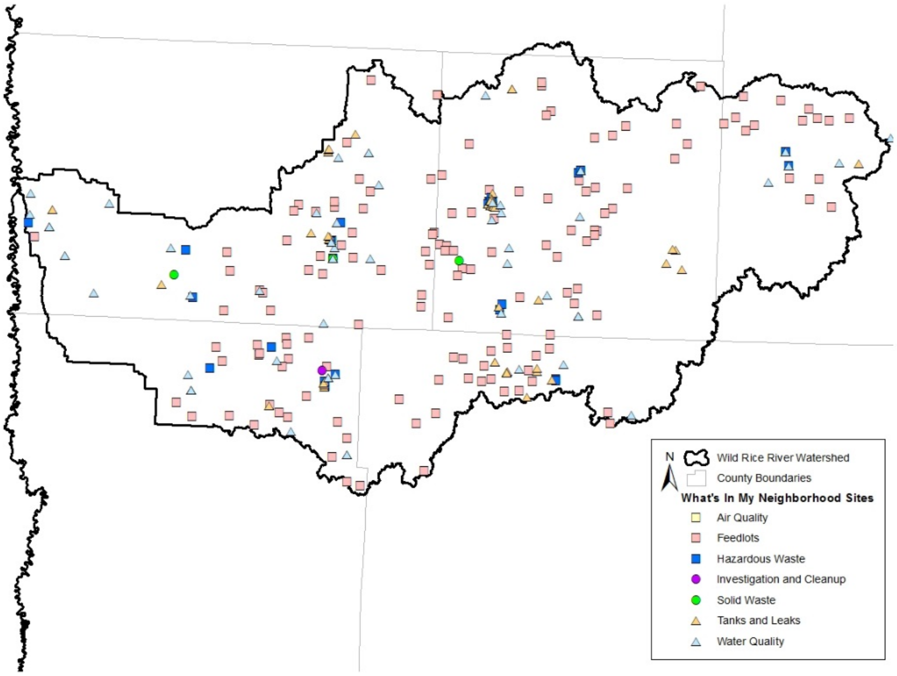

Figure 20. Active "What's In My Neighborhood" site programs and locations for the Wild Rice River Watershed. (Source: MPCA, 2016)

Groundwater quantity

The DNR permits all high capacity water withdrawals where the pumped volume exceeds 10,000 gallons per day or one million gallons per year. Permit holders are required to track water use and report to the DNR annually. The changes in withdrawal volume detailed in this groundwater report are a representation of water use and demand in the watershed and are taken into consideration when the DNR issues permits for water withdrawals. Other factors not discussed in this report but considered when issuing permits include: interactions between individual withdrawal locations, cumulative effects of withdrawals from individual aquifers, and potential interactions between aquifers. This holistic approach to water allocations is necessary to ensure the sustainability of Minnesota's groundwater resources.

The three largest permitted consumers of water in the state for 2014 are (in order) power generation, public water supply (municipals), and irrigation (MDNR, 2016c). According to the most recent DNR Site-specific Water-Use Data System (SWUDS), in 2013 the withdrawals within the Wild Rice River Watershed are primarily utilized for agricultural irrigation (43.5%), such as for crops. The remaining withdrawals include: water supply (32.3%), industrial processing (19.4%), special categories (2.0%), non-crop irrigation (1.5%), and water level maintenance (1.3%). From 1994 to 2013, withdrawals associated with agricultural irrigation have increased ($p<0.1$) with a large jump in quantity in 2012 and 2013 compared to previous years. Industrial processing has decreased at a statistically significant rate ($p<0.001$), water supply appeared to remain constant, and all other categories did not have an adequate amount of reported data to perform statistical analysis.

Figure 21 displays the total high capacity withdrawal locations within the watershed with active permit status in 2013. Permitted groundwater withdrawals are displayed below as blue triangles and surface water withdrawals as red squares. During 1994 to 2013, groundwater withdrawals within the Wild Rice River Watershed exhibit an increasing withdrawal trend ($p<0.05$) (Figure 22, *left*), while surface water withdrawals experienced a declining trend ($p<0.001$) (Figure 22, *right*). Groundwater withdrawals appeared to be constant until 2012, when the amount of water withdrawn almost doubled, most likely related to the increase in agricultural irrigation during those years.

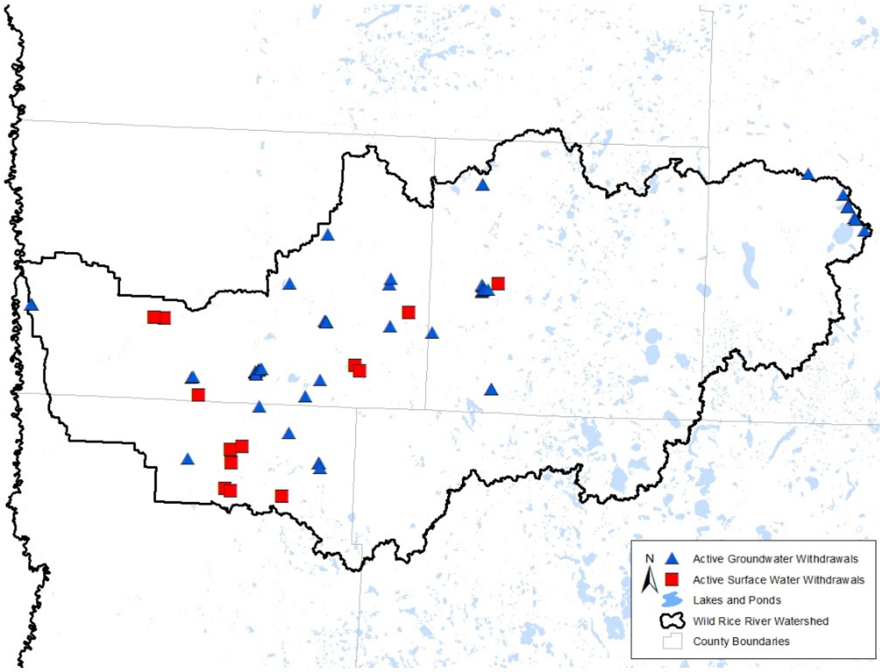

Figure 21. Locations of active status permitted high capacity withdrawals in 2013 within the Wild Rice River Watershed.

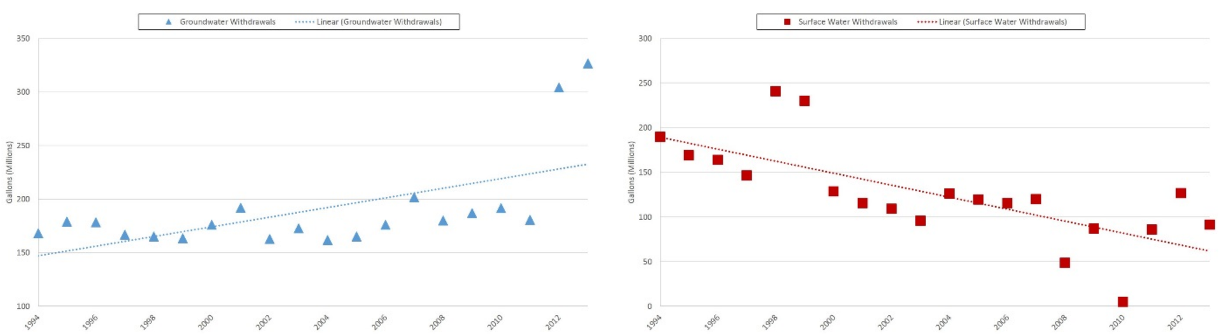

Figure 22. Total annual groundwater (*left*) and surface water (*right*) withdrawals in the Wild Rice River Watershed (1994-2013).

Wetlands

Wetlands are somewhat limited and variably distributed in the Wild Rice River Watershed. There are estimated 110,222-wetland acres in the watershed—or about 11% of the watershed—according to National Wetlands Inventory (NWI) data (Figure 23). This coverage rate is lower than the statewide rate of 19% (Kloiber and Norris, 2013). The majority of the wetlands are located in the eastern half of the watershed. Emergent wetlands (fresh meadows and marshes) are the predominant cover type.

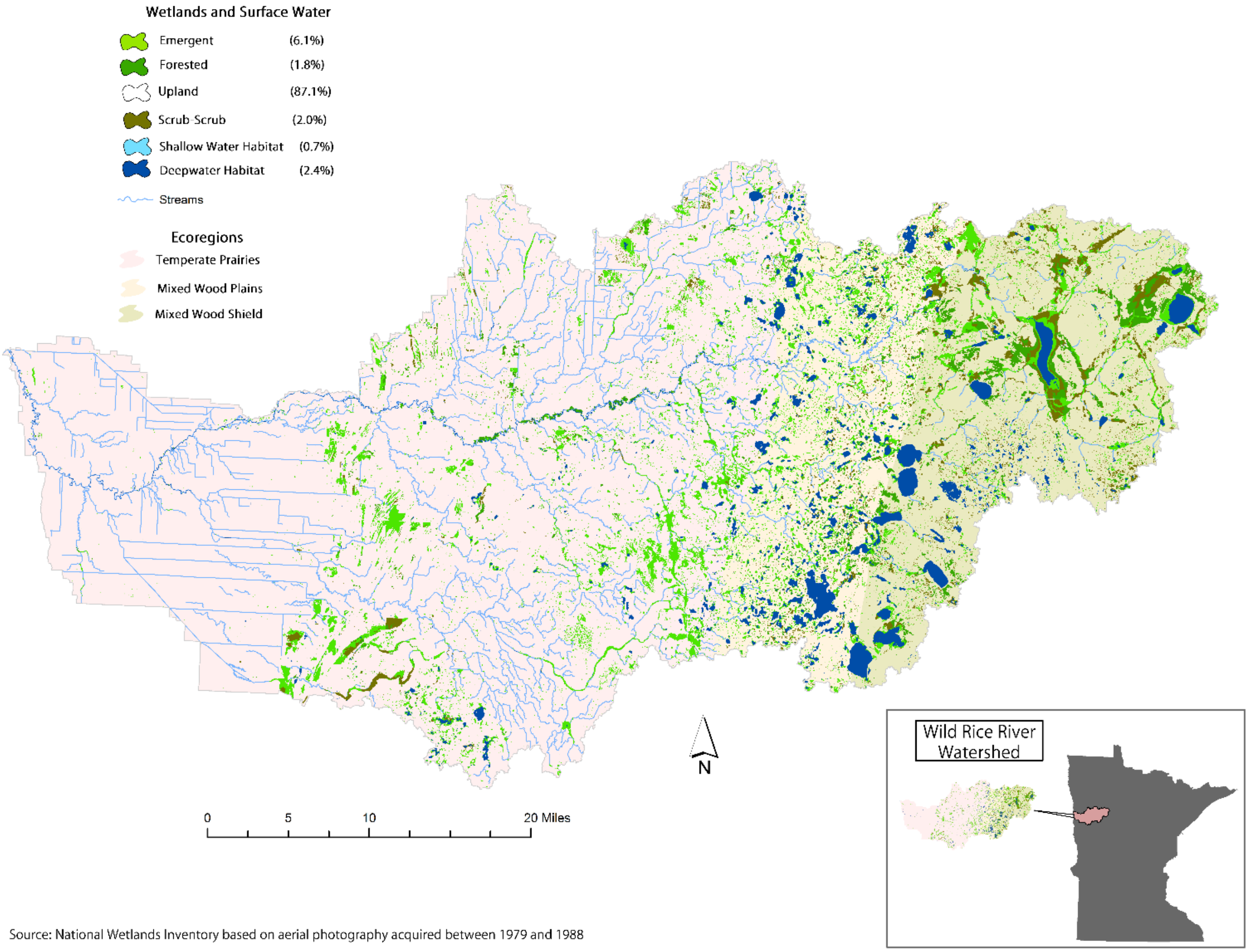

Figure 23. Wetlands and surface water in the Wild Rice River Watershed. Level II Ecoregion boundaries have been included. Wetland data are from the National Wetlands Inventory.

Prior to European settlement, wetlands were much more prevalent throughout the watershed. As wetland soil features typically persist after artificial drainage, soil survey data can be used to estimate historical wetland extent. Mapped poorly and very poorly drained soil units (which would typically support wetlands in the absence of drainage) total 352,270 acres—or approximately 34% of the watershed. Comparing that total to the current NWI estimate reveals that approximately, 69% of the historical wetland extent has been lost. Historical wetland losses by subwatershed increase from east to west in the watershed (Figure 24) as it transitions from the Mixed Wood Shield (northern forest), to the Mixed Wood Plains (central hardwood forest), to the Temperate Prairies (former prairie) Ecoregions (Figure 23).

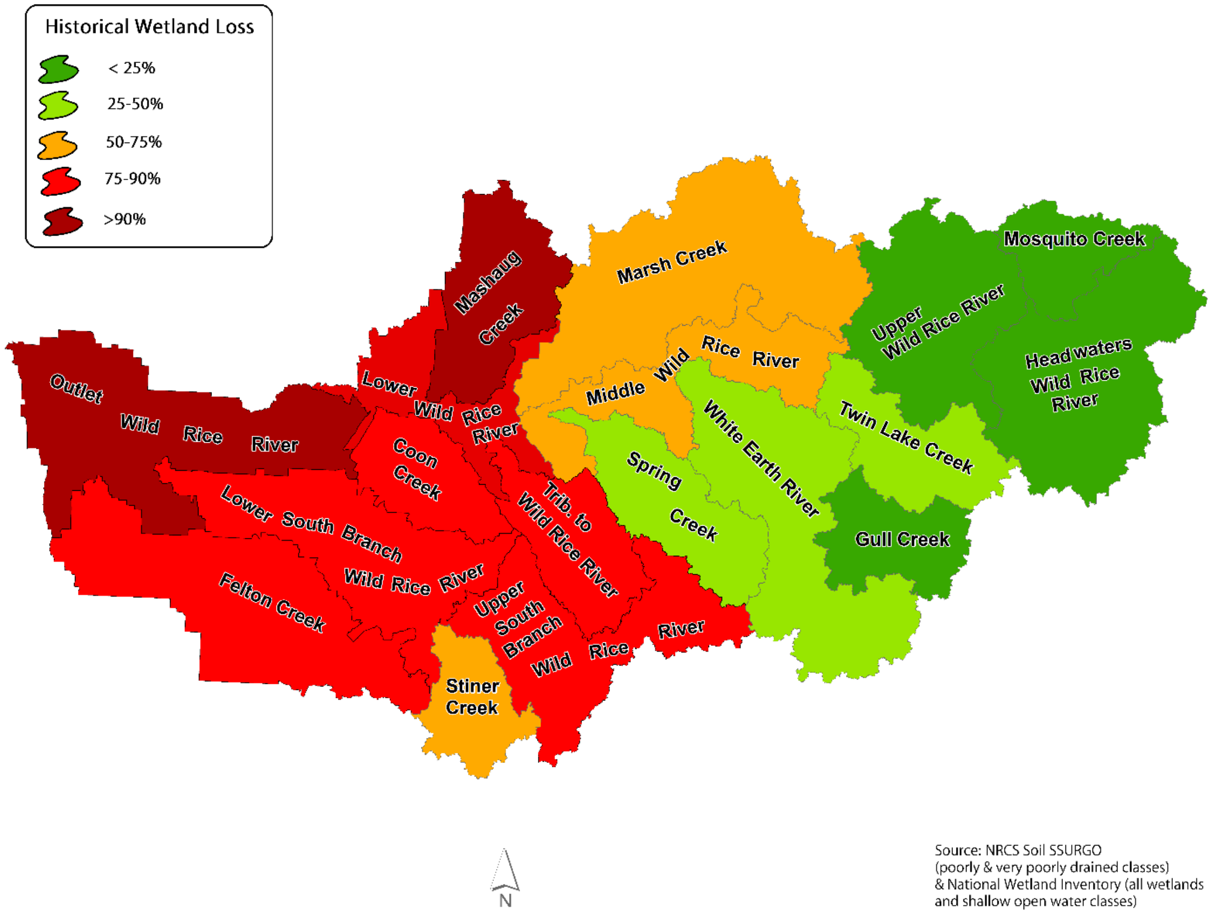

Figure 24. Historic wetland loss by subwatershed in the Wild Rice River Watershed.

Ecoregion differences and two glacial landforms have largely influenced the extent, distribution, and predominant kinds of hydrogeomorphically (HGM) functioning types of wetlands in the Wild Rice River watershed. The eastern half of the watershed predominantly consists of terminal and ground moraine landforms created by glacial advancement (MNGS, 1997). The hill and basin topography of the moraine landform produces numerous lakes and depressional wetlands. Depressional wetland hydrology may be dominated by surface flow, precipitation, and/or groundwater depending on the local setting and whether the basin has a surface water connection (Smith et al., 1995). In many cases, they provide (or contribute significantly) to stream source waters. The easternmost portion of the watershed lies within the Mixed Wood Shield ecoregion (Figure 23) where development pressures are less and most wetlands are intact (Figure 24). The Mixed Wood Plains portion of the watershed (Figure 23) is a transition zone between the northern forests and the prairie that also corresponds with a terminal moraine. Agricultural development and wetland drainage is moderate here, perhaps in part due to local topography limitations (Figure 24). The Temperate Prairies ecoregion and the gentler topography of a ground moraine begins west of the terminal moraine (Figure 23). Depressional wetlands were also once prevalent here; however, the vast majority have been drained to promote more favorable conditions for farming. The western half of the watershed is a glacial lake plain landform created by Glacial Lake Agassiz (MNGS, 1997). The extremely flat landscape that remained following Lake Agassiz had little capacity to drain surface water—promoting saturated soil conditions over expansive areas. Mineral flat HGM type wetlands formed in the glacial lake plain where soils were saturated at or near the surface. These have in large part been effectively drained primarily via surface ditching. There are also several relatively narrow bands of glacial lake beach ridges located here. The beach ridges support wetlands where water accumulates behind downstream ridges (depressional HGM type); as well as, where groundwater discharge saturates a sloping soil surface and peat accumulates (slope HGM type; Smith et al., 1995). Some wetlands continue to exist in the beach ridges, as drainage and agriculture are less practical compared to the glacial lake plain.

The Wild Rice River Watershed supports some notable wetland features. True to its namesake, wild rice populations have been documented on many lakes, ponds, and wetlands in the Mixed Wood Shield and Plains Ecoregion portions of the watershed (Figure 23); as well as, the portion of the Wild Rice River in the area (MPCA Protecting Wild Rice Waters). In addition, calcareous fens—an uncommon type of wetland with alkaline (pH > 6.7) peat that can form where groundwater discharge is mineral-rich—are found in the watershed and are typically associated with the glacial lake beach ridges. Calcareous fens support a unique community of plant species (many are rare) and receive additional protections as state Outstanding Resource Value Waters (ORVW; Minn. R. ch. 7050; https://www.revisor.leg.state.mn.us/rules/?id=7050). The DNR has identified 21 calcareous fens in the watershed, 10 of which are designated ORVW's.

Watershed-wide data collection methodology

Lake water sampling

Fifteen lakes in the Wild Rice River 8-HUC watershed had sufficient data to assess aquatic recreational or aquatic life uses (or both). Nine additional lakes had some level of data that were either inconclusive, or not sufficient in quantity to make assessment decisions. Seven lakes in the eastern portion of the watershed had transparency data submitted by volunteers enrolled in the MPCA's Citizens Lake Monitoring Program (CLMP). Those data were combined with all other available data on those seven lakes to inform aquatic recreational use assessments. Sampling/observation methods are similar among monitoring groups and are described in the document entitled "MPCA Standard Operating Procedure for Lake Water Quality" found at http://www.pca.state.mn.us/publications/wq-s1-16.pdf. The lake recreational use water quality assessment standard requires eight observations/samples within a 10-year period (June to September) for total phosphorus, chlorophyll-a, and Secchi depth.

Stream water sampling

Following the IWM design, water chemistry stations were placed at or near the outlet of each aggregated 12-HUC subwatershed that was >40 square miles in area (purple circles/triangles and green circles in Figure 2. Twenty water chemistry stations were sampled monthly from May through September in 2014, and again June through August of 2015, to provide sufficient water chemistry data to assess all components of the aquatic life and recreational use standards. Seventeen of these water chemistry stations were monitored by MPCA staff; a Surface Water Assessment Grant (SWAG) was awarded to the Clearwater SWCD to monitor the other three stations. (See Appendix 2.1 for locations of stream water chemistry monitoring sites. See Appendix 1 for definitions of stream chemistry analytes monitored in this study).

Battery powered, water quality sondes were deployed at 10 locations within the watershed to continuously monitor DO concentrations. Those deployments spanned a minimum of 4-days, but were often closer to or greater than 10-days in duration. The resulting continuous dataset provides valuable insight into the magnitude of daily DO flux (change from minimum to maximum values), the duration of DO sag (below the water quality standard), and the potential to negatively impact the aquatic communities.

Stream flow methodology

The MPCA and theDNR joint stream water quantity and quality monitoring data for dozens of sites across the state on major rivers, at the mouths of most of the state's major watersheds, and at the mouths of some aggregated 12-HUC subwatersheds are available at the DNR/PCA Cooperative Stream Gaging webpage at: http://www.dnr.state.mn.us/waters/csg/index.html.

Lake biological sampling

A total of 12 lakes were monitored for fish community health in the Wild Rice River Watershed. While data from the last 10 years contributed to the watershed assessments, the majority of data utilized for the 2016 assessment cycle were collected between 2007 and 2015. Waterbody assessments to determine aquatic life use support were completed for 10 lakes within the watershed. To measure the health of aquatic life at each lake, a fish index of biological integrity (IBI) was calculated based on fish samples collected in the lake. A fish classification framework was developed to account for natural variation in community structure, which is attributed to area, maximum depth, alkalinity, shoreline complexity, and geographic location. As a result, an IBI is available for four different groups of lake classes (Schupp Lake Classification, MDNR). Each IBI class uses a unique suite of metrics, scoring functions, impairment thresholds, and confidence intervals (CIs). IBI scores higher than the impairment threshold and upper CI indicate that the lake supports aquatic life. Scores below the impairment threshold and lower CI indicate that the lake does not support aquatic life. When an IBI score falls within the upper and lower confidence limits, additional information may be considered when making the impairment decision such as the consideration of potential local and watershed stressors and additional monitoring information (e.g., water chemistry, physical habitat, plant surveys, and observations of local land use activities).

Stream biological sampling

The biological monitoring component of the IWM in the Wild Rice River and its tributaries was completed during the summer of 2014. Thirty-nine sites on 36 stream reaches were sampled for biology in the Wild Rice River Watershed. Waterbody assessments to determine aquatic life use support were conducted for 35 stream reaches. The monitoring sites were located near the outlets of most minor 14-HUC watersheds. In addition, twelve existing biological monitoring stations within the watershed were revisited in 2014. These monitoring stations were initially established as part of a random Red River Basin wide survey in 2005, or as part of a 2005 survey which investigated the quality of channelized streams with intact riparian zones. While data from the last 10 years contributed to the watershed assessments, the majority of data utilized for the 2016 assessment was collected in 2014. Biological information that was not used in the assessment process will be crucial to the stressor identification process and will also be used as a basis for long term trend results in subsequent reporting cycles.

To measure the health of aquatic life at each biological monitoring station, indices of biological integrity (IBIs), specifically fish and macroinvertebrate IBIs, were calculated based on monitoring data collected for each of these communities. A fish and macroinvertebrate classification framework was developed to account for natural variation in community structure, which is attributed to geographic region, watershed drainage area, water temperature, and stream gradient. As a result, Minnesota's streams and rivers were divided into seven distinct warm water classes and two cold water classes, with each class having its own unique Fish IBI and Invert IBI. Each IBI class uses a unique suite of metrics, scoring functions, impairment thresholds, and confidence intervals (CIs) (For IBI classes, thresholds and CIs, see Appendix 3.1). IBI scores higher than the impairment threshold and upper CI indicate that the stream reach supports aquatic life. Contrarily, scores below the impairment threshold and lower CI indicate that the stream reach does not support aquatic life. When an IBI score falls within the upper and lower confidence limits, additional information may be considered when making the impairment decision such as the consideration of potential local and watershed stressors and additional monitoring information (e.g., water chemistry, physical habitat, observations of local land use activities). For IBI results for each individual biological monitoring station, see Appendices 4.1 and 4.2.

Fish contaminants

The DNR fisheries staff collect most of the fish the Fish Contaminant Monitoring Program. In addition, MPCA's biomonitoring staff collect up to five piscivorous (top predator) fish and five forage fish as part of the IWM. All fish collected by the MPCA are analyzed for mercury and the two largest individual fish of each species are analyzed for polychlorinated biphenyls (PCBs).

Captured fish were wrapped in aluminum foil and frozen until they were thawed, scaled (or skinned), filleted, and ground to a homogenized tissue sample. Homogenized fillets were placed in 60 mL glass jars with Teflon™ lids and frozen until thawed for lab analysis. The Minnesota Department of Agriculture Laboratory analyzed the samples for mercury and PCBs. If fish were tested for perfluorochemicals (PFCs), whole fish were shipped to AXYS Analytical Laboratory, which analyzed the homogenized fish fillets for 13 PFCs. Of the measured PFCs, only perfluorooctane sulfonate (PFOS) is reported because it bioaccumulates in fish to levels that are potentially toxic, and a reference dose has been developed.

From the fish contaminant analyses, MPCA determines which waters exceed impairment thresholds. The Impaired Waters List is prepared by the MPCA and submitted every even year to the EPA. The MPCA has included waters impaired for contaminants in fish on the Impaired Waters List since 1998. Impairment assessment for PCBs (and PFOS when tested) in fish tissue is based on the fish consumption advisories prepared by the MDH. If the consumption advice is to restrict consumption of a particular fish species to less than a meal per week the MPCA considers the lake or river impaired. The threshold concentration for impairment (consumption advice of one meal per month) is an average fillet concentration of 0.22 mg/kg for PCBs (and 0.200 mg/kg for PFOS).

Monitoring of fish contaminants in the 1970s and 1980s showed high concentrations of PCBs were primarily a concern downstream of large urban areas in large rivers, such as the Mississippi River, and in Lake Superior. Therefore, PCBs are now tested where high concentrations in fish were measured in the past and the major watersheds are screened for PCBs in the watershed monitoring collections.

Before 2006, mercury in fish tissue was assessed for water quality impairment based on MDH's fish consumption advisory, the same as PCBs. With the adoption of a water quality standard for mercury in edible fish tissue, a waterbody has been classified as impaired for mercury in fish tissue if ten percent of the fish samples (measured as the 90th percentile) exceed 0.2 mg/kg of mercury. At least five fish samples of the same species are required to make this assessment and only the last 10 years of data are used for the assessment. MPCA's Impaired Waters List includes waterways that were assessed as impaired prior to 2006, as well as more recent impairments.

Load monitoring

The Watershed Pollutant Load Monitoring Network (WPLMN) is a long-term program designed to measure and compare regional differences and long-term trends in water quality among Minnesota's major rivers including the Red, Rainy, St. Croix, Mississippi, and Minnesota; at the outlets of the major tributaries (8 digit HUC scale) draining to these rivers; and for subwatersheds of the major watersheds. Intensive water quality sampling occurs at all WPLMN sites. Thirty-five samples per year are allocated for basin and major watershed sites and 25 samples per season (ice out through October 31) for subwatershed sites. Water sample results and daily average flow data are coupled in the FLUX32 pollutant load model to estimate the transport (load) of nutrients and other water quality constituents past a sampling station over a given period of time. Loads and flow weighted mean concentrations (FWMCs) are calculated for total suspended solids (TSS), total phosphorus (TP), dissolved orthophosphate, nitrate plus nitrite nitrogen (NO3+NO2-N), and total Kjeldahl nitrogen.

More information can be found at the WPLMN website.

Groundwater monitoring

The MPCA maintains an ambient groundwater monitoring network that monitors the aquifers that are most likely to be polluted with non-agricultural chemicals. This network primarily targets the shallow aquifers that underlie the urban parts of the state, due to the higher tendency of vulnerability to pollution. The MPCA's Ambient Groundwater Monitoring Network as of 2016, when this report was produced, consisted of approximately 250 wells that are primarily located in the sand and gravel and Prairie du Chien- Jordan aquifers.

Some wells in the MPCA's network are used to discern the effect of urban land use on groundwater quality and comprise an early warning network. Most wells in this early warning network contain water that was recently recharged into the groundwater, some even less than one year old. The wells in the early warning network are distributed among several different settings to determine the effect land use has on groundwater quality. These assessed land use settings are: 1) sewered residential, 2) residential areas that use subsurface sewage treatment systems (SSTS) for wastewater disposal, 3) commercial or industrial, and 4) undeveloped. The data collected from the wells in the undeveloped areas provide a baseline to assess the extent of any pollution from all other land use settings.

Water samples from the MPCA's Ambient Groundwater Monitoring Network wells generally are collected annually by MPCA staff. This sampling frequency provides sufficient information to determine trends in groundwater quality. The water samples are analyzed to determine the concentrations of over 100 chemicals, including nitrate, chloride, and volatile organic compounds (VOCs).

Information on groundwater monitoring methodology is taken from Kroening and Ferrey's report: The Condition of Minnesota's Groundwater, 2007-2011 (2013). To download ambient groundwater monitoring data, please refer to https://www.pca.state.mn.us/data/groundwater-data.

Wetland monitoring

The MPCA is actively developing methods and building capacity to conduct wetland quality monitoring and assessment. Our primary approach is biological monitoring—where changes in biological communities may be indicating a response to human-caused impacts. The MPCA has developed Indices of Biological Integrity (IBIs) to monitor the macroinvertebrate condition of depressional wetlands that have open water and the Floristic Quality Assessment (FQA) to assess vegetation condition in all of Minnesota's wetland types. For more information about the wetland monitoring (including technical background reports and sampling procedures), please visit the MPCA Wetland monitoring and assessment webpage.

The MPCA currently does not monitor wetlands systematically by watershed. Alternatively, the overall status and trends of wetland quality in the state and by major ecoregion is being tracked through probabilistic monitoring. Probabilistic monitoring refers to the process of randomly selecting sites to monitor; from which, an unbiased estimate of the resource can be made. Regional probabilistic survey results can provide a reasonable approximation of the current wetland quality in the watershed.

Individual aggregated 12-HUC subwatershed results

Aggregated 12-HUC subwatersheds

Assessment results for aquatic life and recreation use are presented for each aggregated 12-HUC subwatershed within the Wild Rice River Watershed. The primary objective is to portray all the full support and impairment listings within an aggregated 12-HUC subwatershed resulting from the complex and multi-step assessment and listing process. This scale provides a robust assessment of water quality condition at a practical size for the development, management, and implementation of effective TMDLs and protection strategies. The graphics presented for each of the aggregated 12-HUC subwatersheds contain the assessment results from the 2016 assessment cycle as any impairment listings from previous assessment cycles. Discussion of assessment results focuses primarily on the 2014 IWM effort, but also considers available data from the last 10 years.

The proceeding pages provide an account of each aggregated 12-HUC subwatershed. Each account includes a brief description of the aggregated 12-HUC subwatershed and summary tables of the results for each of the following: a) stream aquatic life and aquatic recreation assessments, and b) lake aquatic life and recreation assessments. Following the tables is a narrative summary of the assessment results and pertinent water quality projects completed or planned for the aggregated 12-HUC subwatershed. A brief description of each of the summary tables is provided below.

Stream assessments

A table is provided in each section summarizing aquatic life and aquatic recreation assessments of all assessable stream reaches within the aggregated 12-HUC subwatershed (i.e., where sufficient information was available to make an assessment). Primarily, these tables reflect the results of the 2016 assessment process (2018 EPA reporting cycle); however, impairments from previous assessment cycles are also included and are distinguished from new impairments via cell shading (see footnote section of each table). These tables also denote the results of comparing each individual aquatic life and aquatic recreation indicator to their respective criteria (i.e., standards); determinations made during the desktop phase of the assessment process (Figure 4). Assessment of aquatic life is derived from the analysis of biological (fish and invert IBIs), DO, total suspended solids, chloride, pH, total phosphorus, chlorophyll-a, biochemical oxygen demand, and un-ionized ammonia (NH_3) data, while the assessment of aquatic recreation in streams is based solely on bacteria (*Escherichia coli*) data. Included in each table is the specific aquatic life use classification for each stream reach: cold water community (2A); cool or warm water community (2B); or indigenous aquatic community (2C). Where applicable and sufficient data exists, assessments of other designated uses (e.g., class 7, drinking water, aquatic consumption) are discussed in the summary section of each aggregated 12-HUC subwatershed as well as in the watershed-wide Results and Discussion section.

Lake assessments

A summary of lake water quality is provided in the aggregated 12-HUC subwatershed sections where available data exist. This includes aquatic recreation (phosphorus, chlorophyll-a, and Secchi) and aquatic life, where available (chloride and fish IBI). Similar to streams, parameter level and over all use decisions are represented in the table and new versus old impairment listings are distinguished by color coding described in the table footnotes.

Headwaters Wild Rice River Aggregated 12-HUC HUC 0902010801-01

The Headwaters Wild Rice River Subwatershed, located in Clearwater County, encompasses 133 square miles. As the name states, this subwatershed contains the first section of the Wild Rice River, which originates at Upper Rice Lake within the White Earth State Forest. From Upper Rice Lake, the Wild Rice River flows southwest until it enters Lower Rice Lake approximately 6 miles southwest of Minerva. There are two major non-channelized tributaries to the Wild Rice River within this subwatershed, Heir Creek and Buckboard Creek. Lakes in the subwatershed include: Upper Rice, Rockstad, Minerva, McKenzie, and Waptus. The southern portions of the subwatershed are within the White Earth Indian Reservation. Land cover is dominated by forest (66%), but wetlands (14%) and rangeland (11%) were also present. One chemistry station was established within the subwatershed on the Wild Rice River (S005-131).

Table 2. Aquatic life and recreation assessments on stream reaches: Headwaters Wild Rice River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name,* *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators:										Aquatic Life	Aquatic Rec. (Bacteria)
				Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication		
09020108-551 ***Heir Creek,*** *Unnamed Creek to Wild Rice River*	14RD017	5.23	WWg	MTS	MTS	IF	IF	IF	--	IF	IF	--	IF	SUP	--
09020108-646 ***Wild Rice River,*** *Unnamed Creek to Lower Rice Lake*	95RD005	16.53	WWg	EXS	MTS	MTS	MTS	MTS	MTS	MTS	MTS	--	IF	IMP	SUP
09020108-534 ***Buckboard Creek,*** *Headwaters to T144 R38W S11, North Line*	05RD100	7.41	WWg*	MTS	MTS	IF	IF	IF	--	IF	IF	--	IF	SUP	--

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 3. Lake assessments: Headwaters Wild Rice River Aggregated 12-HUC.

Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
							Fish IBI	Chloride	Pesticides	Total Phosphorus	Chlorophyll-a	Secchi		
Upper Rice	15-0059-00	1338	15	Deep Lake	NLF	- -	- -	- -	- -	MTS	MTS	MTS	- -	FS
Rockstad	15-0075-00	136	16	Shallow Lake	NLF	- -	IF	- -	- -	EX	EX	EX	IF	NS
Minerva	15-0079-00	202	15	Deep Lake	NLF	- -	- -	MTS	- -	MTS	EX	MTS	IF	IF
McKenzie	15-0124-00	73	17	Shallow Lake	NLF	- -	- -	MTS	- -	MTS	MTS	MTS	IF	FS
Waptus	15-0128-00	47	48	Deep Lake	NLF	- -	- -	MTS	- -	MTS	MTS	MTS	IF	FS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

The Headwaters Wild Rice River Subwatershed contains three stream reaches (09020108-551, 09020108-646, and 09020108-534), each with one biological monitoring station. All three stream sections are natural, and provide good habitat for fish and macroinvertebrates (Appendix 5). Quality instream substrates and multiple cover types were observed at each monitoring location. One biological station (14RD017) was sampled for fish and macroinvertebrates on Heir Creek (09020108-551). Although this station had a slightly lower MSHA score than the other stations within the subwatershed, it still displayed several good habitat attributes. Coarse gravel, cobble, vegetation, woody debris, and under-cut banks provided good cover for small fishes and macroinvertebrates. Several sensitive minnow species (Blacknose Shiner, Blackchin Shiner) and sensitive macroinvertebrate taxa were captured. IBI scores for both assemblages were good, coinciding with the positive habitat features. The high IBI scores for both biological communities and good habitat conditions suggest that Heir Creek (09020108-551) is a high value resource that should be protected. Chemistry data for Heir Creek was limited to a one-time grab sample collected during the biological monitoring visit.

The longest reach (09020108-646) within the subwatershed is the headwaters portion of the Wild Rice River, which contained one biological station (95RD005). This station had the highest MSHA score within the subwatershed (69.7, Appendix 5). The channel morphology was excellent, as indicated by the presence of good channel development and high channel stability scores. The site also had coarse gravel substrates and moderate flows; habitat features that are considered good for gravel spawners and smaller sensitive fish species. Although the habitat in this portion of the river was good, the Fish Index of Biotic Integrity (FIBI) score fell below the general use threshold. The fish community was dominated by species that are tolerant of low DO (Central Mudminnow, Northern Pike, Black Bullhead). No sensitive species were captured. Contrary to the fish community results, the macroinvertebrate community was comprised of some sensitive taxa, and the Macroinvertebrate Index of Biotic Integrity (MIBI) score was above the threshold. Possible stressors that could explain the poor fish community include a dam that impounds Lower Rice Lake. The dam isolates the river between a headwaters wetland and Lower Rice Lake, possibly creating potential barriers to fish migration as well as the potential for low DO conditions.

The conventional chemistry data collected on the Wild Rice River (09020108-646) suggested that this reach supports aquatic life. Phosphorus is elevated on the reach, and a single DO deployment indicated that large swings in oxygen can occur within this section of the Wild Rice River. A second deployment is needed to confirm that this condition persists across years.

E. coli bacteria results indicate that the Wild Rice River (09020108-646) supports aquatic recreation. However, monthly geometric mean concentrations in the months of June and August are approaching the chronic standard, which suggests that this river reach may be vulnerable to a future recreational use impairment due to excessive bacteria.

The most downstream stream reach (09020108-534) within this subwatershed is Buckboard Creek, which contained one biological station (05RD100). The station had adequate flow, coarse gravel substrate, and extensive cover (MSHA=66.7). The good habitat features were utilized by sensitive fish species such as the Blackchin Shiner and a number of sensitive macroinvertebrates. The FIBI and MIBI scores were both above the general use thresholds indicating full support for aquatic life. A review of historic and contemporary fish data collected by the MPCA and DNR indicated that the reach should be changed from a coldwater to a warmwater designation. The lack of coldwater obligate macroinvertebrate taxa, no coldwater fish taxa, and warm summer average water temperatures suggested that this reach lacks coldwater potential. Instead, the presence of sensitive flow dependent warm and coolwater macroinvertebrate taxa and sensitive fish species suggest that this is a high functioning warmwater system. Chemistry data for Buckboard Creek was limited to a one-time grab sample collected during the biological monitoring visit.

Five lakes within this subwatershed have sufficient data to assess for aquatic recreation. Three of the lakes (Upper Rice, McKenzie and Waptus) meet all Northern Lakes and Forest (NLF) nutrient related standards and fully support recreation. Minerva Lake also supports recreation based on seasonal mean total phosphorus and Secchi transparency meeting the NLF standards; however, this lake is very close to the standard and is a high priority for protection efforts to reduce nutrient inputs that could increase algal blooms. Rockstad Lake exceeded the water quality standards for all three lake eutrophication parameters, indicating that the lake does not support recreation and nuisance algal blooms may be present during the summer months. Consequently, Rockstad Lake will be newly listed as impaired for excessive nutrients during the 2018 reporting cycle. The DNR completed one fish IBI survey on Rockstad Lake in 2014. The data were insufficient to complete an aquatic life use assessment due to evidence of a recent winterkill and difficult sampling conditions (abundant emergent vegetation and woody habitat).

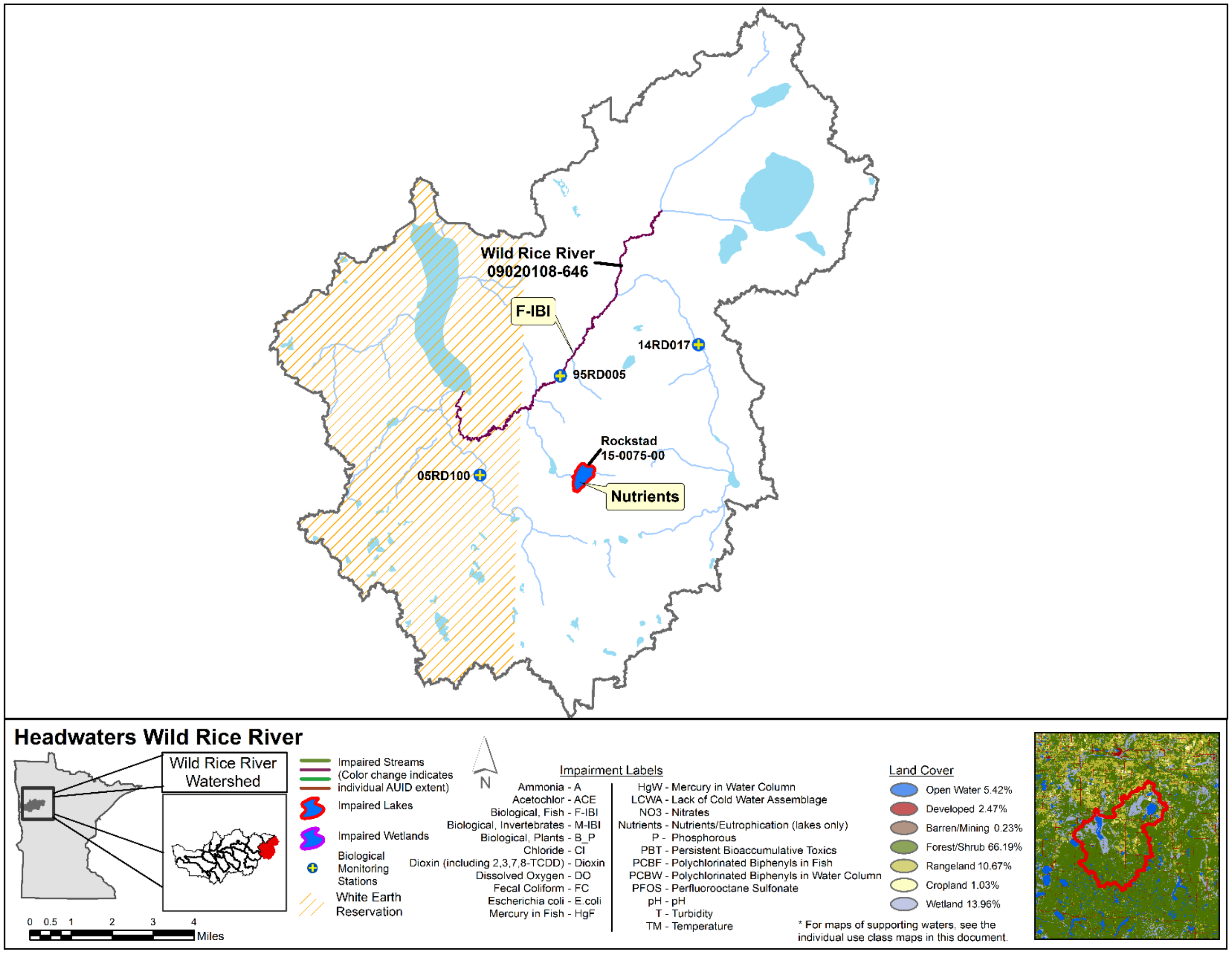

Figure 25. Currently listed impaired waters by parameter and land use characteristics in the Headwaters Wild Rice River Aggregated 12-HUC.

Mosquito Creek Aggregated 12-HUC HUC 0902010801-02

The Mosquito Creek Subwatershed is located within Clearwater County, encompassing 41 miles. This watershed contains the tributary, Mosquito Creek that flows for 5 miles before reaching Lower Rice Lake, where it contributes flow to the Wild Rice River 5.5 miles northwest of Minerva. Most of Mosquito Creek has been channelized to assist drainage. Land use within this watershed is predominantly forest (49 %). A significant amount of rangeland (34%) and wetlands (8%) also exist throughout the subwatershed. One intensive water chemistry station (S007-895) was established within the subwatershed on Mosquito Creek.

Table 4. Aquatic life and recreation assessments on stream reaches: Mosquito Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia - NH_3	Pesticides	Eutrophication	Aquatic Life	Aquatic Rec. (Bacteria)
09020108-591 ***Mosquito Creek,*** *Unnamed Ditch to Unnamed Ditch*	14RD026	4.85	WWg	NA	--	IF	IF	IF	--	IF	IF	--	--	NA	--
09020108-657 ***Mosquito Creek,*** *Unnamed creek to unnamed creek*	--	2.84	WWg	- -	- -	IF	MTS	MTS	MTS	MTS	MTS	- -	IF	IF	SUP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

The Mosquito Creek Subwatershed contains two stream reaches on Mosquito Creek (09020108-591 and 09020108-657). One biological monitoring station (14RD026) was sampled within 09020108-591 for fish, but the stream was more indicative of a wetland than a stream, and was therefore not assessed.

The next downstream reach is Mosquito Creek (09020108-657) which was not sampled for biology. However, chemistry data meets the *E. coli* bacteria standard, and fully supports recreational uses. The minimum number of bacteria samples (15) collected all meet the individual bacteria standard, and all months that have at least five samples where a geometric mean can be calculated also meet the standard. Chloride and unionized ammonia data used for the aquatic life use assessment both meet the use standards; however, the overall assessment decision is 'insufficient information' due to the lack of adequate DO and toxics data.

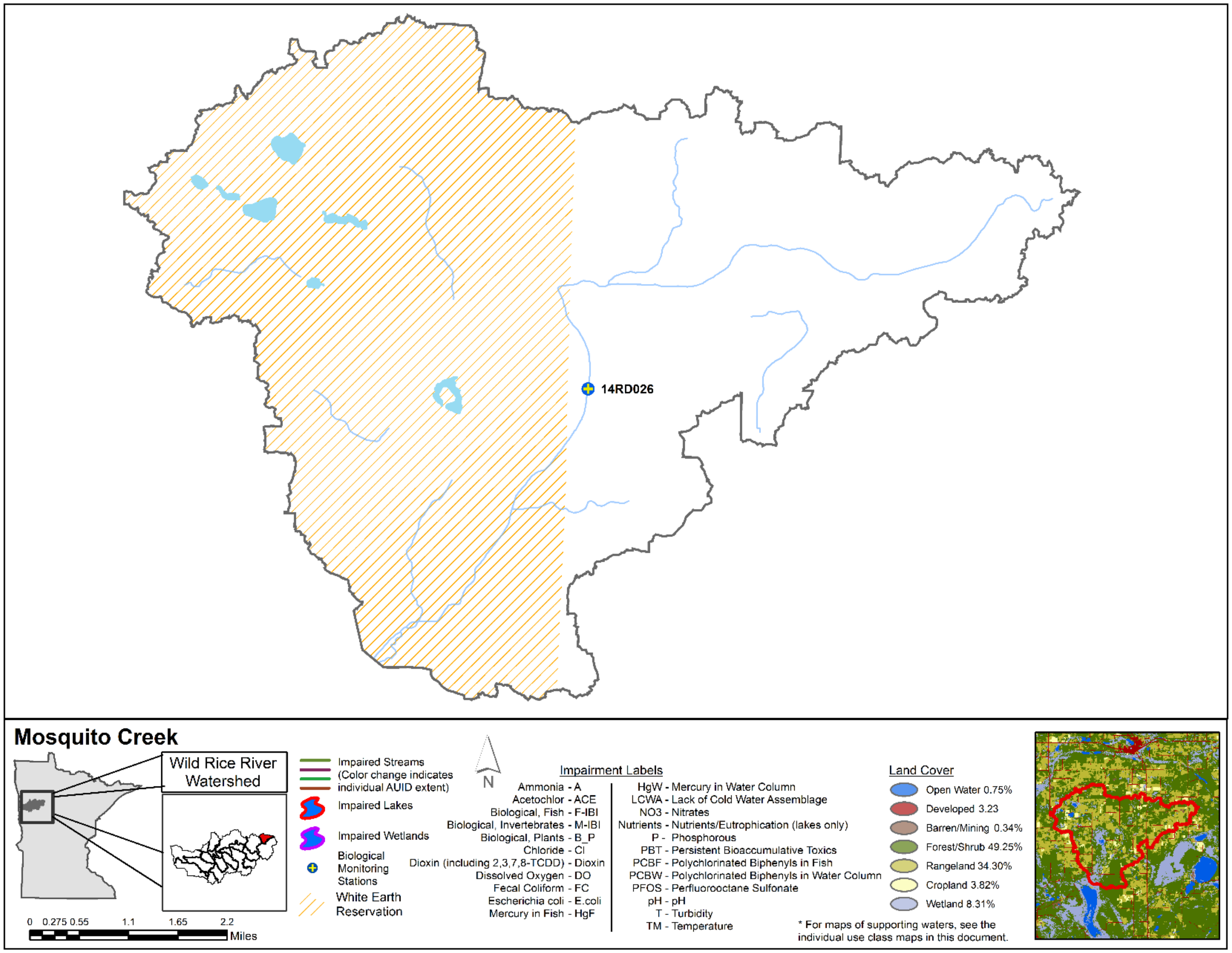

Figure 26. Currently listed impaired waters by parameter and land use characteristics in the Mosquito Creek Aggregated 12-HUC.

Upper Wild Rice River Aggregated 12-HUC　　HUC 0902010802-01

The Upper Wild Rice River Subwatershed is located within Clearwater and Mahnomen Counties. This subwatershed encompasses 105 square miles, and as the name implies, contains the upper portion of the Wild Rice River. Originating in Lower Rice Lake, the Wild Rice River flows for 33 miles before reaching its confluence with Twin Lake Creek at the outlet of the subwatershed. The Upper Wild Rice River Subwatershed also includes the unassessed natural tributary, Roy Lake Creek. The sections of the Wild Rice River within this subwatershed have not been channelized. Several lakes are present throughout the subwatershed, including: Lower Rice, Roy, and Island. Land use within this subwatershed is predominately forest (63%), but rangeland (16%) and wetlands (12%) are also present. Two intensive water chemistry stations were established in the subwatershed on the Wild Rice River (S007-896 on 09020108-512; and S005-130 on 09020108-510).

Table 5. Aquatic life and recreation assessments on stream reaches: Upper Wild Rice River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:** Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-512 ***Wild Rice River,*** *Lower Rice Lake to Roy Lake Creek*	14RD003	8.2	WWg	MTS	IF	IF	MTS	MTS	MTS	MTS	MTS	--	IF	SUP	SUP
09020108-510 ***Wild Rice River,*** *Roy Lake Creek to Twin Lake Creek*	14RD004 14RD030	24.67	WWg	MTS	MTS	IF	MTS	MTS	MTS	MTS	MTS	--	IF	SUP	SUP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 6. Lake assessments: Upper Wild Rice River Aggregated 12-HUC.

Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
							Fish IBI	Chloride	Pesticides	Total Phosphorus	Chlorophyll-a	Secchi		
Roy	44-0001-00	679	15	Deep Lake	NLF	D	MTS	MTS	- -	MTS	IF	EX	FS	IF
Island	44-0038-00	600	43	Deep Lake	NCHF	NT	MTS	MTS	- -	IF	IF	MTS	FS	IF

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐ = insufficient information.

Summary

The Upper Wild Rice River Subwatershed contains two stream reaches (09020108-512 and 09020108-510), forming the upper portions of the mainstem Wild Rice River. The Wild Rice River within this subwatershed has not been channelized, and remains natural. The upstream reach (09020108-512) contains one biological monitoring station (14RD003) sampled for fish and macroinvertebrates. The habitat for aquatic life is fair throughout the reach, indicated by the presence of good attributes (coarse substrate, moderate/high channel stability) and poor attributes (fair channel development, poor sinuosity). The fish community contained sensitive species (Longnose Dace, Iowa Darter) and had an FIBI score that was above the threshold. Macroinvertebrates were collected in 2014 on the same day as fish, and some critical dominant habitats were not sampled resulting in a suspiciously low MIBI score. This prompted attempts for follow up monitoring which all proved unsuccessful due to variable flow conditions. A supporting aquatic life assessment was made based on the fish community. Limited information was available for oxygen and phosphorus on this reach of the river. Other parameters, such as sediment, ammonia, and chloride are meeting standards and supporting aquatic life. Samples collected from the upstream reach on the Wild Rice River suggest that the river meets aquatic recreation use standards, with low amounts of bacteria present in the river.

The downstream reach on the Wild Rice River (09020108-510) contains two biological stations (14RD004, 14RD030) that were sampled for fish and macroinvertebrates. The MSHA scores indicated that the habitat is good within the upstream reaches of the river, and fair in the downstream portion.

Several good habitat attributes were noted, including; coarse substrate, a good variety of cover types, and good channel development (Appendix 5). The fish community contains sensitive species (Blacknose Shiner, Iowa Darter) and larger riverine species (Golden Redhorse, Silver Redhorse, Shorthead Redhorse), with an FIBI score that was above the threshold. Similarly, the macroinvertebrate community has sensitive taxa, with some cool water taxa present, and an MIBI score that is above the threshold. Samples collected from the downstream reach on the Wild Rice River suggest that the river meets aquatic recreation use standards, with low bacteria levels in the river. Chemistry, such as chloride, ammonia, and sediment were found in low concentrations, supporting aquatic life. Eutrophication is not likely on this reach; while phosphorus was elevated, the stream is not responding with increased productivity (high oxygen flux or algal growth).

Two lakes in this subwatershed have sufficient data for aquatic life use assessments. The DNR conducted two fish IBI surveys on Roy Lake (2007 and 2015), both of which showed a fish community dominated by neutral species like Northern Pike, Walleye and Largemouth Bass. The surveys also identified tolerant (Common Carp) and sensitive (Iowa Darter) fish species. Roy Lake has a relatively small watershed and low levels of shoreline disturbance, but long-term Secchi transparency trend analysis indicates that lake transparency is on the decline (Roy Lake already exceeds the Secchi transparency standard).

The DNR also conducted two fish surveys on Island Lake (2010; 2015). The 2015 survey was the primary source of data for assessment purposes. Similar to Roy Lake, neutral species such as Northern Pike, Walleye, and Largemouth Bass were the most abundant fish species captured. Based on the survey findings, the DNR assessed both Roy and Island lakes as fully supporting aquatic life uses.

Aquatic recreational use assessments on both lakes are inconclusive. Roy Lake meets the NLF seasonal mean total phosphorus standard, but Secchi transparency exceeds and chl-a seasonal mean concentration is right at the standard. As a declining trend in transparency has been observed, Roy Lake would be a high priority for protection efforts. Island Lake recreational data show nutrients meeting (but easily within range of) the NCHF standard; a large Secchi transparency dataset supplied by CLMP volunteer efforts meets the standard, but like in Roy Lake chl-a is right at the standard. An additional year(s) of recreational parameter data would better describe if the lakes support recreational use.

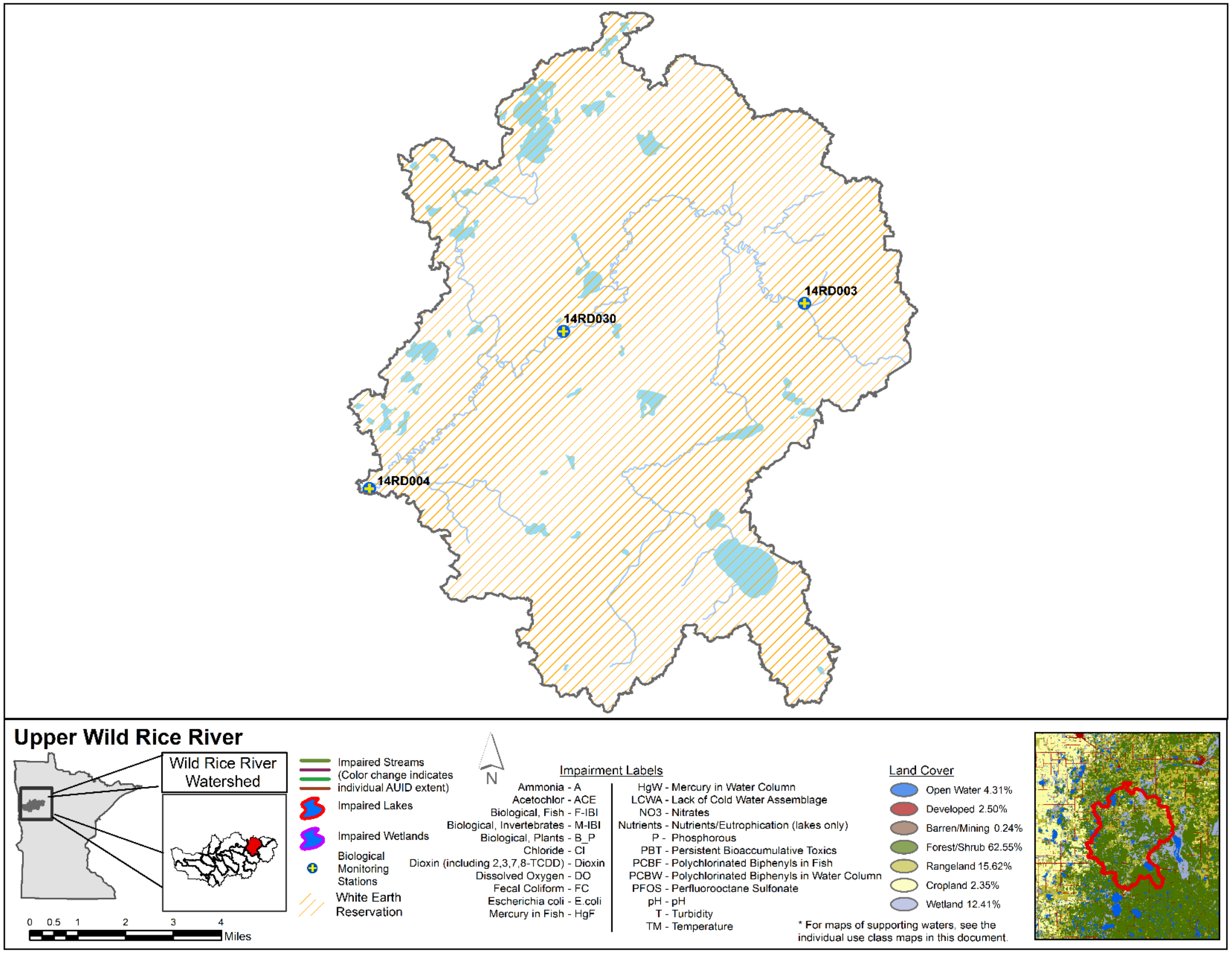

Figure 27. Currently listed impaired waters by parameter and land use characteristics in the Upper Wild Rice River Aggregated 12-HUC.

Twin Lake Creek Aggregated 12-HUC HUC 0902010803-01

The Twin Lake Creek Subwatershed is located within Clearwater and Mahnomen Counties and encompasses 62 square miles within the White Earth Indian Reservation. Twin Lake Creek originates within North Twin Lake and flows for 13 miles until it reaches its confluence with the Wild Rice River 7 miles northwest of Naytahwaush. Bad Boy Creek and Unnamed Creek also lie within the subwatershed, forming the headwaters of Twin Lake Creek, flowing 5 miles west before flowing into North Twin Lake. Twin Lake Creek, Bad Boy Creek, and Unnamed Creek have not been channelized. Land use within this subwatershed is predominately forest (74%), but open water (11%), barren (6%), and wetlands (6%) are also present. The water chemistry station (S007-788) on Twin Lake Creek is located off the HWY 200 bridge crossing three miles southwest of Bealieu.

Table 7. Aquatic life and recreation assessments on stream reaches: Twin Lake Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:**										**Aquatic Life**	**Aquatic Rec. (Bacteria)**
				Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication		
09020108-532 ***Unnamed Creek,*** *T144 R39W S34, East Line to Bad Boy Creek*	14RD035 15RD100	1.75	CWg	IF	IF	IF	IF	IF	--	IF	IF	--	IF	IF	--
09020108-509 ***Twin Lake Creek,*** *Sargent Lake to Wild Rice River*	14RD005	12.94	WWg	MTS	--	IF	EXS	EXS	MTS	MTS	MTS	--	MTS	IMP	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 8. Lake assessments: Twin Lake Creek Aggregated 12-HUC

Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
							Fish IBI	Chloride	Pesticides	Total Phosphorus	Chlorophyll-a	Secchi		
Bass	44-0006-00	632	20	Deep Lake	NLF	NT	MTS	MTS	- -	MTS	MTS	MTS	FS	FS
South Twin	44-0014-00	1101	29	Deep Lake	NLF	NT	MTS	MTS	- -	MTS	MTS	MTS	FS	FS
North Twin	44-0023-00	954	16	Shallow Lake	NLF	I	MTS	MTS	- -	MTS	MTS	MTS	FS	FS
Sargent	44-0108-00	139	15	Shallow Lake	NCHF	- -	MTS	- -	- -	- -	- -	- -	FS	- -

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
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Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

The Twin Lake Creek Subwatershed contains two stream reaches (09020108-532 and 09020108-509). The most upstream reach on Unnamed Creek (09020108-532) had two biological stations (14RD035, 15RD100) that were sampled for fish and macroinvertebrates. The upstream station (15RD100) provided the best habitat within the subwatershed (MSHA=76.5, Appendix 5). The channel morphology was excellent, as indicated by the presence of good channel development and high channel stability scores. The site also had coarse gravel substrates and moderate flows; habitat features that are considered good for gravel spawners and smaller sensitive fish species. However, the downstream station (14RD035) is impacted by beaver activity, and scores slightly lower (MSHA=63, Appendix 5) due to the increase in siltation. This DNR designated trout stream demonstrated coldwater potential but it was impacted by beaver activity during the summers of 2014 – 2016. Therefore, aquatic life was not assessed using fish and macroinvertebrates.

Chemistry data for Unnamed Creek was limited to a one-time grab sample collected during the biological monitoring visit.

The downstream reach within the subwatershed is Twin Lake Creek (09020108-509), which contained one biological station (14RD005) that was sampled for fish. A macroinvertebrate sample was not collected within this reach. The habitat was fair, indicated by fine sediments and fair channel development (MSHA=47, Appendix 5). The fish community contained sensitive species (Longnose Dace, Iowa Darter) and had an FIBI score that was above the threshold. Water quality data were collected at the intensive monitoring station (S007-788) located where the creek crosses under Highway-200. Those data indicate that *E. coli* bacteria concentrations are chronically elevated, and could pose a health risk through bodily contact; as such, Twin Lake Creek does not support aquatic recreation and will be newly listed for excessive *E. coli* bacteria. The data also suggest that suspended solids (sediments) may be impacting aquatic life within the stream; both total suspended solids (TSS) and Secchi tube datasets fail to meet respective transparency standards for the region. An aquatic life impairment will be added due to excess sediment in creek.

Four lakes in this subwatershed have sufficient data to assess aquatic life and/or recreation. All lakes performed well, where available data were sufficient for assessment purposes. Three lakes (North Twin, South Twin and Bass) all meet the NLF ecoregion standards for lake eutrophication, and all three fully support aquatic recreation. Transparency data spanning more than eight years (collected largely under the Citizen Lake Monitoring Program [CLMP] indicate a statistically significant improving transparency trend on North Twin Lake (North Twin already meets the Secchi transparency standard).

The DNR completed aquatic life assessments based on fish community; all four lakes indicate full support with many benthic dwelling and intolerant species found during the surveys. North and South Twin Lakes, in particular, were noted to have a higher abundance of intolerant species during multiple surveys (North Twin Lake survey in 2014 found six species of intolerant fish). Bass Lake also contained sensitive species (Iowa Darter, Smallmouth Bass). The DNR assessment of Sargent Lake made mention that sampling effort was low due to difficult conditions, and that the fish populations may be the result of immigration from other nearby and connected lake basins; however, based on the 2015 survey Sargent Lake also fully supports aquatic life use.

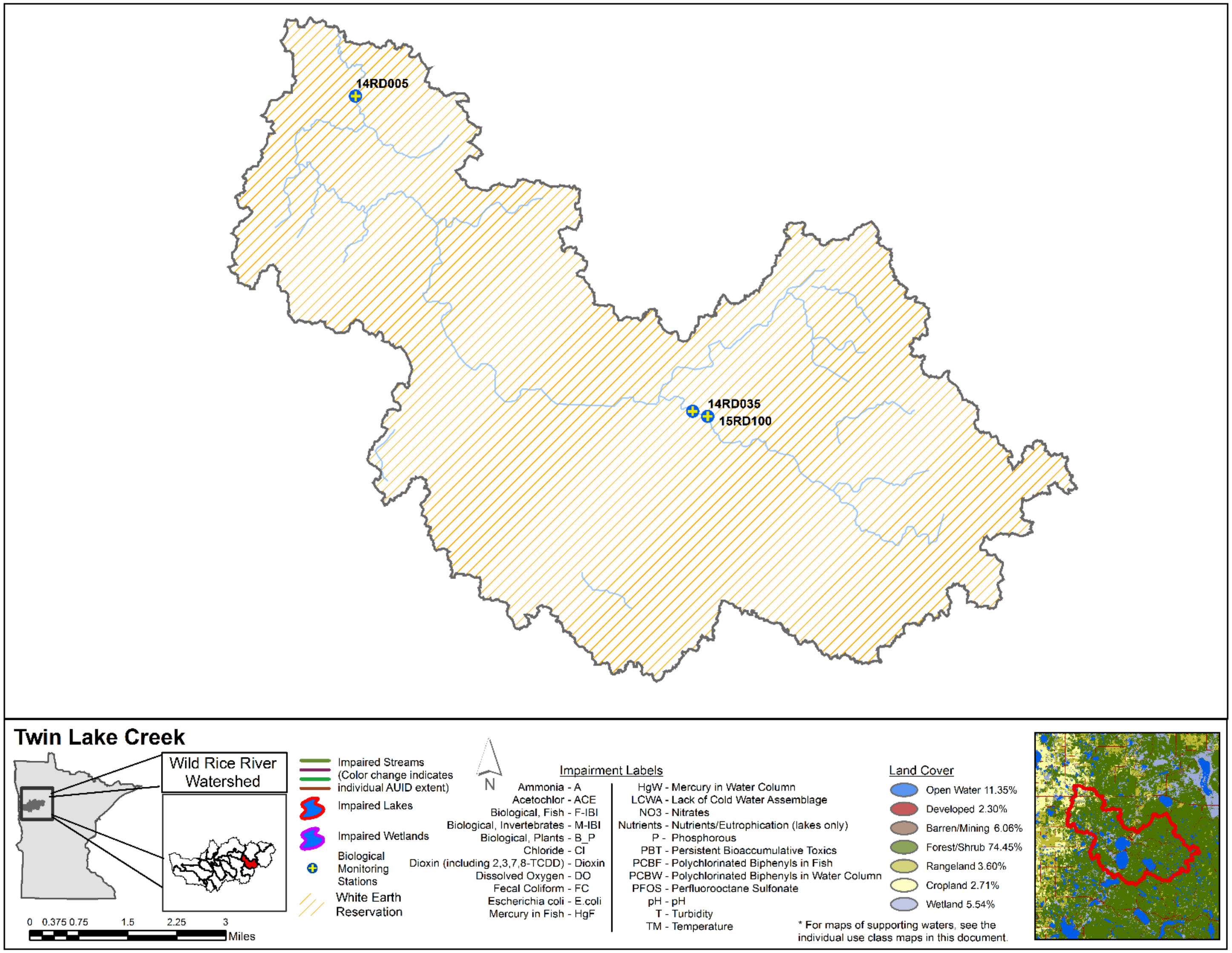

Figure 28. Currently listed impaired waters by parameter and land use characteristics in the Twin Lake Creek Aggregated 12-HUC.

White Earth River Aggregated 12-HUC HUC 0902010804-01

The White Earth River Subwatershed is located within Mahnomen and Becker Counties and encompasses 137 square miles within the White Earth Indian Reservation. The White Earth River originates within White Earth Lake and flows for 26 miles before reaching its confluence with the Wild Rice River 2 miles east of Mahnomen. Whiskey Creek is also located within this subwatershed. Portions of Whiskey Creek have been channelized to aid drainage, but the White Earth River has not been channelized. Two assessable lakes, Strawberry Lake and White Earth Lake, are also located within the White Earth River Subwatershed. Land use within this subwatershed is predominately forest (43%), but cropland (20%), rangeland (14%), and open water (11%) are also present. The water chemistry station (S003-162) on the White Earth River is located off the 160th Ave culvert 2 miles east of Mahnomen.

Table 9. Aquatic life and recreation assessments on stream reaches: White Earth River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name,* *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	Aquatic Life	Aquatic Rec. (Bacteria)
09020108-505 ***White Earth River,*** *White Earth Lake to Wild Rice River*	95RD004 14RD021 14RD006	26.22	WWg	MTS	MTS	IF	EXS	MTS	MTS	MTS	MTS	--	MTS	IMP	IMP
09020108-593 ***Whiskey Creek,*** *Unnamed Creek to White Earth River*	--	5.75	WWg	--	--	IF	MTS	--	MTS	MTS	MTS	--	IF	IF	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: -- = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 10. Lake assessments: White Earth River Aggregated 12-HUC.

Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
							Fish IBI	Chloride	Pesticides	Total Phosphorus	Chlorophyll-a	Secchi		
Strawberry	03-0323-00	1445	40	Deep Lake	NLF	NT	MTS	- -	- -	MTS	MTS	MTS	FS	FS
White Earth	03-0328-00	1980	120	Deep Lake	NCHF	- -	MTS	- -	- -	MTS	MTS	MTS	FS	FS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.

Summary

The White Earth River Subwatershed contains two stream reaches, the White Earth River (09020108-505) and Whiskey Creek (09020108-593); however, only the White Earth River was sampled for biology. The White Earth River is a natural system that provides fair habitat for fish and macroinvertebrates. Good channel development, moderate flow, and many different cover types were noted; however, less desirable attributes such as fine sediments, and moderate siltation were also noted (Appendix 5).

Three biological stations (95RD004, 14RD021, 14RD006) were sampled for fish and macroinvertebrates on the White Earth River. The biological communities at the upstream (95RD004) and downstream (14RD006) stations contain sensitive species and have FIBI and MIBI scores that are above the threshold. Gravel spawning and sensitive fishes are present within all three of the biological stations, indicating that coarse substrate and good habitat is available throughout the subwatershed (Appendix 5). However, the biological communities at the middle site (14RD021) show signs of degradation. Both tolerant (Fathead Minnow) and sensitive (Pearl Dace) fish species were captured during the 2014 and 2015 surveys resulting in FIBI scores that are just below the threshold. Similarly, sensitive macroinvertebrate taxa were present at all three bio stations but the MIBI score at 14RD021 was just above the threshold in 2014 and just below the threshold in 2015. In 2014, aquatic vegetation was sampled, whereas in 2015 it was not. Mayfly and caddis fly taxa associated with vegetation that were found in the 2014 sample, were not present within the 2015 sample, causing a slightly deflated MIBI score. In 2015, cattle were allowed access to the stream and the riparian area was well grazed. Additionally, beaver activity was noted in both 2014 and 2015 at 14RD021.

Due to the good IBI scores at the upstream (95RD004) and downstream (14RD006) stations, and fair scores at 14RD021, the reach was determined to support aquatic life. If observed riparian degradation is the new norm, future impairment is likely. The reach is very near an impaired designation and likely vulnerable to additional stress; consequently, it should be prioritized for greater protection so that it does not become impaired.

The White Earth River (09020108-505) and Whiskey Creek (09020108-593) both exceed the monthly geometric mean standard for *E. coli* bacteria. Although neither reach exceeds the individual standard, the monthly geometric mean standard is more stringent and meant to be protective of recreational uses; exceeding this standard suggests bacteria concentrations are chronically elevated and hold potential to affect human health. As such, both of these reaches will be newly listed for excessive bacteria.

Two lakes in this subwatershed have sufficient data to assess aquatic life and recreation. Chemistry parameters reviewed during the aquatic recreation use assessments indicate that Strawberry and White Earth Lakes both easily meet their respective ecoregion eutrophication standards (Strawberry Lake lies within the NLF, and White Earth Lake within the NCHF ecoregions). The DNR conducted fish IBI surveys on both lakes in 2012 (White Earth was additionally surveyed in 2007). Fish IBI scores in both lakes were positively influenced by the large number of intolerant species and the low number of tolerant species observed. Both lakes have mostly intact watersheds, with landscape disturbances estimated to be low (~5% for each) and both lakes fully support aquatic life.

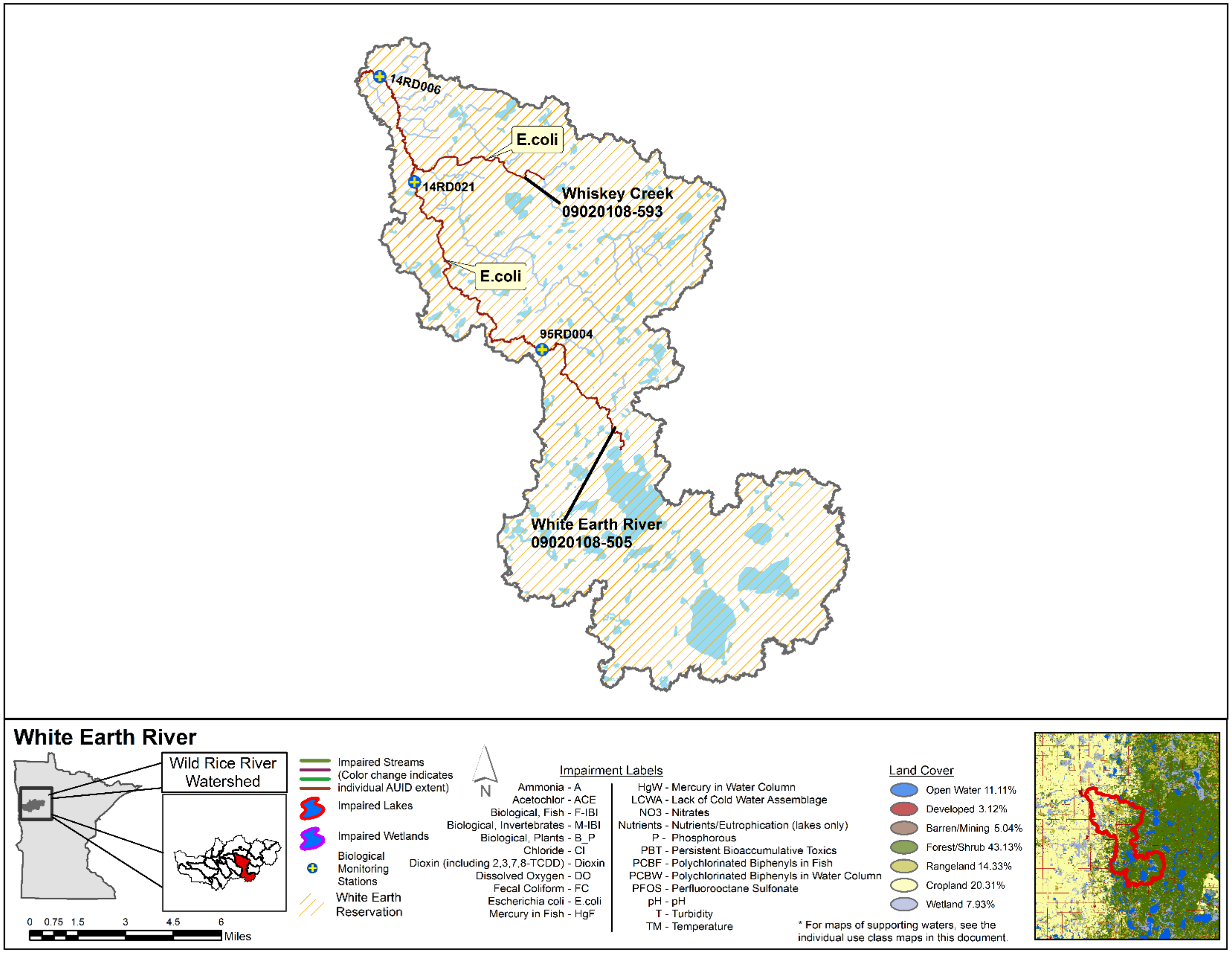

Figure 29. Currently listed impaired waters by parameter and land use characteristics in the White Earth River Aggregated 12-HUC.

Gull Creek Aggregated 12-HUC HUC 0902010804-02

The Gull Creek Subwatershed is located within Mahnomen and Becker Counties and encompasses 49 square miles within the White Earth Indian Reservation. Gull Creek flows for 4 miles before reaching White Earth Lake 6 miles northeast of White Earth. This subwatershed is dominated by small tributaries that drain into Gull Creek. Tributaries within this subwatershed, from north to south, include: Little Elbow Creek; Unnamed Creek (Snider Lake to Egg Lake); Unnamed Creek (Gull Lake to McCraney Lake); Tulaby Creek; and Unnamed Creek (McCraney Lake to Gull Creek). All of the streams within this subwatershed are non-channelized. Several lakes are present throughout the subwatershed, including Tulaby, Snider, and McCraney. Land use within this subwatershed is predominately forest (79%), but open water (9%), and wetlands (7%) were also present. Due to the small and intermittent nature of these streams, no biological monitoring stations were established.

Table 11. Aquatic life and recreation assessments on stream reaches: Gull Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

				Aquatic Life Indicators:											
AUID ***Reach Name***, *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-569 ***Gull Creek,*** *Unnamed creek to White Earth Lake*	- -	1.44	WWg	- -	- -	- -	MTS	MTS	MTS	- -	- -	- -	MTS	SUP	SUP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
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Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 12. Lake assessments: Gull Creek Aggregated 12-HUC.

Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
							Fish IBI	Chloride	Pesticides	Total Phosphorus	Chlorophyll-a	Secchi		
Tulaby	44-0003-00	817	43	Deep Lake	NLF	NT	MTS	- -	- -	EX	EX	MTS	FS	NS
Snider	44-0045-00	617	25	Deep Lake	NCHF	NT	MTS	MTS	- -	MTS	MTS	MTS	FS	FS
McCraney	44-0080-00	270	40	Deep Lake	NLF	- -	- -	MTS	- -	MTS	MTS	MTS	- -	FS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
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Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

The Gull Creek Subwatershed contains one stream reach (09020108-569) on Gull Creek. Biological samples were not collected due to lake and wetland influences. However, this reach does have sufficient chemistry data to assess for aquatic recreation and aquatic life. Chemistry data that was collected by Becker County SWCD on Gull Creek all meet their respective standards. Secchi transparency and TSS datasets have no exceedances, with up to six years of data. Seasonal mean total phosphorus easily meets the regional standard. DO, unionized ammonia and biological monitoring data are not available for review; however, based on the low sediment and nutrient concentrations, this reach fully supports aquatic life. Aquatic recreation data (*E. coli* bacteria; also submitted by Becker SWCD) meet the individual and monthly geometric mean standards, indicating that this reach fully supports recreation.

Three lakes in this subwatershed had sufficient data for aquatic life/recreational use (or both) assessments. Snider Lake fully supports both intended uses. Lake eutrophication parameters collected for Snider Lake currently meet the NLF ecoregion standards, but seasonal mean total phosphorus is approaching the regional standard; protecting this lake to promote continued recreational use and prevent it from being listed for excessive nutrients should be a local priority. The DNR conducted fish IBI surveys on Snider Lake in 2009 and 2015. Different survey techniques were used between the two years. The 2015 nearshore survey identified multiple intolerant fish species, despite difficulties encountered while sampling.

Tulaby Lake is a headwaters lake and was listed for excessive nutrients during the 2010 reporting cycle. More recent data confirm that the lake is still impaired, with mild to nuisance algal blooms prevalent during the late summer months in all years of data collection. The DNR conducted a fish IBI survey on Tulaby Lake in 2015, which identified low species richness, consistent with similar headwaters lakes. A high number of minnow species and the absence of tolerant species in trap nets positively influenced the overall IBI assessment. Watershed disturbance was estimated to be low (~3%), but additional shoreline development may become problematic (shore habitat is sparse). Tulaby Lake fully supports aquatic life at this time, but is considered vulnerable.

McCraney Lake was assessed for aquatic recreation. Eutrophication parameters all easily meet the NCHF ecoregion standards. The highest surface (0-2 meter depth) phosphorus concentration observed was less than half of the ecoregion standard. McCraney Lake fully supports recreation.

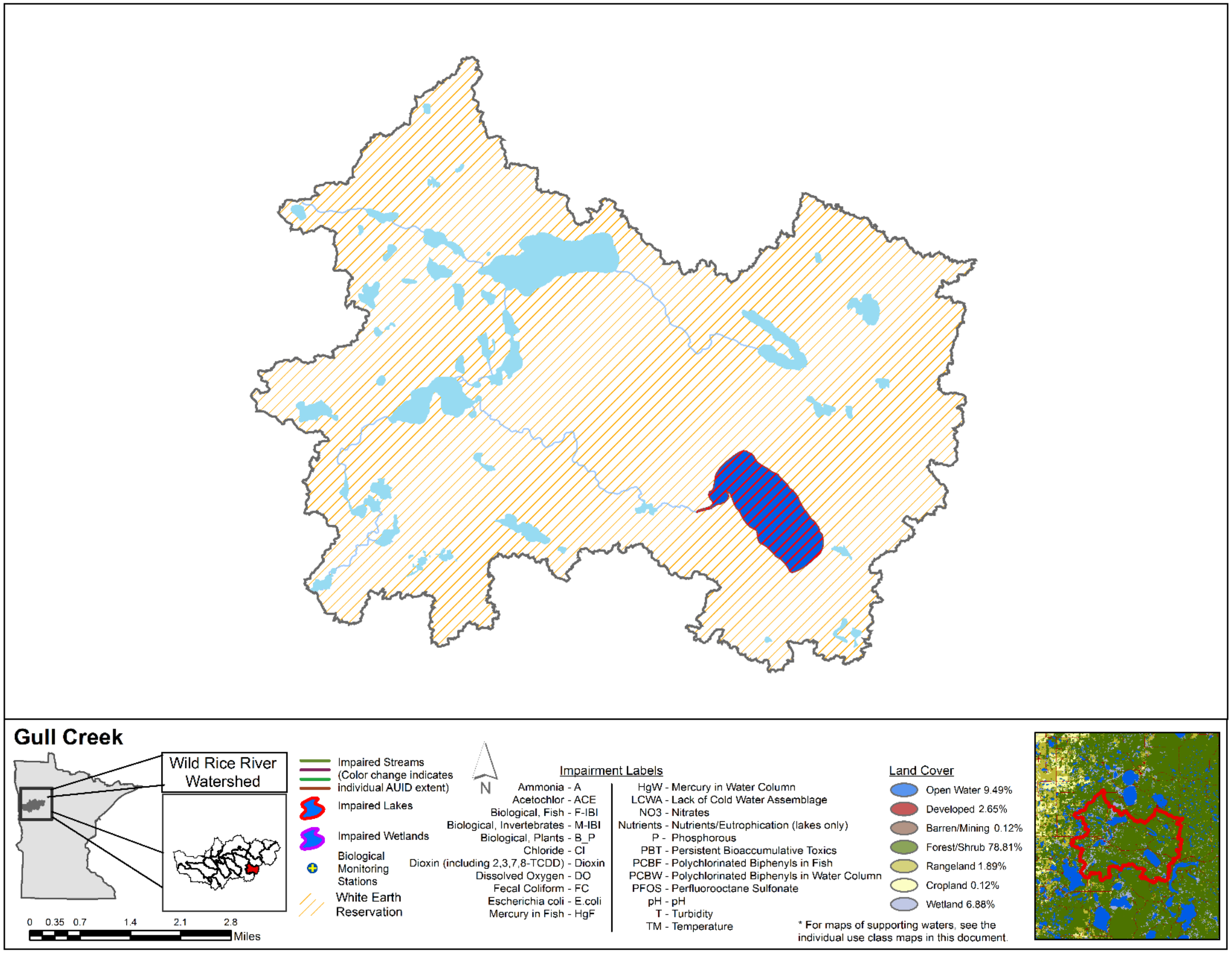

Figure 30. Currently listed impaired waters by parameter and land use characteristics in the Gull Creek Aggregated 12-HUC.

Spring Creek Aggregated 12-HUC

HUC 0902010805-01

The Spring Creek Subwatershed is located within Norman, Mahnomen, and Becker Counties, encompassing 69 square miles, with a majority of the subwatershed located within the White Earth Indian Reservation; the town of Waubun is the only town located within the subwatershed. The headwaters of Spring Creek form 4 miles north of White Earth. The creek flows for 20 miles before it reaches its confluence with the Wild Rice River, 7 miles east of Twin Valley. Spring Creek is spilt into two sections, as the upstream section of Spring Creek has been channelized to aid drainage. Land use within this subwatershed is predominately cropland (60%), but rangeland (13%), wetlands (11%), and forest (10%) are also present. The water chemistry station (S003-161) on Spring Creek is located off the CSAH 40 culvert, 2 miles southeast of Fossum. There were no assessed lakes within the subwatershed.

Table 13. Aquatic life and recreation assessments on stream reaches: Spring Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

				Aquatic Life Indicators:											
AUID ***Reach Name*****,** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-647 ***Spring Creek,*** *Headwaters to 140th Ave*	14RD022	7.86	WWm	MTS	EXS	IF	IF	IF	--	IF	IF	--	IF	IMP	--
09020108-648 ***Spring Creek,*** *140th Ave to Wild Rice River*	14RD007	11.72	WWg	MTS	MTS	IF	MTS	MTS	MTS	MTS	MTS	--	MTS	SUP	IMP

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Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

The Spring Creek Subwatershed contains two stream reaches (09020108-647 and 09020108-648), each with one biological monitoring station. The upstream reach (09020108-647) has been channelized and provides poor modified use habitat for fish and macroinvertebrates. Poor sinuosity, moderate siltation, and poor channel development were noted (Appendix 5), indicating that habitat is likely a limiting factor for biological communities within this reach. Although the habitat is poor, the fish community contained sensitive species (Pearl Dace) and had an FIBI score that was above the modified use threshold. Contrary to the fish community, the macroinvertebrate community contained tolerant taxa and had an MIBI score that was below the modified use threshold. The limited habitat is likely a contributing factor to the macroinvertebrate impairment. Crucial macroinvertebrate habitat includes coarse substrate and woody debris, and this portion of Spring Creek only has submerged aquatic vegetation and overhanging vegetation for available habitat. Conventional chemistry data are limited to one-time grab samples collected during biological monitoring efforts.

The downstream reach (09020108-648), is a natural system that displays fair habitat for fish and macroinvertebrates. The monitoring site had coarse substrate, good channel development, and multiple flow velocities. Contrary to the channelized upper section of Spring Creek, the habitat within this natural stream section is of better quality for aquatic life. The fish community within this reach contains sensitive species (Blacknose Shiner, Longnose Dace) and larger riverine species (Golden Redhorse), and has an FIBI score that is above the threshold. Likewise, coarse substrate and wood were available for macroinvertebrate colonization. The site had 56 unique macroinvertebrate taxa including a number of sensitive taxa, leading to an MIBI score that was above the threshold. The chemistry data suggests that the stream supports aquatic life with very few individual exceedances of any single parameter. Norman and Mahnomen County SCWDs, student and citizen volunteers, and MPCA staff have extensively monitored this stream section for chemistry parameters and the datasets are some of the most robust within the entire Wild Rice River Watershed. However, this section of Spring Creek has consistently elevated bacteria concentrations (severely elevated at times), exceeding both the individual and monthly geometric mean standards. This downstream portion of Spring Creek does not support aquatic recreation, and will be newly listed for excessive *E. coli* bacteria.

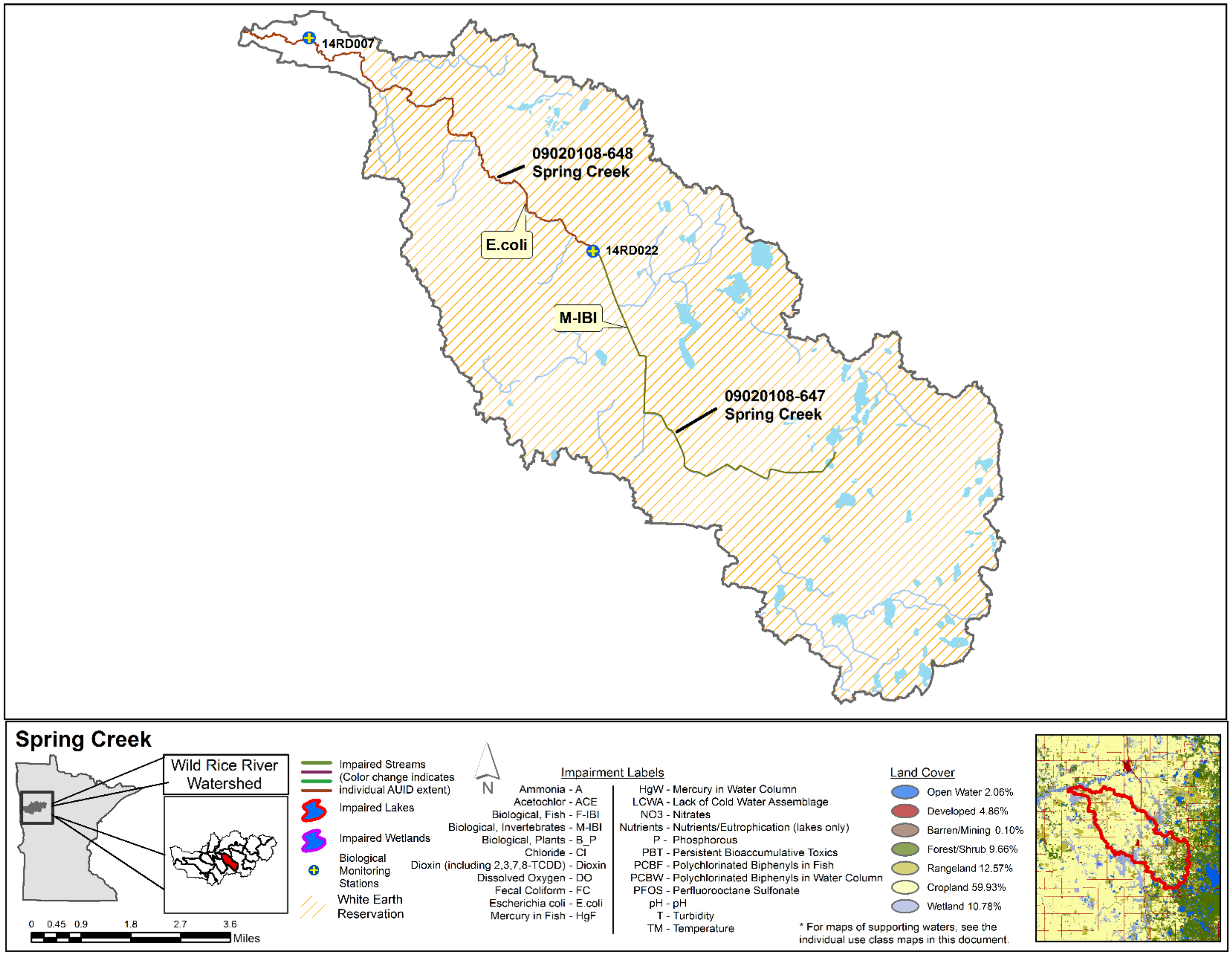

Figure 31. Currently listed impaired waters by parameter and land use characteristics in the Spring Creek Aggregated 12-HUC.

Middle Wild Rice River Aggregated 12-HUC HUC 0902010806-01

The Middle Wild Rice River Subwatershed is located within Norman and Mahnomen counties, encompassing 81 square miles with the majority of the subwatershed located within the White Earth Indian Reservation. As the name suggests, this subwatershed contains the middle portion of the Wild Rice River. The Wild Rice River within this subwatershed originates at the confluence of Twin Lake Creek, 2 miles southeast of Beaulieu, and flows for 60 miles until it reaches the outlet of the subwatershed at Marsh Creek. One assessable tributary, Unnamed Creek is located one mile south of Fossum. Circle Lake (44-0140-00) and Church Lake (44-0092-00) did not have sufficient data for an assessment. All of the assessed streams within the subwatershed are natural. However, over 15 small unassessed tributaries that flow into the Wild Rice River in this subwatershed have been channelized to aid drainage. Over half of the land use within the subwatershed is cropland (63%), but wetlands (11%), forest (9%), and rangeland (8%) are also present. Two intensive water chemistry stations were established within the subwatershed, both on the Wild Rice River (S003-163 on 09020108-506, S006-197 on 09020108-504,).

Table 14. Aquatic life and recreation assessments on stream reaches: Middle Wild Rice River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

				Aquatic Life Indicators:											
AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-506 ***Wild Rice River,*** *Twin Lake Creek to White Earth River*	14RD016 94RD518	25.8	WWg	MTS	MTS	IF	EXS	MTS	MTS	MTS	MTS	--	MTS	SUP	IMP
09020108-504 ***Wild Rice River,*** *White Earth River to Marsh Creek*	15RD207 10EM005 95RD011 14RD008	27.17	WWg	MTS	MTS	IF	EXS	EXS	MTS	MTS	MTS	--	MTS	IMP	SUP
09020108-640 ***Unnamed Creek,*** *Unnamed Creek to Wild Rice River*	14RD031	0.8	WWg	MTS	MTS	IF	IF	IF	--	IF	IF	--	IF	SUP	--

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)

Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 15. Lake assessments: Middle Wild Rice River Aggregated 12-HUC.

Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
							Fish IBI	Chloride	Pesticides	Total Phosphorus	Chlorophyll-a	Secchi		
Church	44-0092-00	167	15	Shallow Lake	NCHF	- -	NA	- -	- -	- -	- -	- -	- -	NA

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.

Summary

The Middle Wild Rice River Subwatershed contains three stream reaches (09020108-506, 09020108-504, and 09020108-640). All three stream sections have not been channelized, and provide fair habitat for fish and macroinvertebrates. Quality instream substrates and good channel morphology were observed throughout the entire subwatershed (Appendix 5). The upstream reach on the Wild Rice River (09020108-506) contains two biological monitoring stations (14RD016, 94RD518) that were sampled for fish and macroinvertebrates. All fish and macroinvertebrate IBI scores were above their respective impairment thresholds. The fish community contained sensitive species (Rock Bass, Longnose Dace) and larger riverine species (Golden Redhorse, Silver Redhorse, Shorthead Redhorse) and the macroinvertebrate community included a number of sensitive taxa. This reach displayed the best habitat within the subwatershed characterized by good channel stability and channel development, and a range of flow velocities.

The Wild Rice River (09020108-506) does not support aquatic recreation. The reach exceed the geometric monthly mean standard for recreation use; July had elevated concentrations observed and August was close to the standard. This reach will be newly listed for *E. coli* bacteria. Additionally, Twin Lake Creek (which also has a newly proposed listing for excessive bacteria) contributes water to the upper end of this reach of the Wild Rice River. Addressing the bacteria impairment in Twin Lake Creek may benefit this portion of the Wild Rice River as well.

Chemistry data collected on the upstream reach mostly showed supporting conditions for the aquatic communities. There does appear to be potential for elevated levels of sediment (TSS) to settle out of suspension and degrade habitat. Current invertebrate scores indicate healthy communities, and no impairment is proposed at this time for sediment.

The downstream reach on the Wild Rice River (09020108-504) contains four biological monitoring stations (15RD207, 10EM005, 95RD011, and 14RD008) that were sampled for fish and macroinvertebrates. Both fish and macroinvertebrate IBI scores are above their respective impairment thresholds. The fish community within this reach contains sensitive species (Blacknose Shiner, Longnose Dace) and larger riverine species (Golden Redhorse, Silver Redhorse, Shorthead Redhorse). The macroinvertebrate community also appears to be healthy. The habitat in the reach is fair and includes some coarse substrate, multiple cover types, and good channel development. This reach has chemistry datasets that are some of the most robust in the Wild Rice River Watershed. The *E. coli* bacteria dataset has an outlier that was determined to be unrepresentative of expected stream conditions due to an intense rainfall event (>3 inches) gaged at the National Weather Service volunteer station in the nearby city of Ada. This datum was rejected and the resulting dataset meets the individual and monthly bacteria standards and supports recreation use.

Chemistry data collected on (09020108-504) and used for aquatic life use assessments are similar to the immediately upstream reach. Nearly all of the conventional chemistry parameters meet their respective standards with the exception of the TSS and Secchi transparency datasets, which suggest that suspended solids have the potential to degrade instream habitat. More than 60% of all TSS and 35% of all Secchi observations exceed the regional standards. As such, this reach of the Wild Rice River does not support aquatic life and will be newly listed for TSS. Existing turbidity impairments on the upstream tributary White Earth River (09020108-505), and the two Wild Rice River reaches immediately downstream suggest that the White Earth River is the potential source for much of the sediment load observed at the outlet of this subwatershed.

The main tributary flowing into the Wild Rice River in this subwatershed is an unnamed creek (09020108-640). One biological monitoring station (14RD031) was sampled for fish and macroinvertebrates. The habitat is fair throughout the reach (MSHA = 57.5, Appendix 5). Coarse substrate, good channel development, and multiple velocity types were present in the reach along with fair sinuosity and moderate siltation. IBI scores for both assemblages were good, reflecting the available habitat. Some sensitive fish species (e.g. Pearl Dace) and sensitive macroinvertebrate taxa were sampled. All available chemistry data were collected as one-time grab samples during routine biological monitoring and are not sufficient for chemistry related assessments.

Church Lake was not assessed for aquatic life or recreation. There was not enough chemistry data to assess for aquatic life. Circle Lake was visited only one time during the 2007 National Lake Assessment sponsored by the EPA. In addition, the lake is subject to frequent winter kills, so the two fish IBI surveys conducted in 2010, were not used for aquatic life assessment.

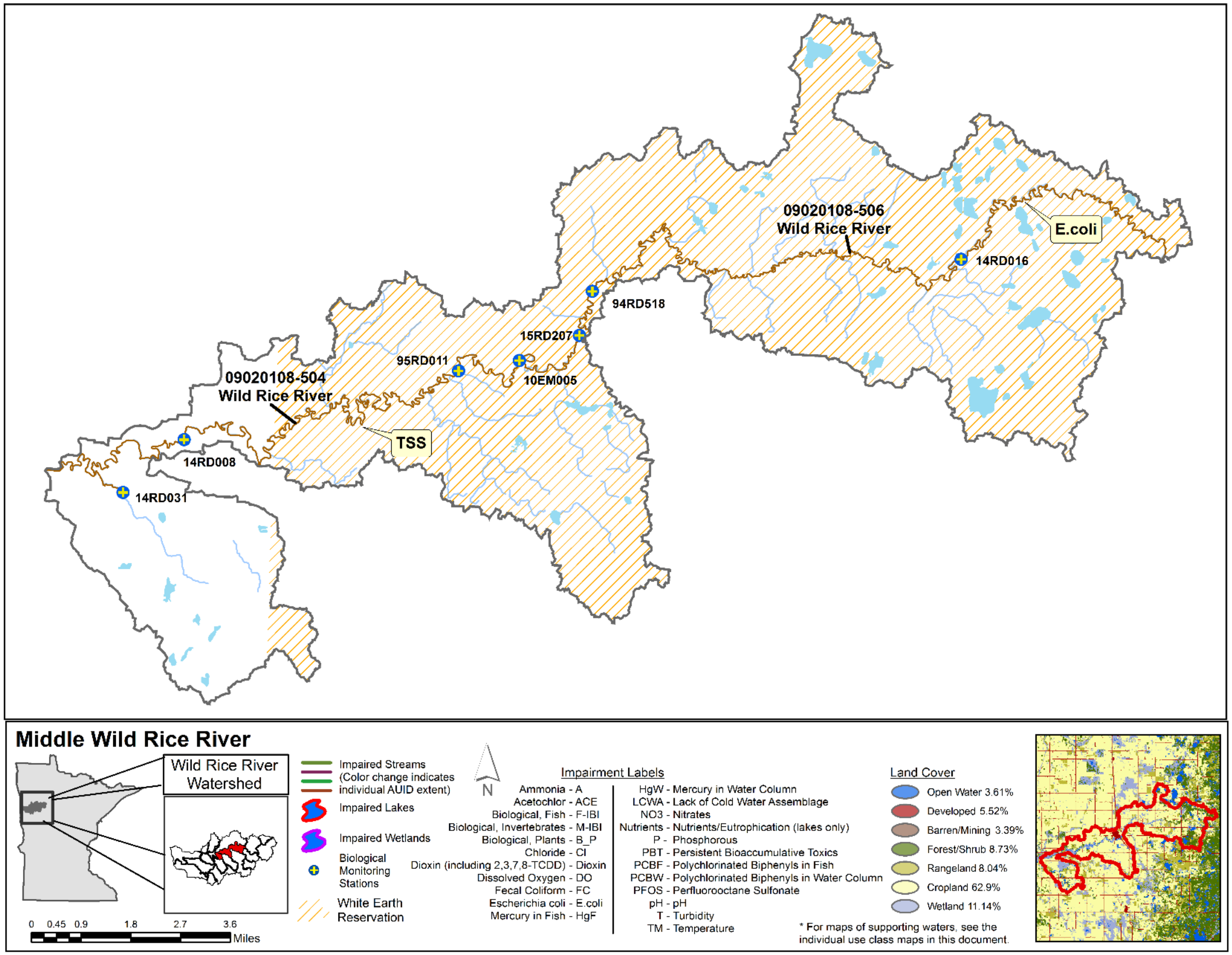

Figure 32. Currently listed impaired waters by parameter and land use characteristics in the Middle Wild Rice River Aggregated 12-HUC.

Marsh Creek Aggregated 12-HUC

HUC 0902010807-01

The Marsh Creek Subwatershed is located within Norman, Mahnomen and Polk Counties and encompasses 166 square miles, with the majority of the subwatershed located within the White Earth Indian Reservation. Marsh Creek originates at Blair Lake, 4 miles northwest of Beaulieu, and flows for 41 miles until it reaches its confluence with the Wild Rice River, 1 mile southwest of Fossum. The upstream portion of Marsh Creek, and all of the tributaries flowing into Marsh Creek, have been channelized to aid drainage. A majority of the land within this subwatershed is utilized for cropland (66%), but wetlands (13%), barren (9%), and forest (9%) are also present. Two water chemistry stations were monitored in this subwatershed (S007-789 on 09020108-652; and S006-198 on 09020108-651).

Table 16. Aquatic life and recreation assessments on stream reaches: Marsh Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

				Aquatic Life Indicators:											
AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-519 ***Marsh Creek,*** *Blair Lake to Beaulieu Lake*	14RD020	8.3	WWm	MTS	--	IF	IF	IF	--	IF	IF	--	IF	SUP	--
09020108-651 ***Marsh Creek,*** *Beaulieu Lake to 47.4054 -95.9973*	07RD002	11.82	WWm	MTS	MTS	IF	MTS	IF	MTS	MTS	MTS	--	MTS	SUP	IMP
09020108-598 ***Unnamed Creek,*** *Unnamed Ditch to Unnamed Creek*	07RD001	2.46	WWm	MTS	MTS	IF	IF	IF	--	IF	IF	--	MTS	SUP	--
09020108-652 ***Marsh Creek,*** *95.9973 47.4056 to Wild Rice River*	14RD082 14RD009	21.27	WWg	MTS	MTS	IF	IF	MTS	MTS	MTS	MTS	--	IF	IMP	SUP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 17. Lake assessments: Marsh Creek Aggregated 12-HUC.

Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
							Fish IBI	Chloride	Pesticides	Total Phosphorus	Chlorophyll-a	Secchi		
Little Vanose	44-0169-00	138	28	Deep Lake	NCHF	- -	- -	- -	- -	- -	- -	MTS	--	IF

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

The Marsh Creek Subwatershed contains four stream reaches (09020108-519, 09020108-651, 09020108-598, and 09020108-652). The most upstream reach on Marsh Creek (09020108-519) has been channelized to aid drainage and has one biological monitoring station (14RD020). This modified use stream reach has several poor habitat attributes including, dominant fine sediments, moderate siltation, poor channel development, and slow flow (Appendix 5). This stream section is fed by an irrigation pipe (Figure 33), and due to the channelization, the flow regime within this stream reach is determined by the amount of water flowing through the tile drainage outlet pipe. By mid-summer, the tile drainage outlet pipe ceases to discharge and the stream dries up (Figure 34). Due to the intermittent nature of the stream, fish were sampled during the beginning of the summer, but the stream was dry during the macroinvertebrate index period. The fish community contained several sensitive species (Pearl Dace, Iowa Darter), and had an FIBI score that was above the modified use threshold. Due to the intermittent nature of the stream, this system should be considered vulnerable, and better flow management practices should be investigated to reduce the possibility of a future impairment. This reach of Marsh Creek does not have adequate chemistry data for assessment purposes; the aquatic life use assessment relies solely on biological monitoring data.

09020108-651, the next downstream segment of Marsh Creek, is a channelized, habitat limited system (sparse cover and poor channel development) which was designated as modified. One biological station (07RD002) was sampled for fish and macroinvertebrates in 2007. The fish sample contained a mixture of tolerant (Fathead Minnow, Central Mudminnow) and sensitive (Iowa Darter) species, and had an FIBI score that is at the modified use threshold. This stream has a drainage area of 55 square miles, and if it were to have a slightly smaller drainage area (50 sq. mi), it would have been in the low gradient fish class, and would have scored much better. Although the fish assemblage is right at the modified use threshold, the fish community contains sensitive species (Iowa Darter) and indicates full support for aquatic life. Similarly, the macroinvertebrate community was dominated by tolerant taxa, but sensitive taxa were also captured within the reach. The MIBI score was just above the threshold, and indicated full support for aquatic life. Chemistry data on this reach indicated that productivity and nutrients are low, although during events, concentrations do peak. Sediment does not appear to be impacting aquatic life at this time.

Bacteria data collected at the intensive chemistry monitoring station (S006-198) indicate that *E. coli* bacteria levels are chronically elevated. No single sample exceeds the individual standard, but concentrations are consistently high enough to exceed the monthly geometric mean standard for the month of August. As such, this reach of Marsh Creek does not support aquatic recreation due to the potential human health effects resulting from direct bodily contact; this reach will be newly listed for excessive bacteria.

The next downstream portion of Marsh Creek (09020108-652) is a natural portion of the stream that has the best MSHA score within the subwatershed, characterized by the presence of coarse substrate, a good variety of cover types, and good channel development (Appendix 5). Two biological stations (14RD009, 14RD082) were sampled for fish and macroinvertebrates within this portion of Marsh Creek. The FIBI score was well above the threshold. The fish community contained sensitive species (Pearl Dace, Longnose Dace) and larger riverine species (Golden Redhorse, Shorthead Redhorse). The Macroinvertebrate results were mixed. MIBI score at the downstream station was above the threshold and contained multiple sensitive taxa collected from rocks and overhanging bank vegetation. However, at the upstream station, the MIBI score was just below the threshold. The lower MIBI score is likely due to the fact that rock substrates were not sampled at the site; samples were collected from wood, overhanging bank vegetation, and aquatic macrophytes. Rock substrates were available according to the MSHA, and if sampled, the MIBI score would likely have been above the threshold. Therefore, based on a weight of evidence, both biological communities indicate that this is a well-functioning, heathy stream.

This reach on the Marsh Creek has an existing turbidity impairment. New TSS and Secchi transparency data indicate suspended sediment concentrations have improved since the original listing in 2008. However, the datasets are not yet strong enough to indicate standards are consistently met. Mahnomen County SWCD provided locational information on a number of sediment basins that have been installed upstream of this reach. The improvement in sediment related indicators suggests that these basins are trapping and settling suspended sediments as intended. The efforts to control runoff in this watershed may be a success story; an example of how BMPs can lead to water quality improvement and the removal of a waterbody from the 303(d) Impaired Waters List.

Bacteria data collected at the intensive chemistry monitoring station on this reach (S007-789) indicate full support for aquatic recreation. A single exceedance of the individual bacteria standard was excluded because the sample was collected immediately following a large rain event (>3 inches). Excluding the storm event sampling, the dataset meets both the individual and monthly geometric mean standards.

The only major tributary flowing into Marsh Creek is Unnamed Creek (Trib. to Marsh Creek, 09020108-598) located 1.5 mi SE of Bejou. Unnamed Creek is designated as modified, similar to the upstream portions of Marsh Creek; the channelization has affected habitat quality within the stream. The site was severely embedded with sediment and had poor cover conditions with poor channel development. One biological monitoring station (07RD001) was sampled for fish and macroinvertebrates during the summer of 2007. The fish community was dominated by tolerant fish species (Black Bullhead, Fathead Minnow) and had an FIBI score that was just below the threshold. Sampling notes taken during the fish sample indicated that low flow conditions were present, and a beaver dam had been built within the reach. Therefore, the assessment relied more heavily on the macroinvertebrate result

Little Vanose Lake was not assessed for aquatic recreation due to a lack of phosphorus data but Secchi transparency data collected by volunteers enrolled in the CLMP in 2006 and 2009 indicate that Secchi transparency meets expectations for the lake NCHF ecoregion standard.

Figure 33. Marsh Creek (09020108-519) during the spring/ early summer

Figure 34. Marsh Creek (09020108-519) during mid-summer

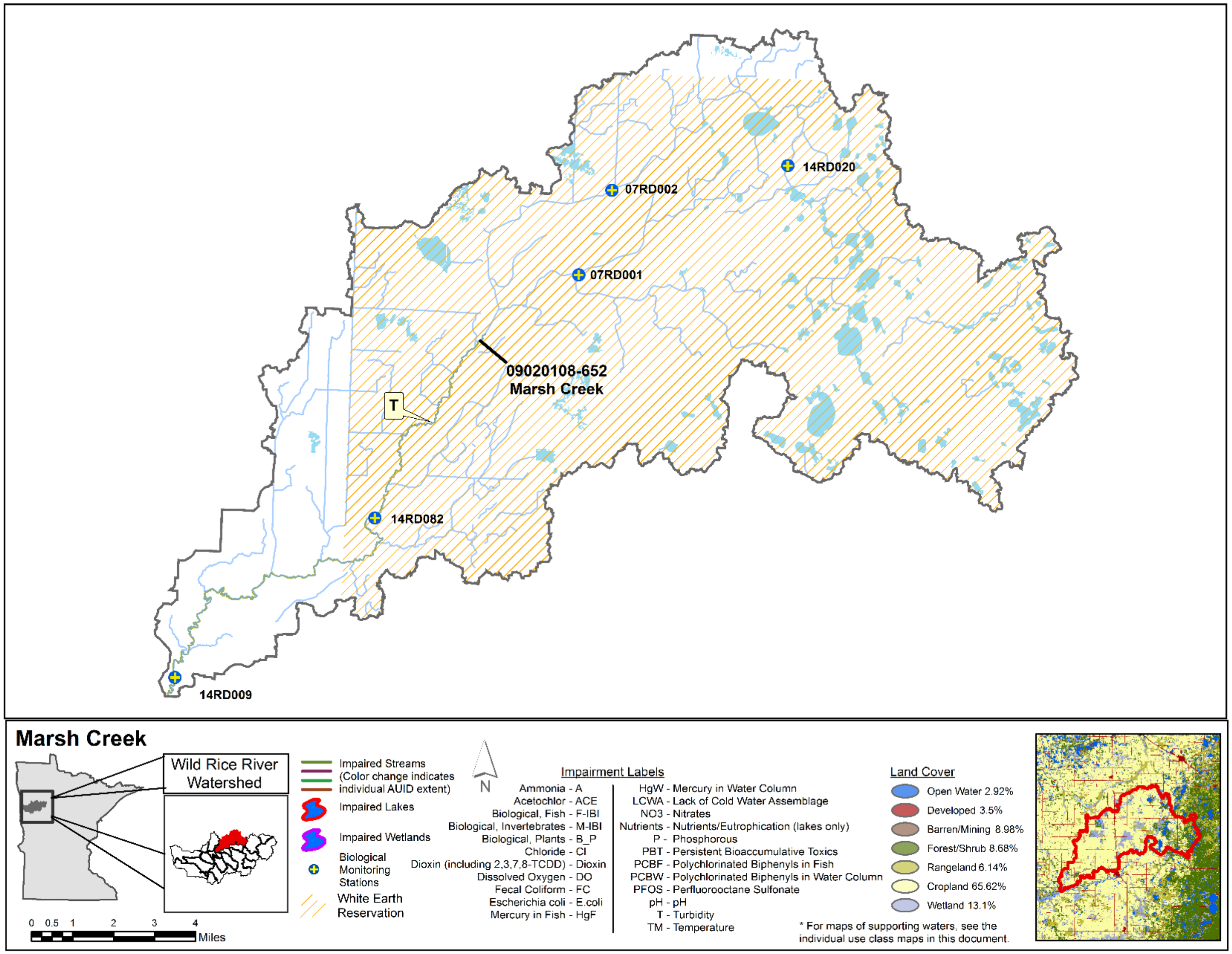

Figure 35. Currently listed impaired waters by parameter and land use characteristics in the Marsh Creek Aggregated 12-HUC.

Mashaug Creek Aggregated 12-HUC

HUC 0902010808-01

The Mashaug Creek Subwatershed is located within Norman County, encompassing 74 square miles. Mashaug Creek originates 8 miles northeast of Gary, and flows for 18 miles until it reaches its confluence with the Wild Rice River, 2 miles northwest of Twin Valley. One major tributary to Mashaug Creek (Garden Slough) is also located within this subwatershed and flows for 10 miles before meeting Mashaug Creek 3 miles southwest of Gary. The headwaters to Garden Slough, and several small tributaries flowing into Mashaug Creek, have been channelized to aid drainage. The land use within the Mashaug Creek Subwatershed is dominated by cropland (75%), but wetlands (9%) and rangeland (6%) also exist. The intensive water chemistry station (S007-793) was located off the culvert at the CR 160 crossing.

Table 18. Aquatic life and recreation assessments on stream reaches: Mashaug Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

				Aquatic Life Indicators:											
AUID ***Reach Name*****,** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-579 ***Garden Slough,*** *Headwaters to Mashaug Creek*	14RD037	10.04	WWg	EXS	--	IF	IF	IF	--	IF	IF	--	IF	IMP	--
09020108-656 ***County Ditch 42,*** *Co Rd 151 to Unnamed Creek*	07RD027	1.43	WWg	MTS	MTS	IF	IF	IF	--	IF	IF	--	IF	SUP	--
09020108-650 ***Mashaug Creek,*** *T-92 to Wild Rice River*	14RD034 05RD114 14RD014	12.38	WWg	EXS	EXS	MTS	MTS	MTS	MTS	MTS	MTS	--	IF	IMP	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
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Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

The Mashaug Creek Subwatershed contains three stream reaches (09020108-579, 09020108-656, and 09020108-650); the most upstream reach (09020108-579) is Garden Slough, which flows into the headwaters of Mashaug Creek. Garden Slough has been channelized to aid drainage. The stream is designated as modified due to the channelization; recognizing that habitat is limiting the aquatic life (Appendix 5). One biological station (14RD037) was sampled for fish within Garden Sough. Due to the intermittent nature of the stream, a macroinvertebrate sample was not collected. The fish community was dominated by tolerant fish species (Central Mudminnow, Fathead Minnow), indicative of low DO conditions. The FIBI was well below the impairment threshold. Preliminary monitoring data collected by stressor identification staff suggests that Garden Slough experiences periods of low DO. In addition, low flow conditions were noted during the fish and macroinvertebrate visits suggesting that flow permanence is an issue in Garden Slough. Variable flows and low DO levels could be attributed to the flood management dam (Mashaug Creek Dam No. 3; Figure 36), located downstream of the biological station. The dam is designed to only let water flow through during periods of high flow. The dam also creates a fish barrier during low flow conditions, limiting fish passage to the upstream portions of Garden Slough. Better management of the drainage structures within this portion of the subwatershed should be implemented to allow the stream to flow year round, allowing fish to pass throughout the creek, and increase DO levels within the entire stream reach. There is not sufficient chemistry data for either aquatic life or recreation use assessments, as data is limited to one-time grab samples at the biological visit.

The other major tributary flowing into Mashaug Creek is County Ditch 42 (09020108-656). County Ditch 42 has been channelized to aid drainage, but the stream still displays several good habitat attributes. MSHA scores indicated that coarse substrates, good channel development, and moderate/high channel stability was present throughout the stream reach (Appendix 5). One biological station (07RD027) was sampled for fish and macroinvertebrates. The fish community was dominated by tolerant fish species (Fathead Minnow, Brook Stickleback) and had an FIBI score that was just below the threshold. Similarly, the macroinvertebrate community was dominated by tolerant taxa, with an MIBI score that was just above the threshold. Since both biological samples are within their respective confidence intervals and the habitat was fair, County Ditch 42 was determined to support aquatic life. There is not sufficient chemistry data for either aquatic life or recreation use assessments, as data is limited to one-time grab samples at the biological visit.

Mashaug Creek (09020108-650) is the main stream that flows throughout the subwatershed, before reaching its confluence with the Wild Rice River. Mashaug Creek is a natural system with generally fair habitat throughout. Coarse substrates, good channel development, and good sinuosity were noted during the sampling events (Appendix 5). Although Mashaug Creek displays several good habitat attributes, slow flow and fine substrates were also noted. Three biological stations (14RD034, 05RD114, 14RD014) were sampled for fish and macroinvertebrates on Mashaug Creek. The fish community contained sensitive species (Longnose Dace), but was mostly comprised of tolerant species (Fathead Minnow, Central Mudminnow) with FIBI scores that were at or below the threshold. The macroinvertebrate community was dominated by low DO tolerant taxa, and had an MIBI score that was below the threshold. This section of Mashaug Creek appears to have hydrologic issues, the downstream portion of the reach has an unstable channel, and the entire reach is very flashy during rain events. The biological communities indicate that flow permanence is an issue. The water control structure at HWY 34 may be creating a fish barrier, impacting fish connectivity, and limiting the amount of flow available to Mashaug Creek.

Chemistry data collected at the intensive chemistry monitoring station on Mashaug Creek (S007-793) are sufficient for both aquatic life and recreational use assessments. Conventional chemistry data do not indicate any obvious stressors. Seasonal mean total phosphorus concentrations and Secchi transparency datasets are both very near to, but meet their respective standards; this indicates that sediment and productivity are likely not impacting aquatic life use. Notes of low to no flow were indicated in summer 2015. Bacteria levels meet the individual standard, but exceed the monthly geometric mean standard. Due to the consistently elevated bacteria concentrations, this reach does not support aquatic recreation.

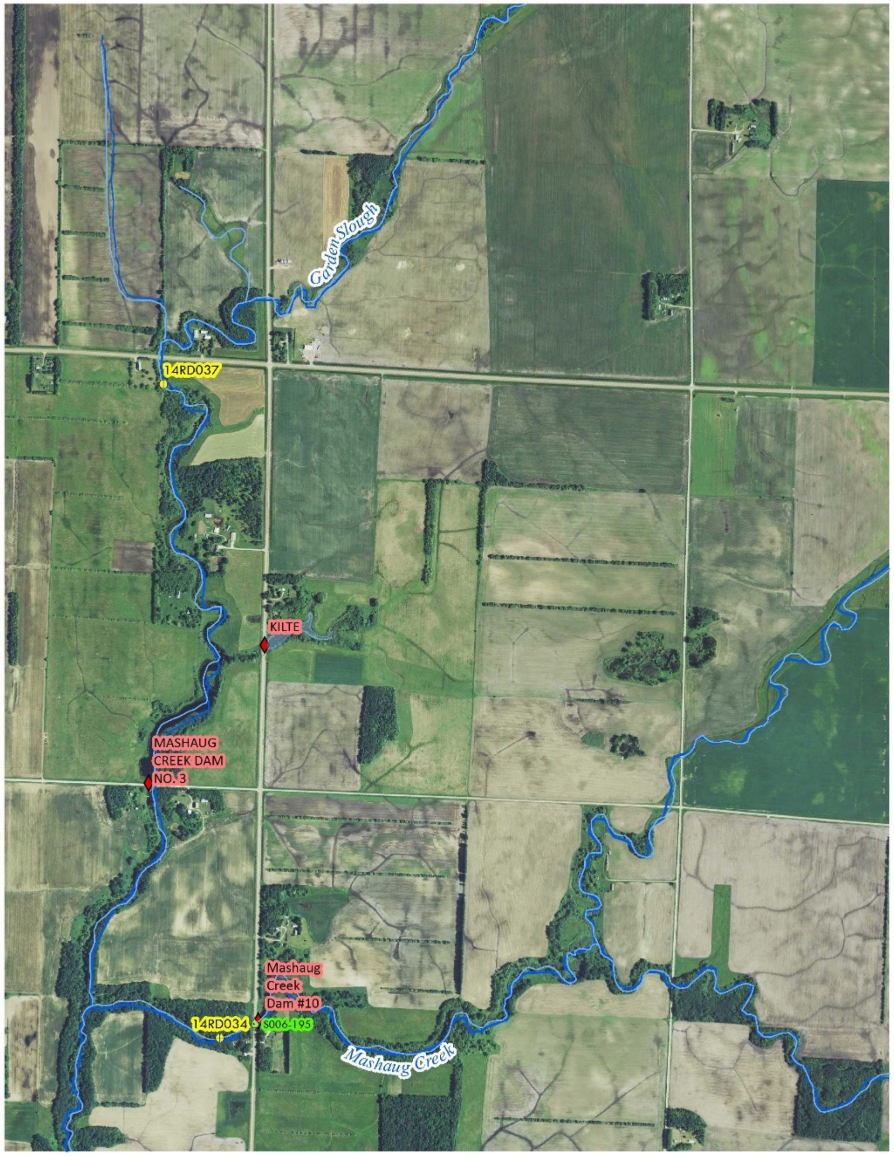

Figure 36. Flood management dams within the upstream portion of the Mashaug Creek Subwatershed

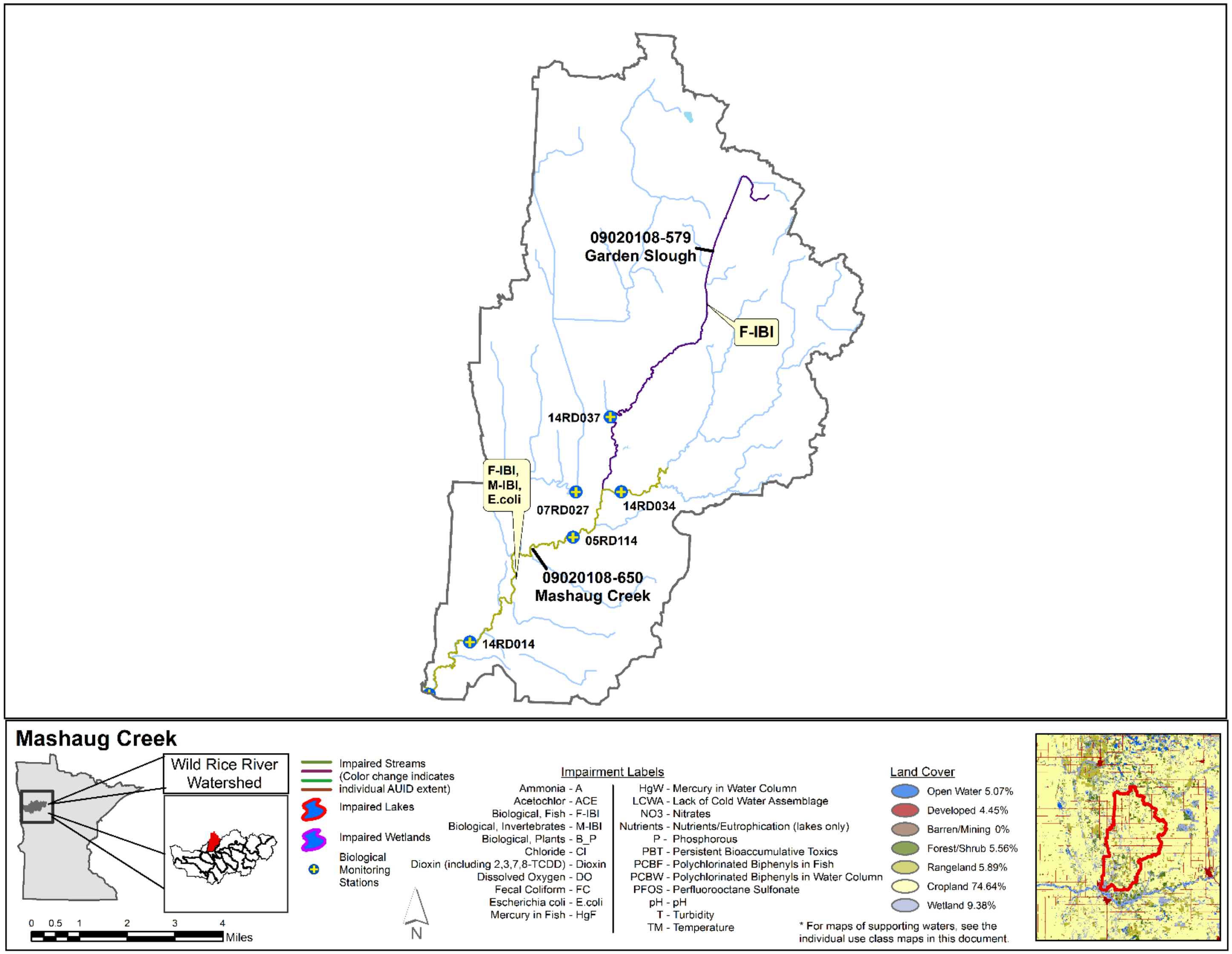

Figure 37. Currently listed impaired waters by parameter and land use characteristics in the Mashaug Creek Aggregated 12-HUC.

Lower Wild Rice River Aggregated 12-HUC — HUC 0902010809-01

The Lower Wild Rice River Subwatershed is located within Norman County, and encompasses 58 square miles. As the name suggests, this subwatershed contains the lower portion of the Wild Rice River. The Wild Rice River within this subwatershed originates at the confluence of Marsh Creek, 5 miles northeast of Twin Valley, and flows for 28 miles until it reaches the outlet of the subwatershed at Unnamed Creek. Unnamed Creek, located within the Marsh River 8-HUC Watershed, is connected to the Wild Rice River at the outlet of this subwatershed, and was channelized to allow logs to be floated down the Wild Rice River and to a logging facility just east of Ada. Today it provides flood relief for the Wild Rice River. At higher flows, some of the flow within the Wild Rice River is diverted into the Marsh River, through the Unnamed Creek. Several tributaries flowing into the Wild Rice River have been channelized to aid drainage, and the Wild Rice River mainstem is channelized for the last 4 miles within the subwatershed. The land use for the Lower Wild Rice River Subwatershed is dominated by cropland (60%), but wetlands (19%) and rangeland (7%) are also present. The intensive water chemistry station established within the subwatershed is on the Wild Rice River (S001-155).

Table 19. Aquatic life and recreation assessments on stream reaches: Lower Wild Rice River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

				Aquatic Life Indicators:											
AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-643 ***Wild Rice River,*** *Marsh Creek to Unnamed Creek*	05RD115 14RD041 95RD014 07RD009	28.49	WWg	MTS	MTS	MTS	EXS	EXS	MTS	MTS	MTS	--	MTS	IMP	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

The Lower Wild Rice River Subwatershed contains one stream reach on the Wild Rice River (09020108-643). The habitat in this section of the river is good (upstream) to fair (downstream). The upstream section has good channel development, multiple velocity types, and good depth variability (Appendix 5). The downstream 3.5-mile section has been channelized to aid drainage. Four biological monitoring sites (05RD115, 14RD041, 95RD014, and 07RD009) were sampled for fish and macroinvertebrates. The fish and macroinvertebrate communities had IBI scores above their respective impairment thresholds and contained numerous sensitive fish species (Rock Bass, Smallmouth Bass) and macroinvertebrate species.

This reach of the Wild Rice River (09020108-643) has sufficient data to assess for aquatic life and recreation. This reach has an existing aquatic life impairment; turbidity was listed in 2010 on the now retired river reach (09020108-503) which was split into two shorter reaches (09020108-643 and 09020108-644) in 2016. That turbidity listing now applies to this upstream reach of the split (09020108-643). Available data that were reviewed during the assessment process indicate that the turbidity listing is still warranted; both TSS and Secchi transparency datasets exceed the regional standards (>60% and >40% rate of exceedance respectively). Phosphorus and DO concentrations are good, indicating that productivity is not likely an issue in this reach.

However, the reach does not support aquatic recreation. There is a single exceedance of the individual standard and the monthly geometric mean standard calculated for June exceeds the monthly standard (July is also right at the standard). These data indicate that bacteria concentrations are chronically elevated and may pose a risk to human health.

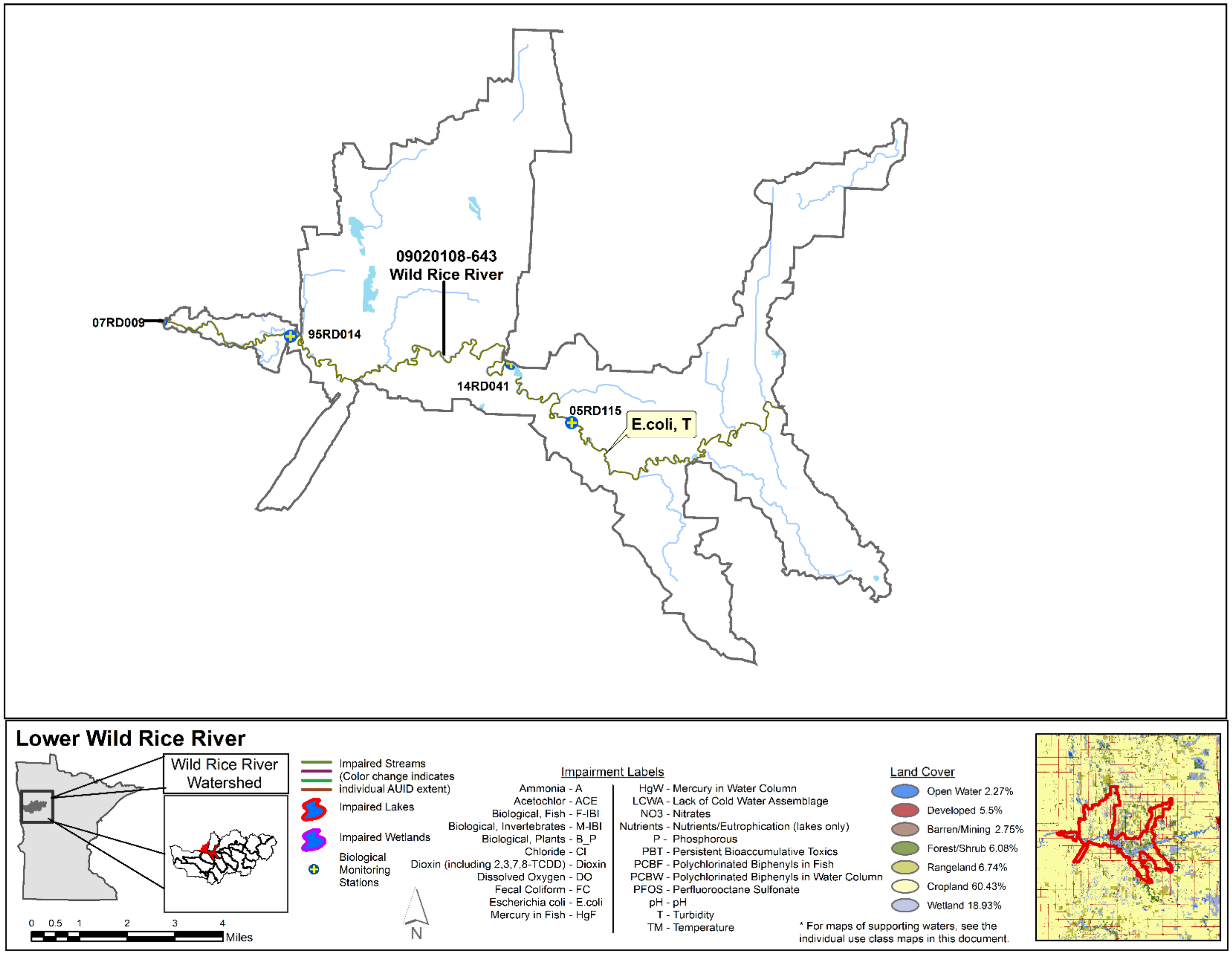

Figure 38. Currently listed impaired waters by parameter and land use characteristics in the Lower Wild Rice River Aggregated 12-HUC.

Coon Creek Aggregated 12-HUC

HUC 0902010809-02

The Coon Creek Subwatershed is located in Norman County, and encompasses 49 square miles. Coon Creek flows through this subwatershed for 15 miles before reaching its confluence with the Wild Rice River, 4 miles northwest of Twin Valley. One unassessed tributary, County Ditch 46, is also included within the Coon Creek Subwatershed, located 1-mile southwest of Home Lake. Most of the tributaries flowing into Coon Creek have been channelized to aid drainage. County Ditch 46 has also been channelized. The land use within the Coon Creek Subwatershed is dominated by cropland (74%), but wetlands (11%) and rangeland (7%) are also present. There are two intensive water chemistry station (S003-157 and S006-193) within this subwatershed.

Table 20. Aquatic life and recreation assessments on stream reaches: Coon Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

				Aquatic Life Indicators:											
AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-577 ***Coon Creek,*** *Unnamed Creek to Unnamed Creek*	14RD044	3.99	WWg	MTS	MTS	IF	MTS	IF	MTS	MTS	MTS	--	MTS	SUP	IMP
09020108-578 ***Coon Creek,*** *Unnamed Creek to Unnamed Creek*	14RD080	2.26	WWg	MTS	MTS	IF	IF	IF	--	IF	IF	--	IF	SUP	--
09020108-544 ***Coon Creek,*** *Unnamed Creek to Wild Rice River*	14RD015	1.44	WWg	MTS	IF	MTS	MTS	EXS	MTS	MTS	MTS	--	IF	SUP	IMP

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Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

The Coon Creek Subwatershed contains three stream reaches on Coon Creek (09020108-577, 09020108-578, and 09020108-544). The most upstream reach is 09020108-577, is a natural channel with fair habitat that includes multiple cover types, coarse substrates, low channel stability, fair sinuosity, and fair channel development (Appendix 5). One biological station (14RD044) was sampled for fish and macroinvertebrates. The fish community contained sensitive species (Pearl Dace, Rock Bass), and had an FIBI score that was well above the threshold. The macroinvertebrate community contained several sensitive taxa including several good Ephemeroptera, Plecoptera, and Tricoptera taxa but the MIBI score was just below the impairment threshold. The evidence suggests that this section of stream supports aquatic life based on a full evaluation of the existing biological data. The chemistry data was collected on the most upstream reach of Coon Creek at S006-193 (09020108-577). The reach fully supports aquatic life based on relatively low sediment and phosphorus concentrations and low productivity in the stream. However, bacteria samples exceeded the individual and monthly geometric mean standards and therefore the reach does not support aquatic recreation. It will be newly listed for *E. coli*.

The central reach in the Cook Creek Subwatershed (090201085-578) is natural with fair overall habitat, channel development, and moderate channel stability (Appendix 5). One biological monitoring station (14RD080) was sampled for fish and macroinvertebrates within this reach. The fish community contains sensitive species (Pearl Dace), with an FIBI score that is above the threshold. Similarly, the macroinvertebrate community contains sensitive taxa, with an MIBI score that is above the threshold. There is not sufficient chemistry data for either aquatic life or recreation use assessments, as data is limited to one-time grab samples at the biological visit.

The downstream reach on Coon Creek (09020108-544) is also natural. This reach provides the best habitat within the subwatershed, with good channel development, moderate/high channel stability, and the presence of coarse substrate (Appendix 5). The fish community of this reach contains multiple sensitive species (Longnose Dace, Pearl Dace, Rock Bass), and has an FIBI score that is above the threshold. The macroinvertebrate community has MIBI scores that are just below the threshold. However, the macroinvertebrate sample was collected directly after the fish sample, when the stream had been disturbed, likely contributing to the lower MIBI score. Due to the presence of multiple good macroinvertebrate taxa, the overall indication is that this section Coon Creek supports aquatic life based on the biology.

This final downstream reach of Coon Creek has sufficient chemistry data to assess for aquatic life and recreation. Secchi transparency and TSS concentrations are hovering near their standards. The assessment of eutrophication and DO data were inconclusive; seasonal mean total phosphorus exceeds the standard. The potential exists for productivity to be elevated; however, limited data indicates that algae in the water column are low. While the reach is, fully supporting now based on the fish and macroinvertebrate indicators, nutrients and suspended sediments may have the potential to adversely affect the aquatic communities in this reach of Coon Creek; best management practices on the landscape to protect the stream from further inputs of sediment and phosphorus should be a local protection priority.

Bacteria data collected on this reach of Coon Creek do not meet the monthly geometric mean standard during the months of June and August and suggest that this reach does not support aquatic recreation. This reach will be newly listed for *E. coli* bacteria.

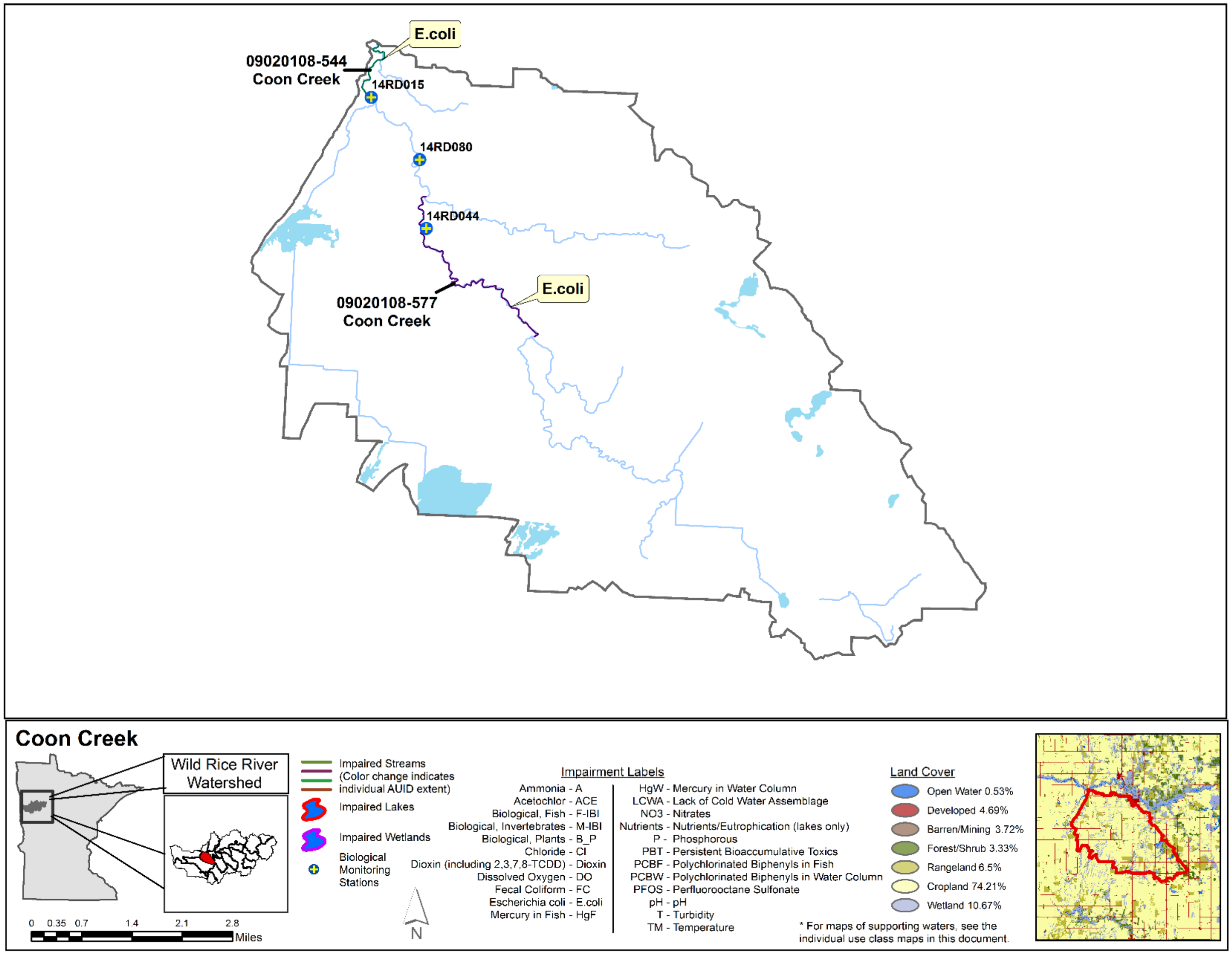

Figure 39. Currently listed impaired waters by parameter and land use characteristics in the Coon Creek Aggregated 12-HUC.

Tributary to Wild Rice River Aggregated 12-HUC HUC 0902010809-03

The Tributary to Wild Rice River Subwatershed is located within Norman, Mahnomen, and Becker Counties, encompassing 61 square miles. Unnamed Creek (Tributary to Wild Rice River) flows for 15 miles until it reaches its confluence with the Wild Rice River, 3 miles west of Twin Valley. Several minor tributaries flow into Unnamed Creek; most of which have been channelized to aid drainage. The headwaters section of Unnamed Creek has also been channelized. Land use within the Tributary to Wild Rice River Subwatershed is dominated by cropland (76%), but wetlands (10%) and rangeland (6%) are also present. Two intensive water chemistry stations (S007-791, S003-160 and S006-196) are located within this subwatershed.

Table 21. Aquatic life and recreation assessments on stream reaches: Trib. to Wild Rice River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-639 ***Unnamed Creek,*** *Headwaters to Unnamed Creek*	--	4	WWg	--	--	NA	MTS	--	MTS	MTS	MTS	--	IF	IF	SUP
09020108-545 ***Unnamed Creek,*** *Unnamed Creek to Unnamed Creek*	14RD001	3.46	WWg	MTS	MTS	IF	IF	IF	MTS	MTS	MTS	--	IF	SUP	IF
09020108-546 ***Unnamed Creek,*** *Unnamed Creek to Wild Rice River*	14RD011	7.4	WWg	MTS	MTS	IF	IF	MTS	MTS	MTS	MTS	--	IF	SUP	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

The Tributary to Wild Rice River Subwatershed contains three stream reaches (09020108-639, 09020108-545, and 09020108-546) that are all unnamed. All three reaches have not been channelized, and provide fair habitat for aquatic life. The most upstream reach, (09020108-639) was not sampled for biology. However, chemistry data was collected in 2010 and 2011 under a surface water assessment grant (SWAG) awarded to Norman and Mahnomen County SWCDs. Phosphorus is elevated in this reach, with low concentrations of algae in the water column. The water was clear, with low concentrations of suspended sediment. DO was impacted by the presence of wetlands upstream of the sampling location and was not assessed. Without biological data, a complete assessment for aquatic life could not be made.

Bacteria data collected under the same SWAG project met both the individual and monthly geometric mean standards, supporting aquatic recreation. The August monthly geometric mean is approaching the standard; the potential exists for this reach to become impaired in the future.

The next downstream reach (09020108-545) has one biological station (14RD001) that was sampled for fish and macroinvertebrates. Although the overall habitat rating was fair (MSHA=51.97, Appendix 5), the stream had coarse substrates, and good channel development. These good habitat features are utilized by sensitive fish species such as Pearl Dace and a number of sensitive macroinvertebrates. The FIBI score was above the general use threshold. The MIBI score was below the general use threshold. This sample was hyperdominated by tolerant midge taxa, likely due to an early season sample. Other macroinvertebrate taxa within the community are indicating full support for aquatic life. Norman and Mahnomen SWCDs collected chemistry data on this reach in conjunction with citizen and student volunteers. Datasets were small; however, it appears that oxygen concentrations stay above the standard on this reach. Phosphorus is elevated, but little response is noted in the stream, as algae concentrations are low. Sediment data is sparse, but it does not look to be indicative of a problem.

Bacteria data collected on this reach do not meet minimum data requirements for assessment purposes. Out of the fourteen samples that were collected, none of them exceed the individual standard but concentrations are high enough that if a geometric mean could be calculated, it may indicate impaired conditions; no months have the minimum five samples required to calculate a geometric mean. The elevated bacteria levels suggest that work to address sources of bacteria in the watershed should be a local protection priority.

The final downstream reach on Unnamed Creek (09020108-546) contains one biological station (14RD011) that was sampled for fish and macroinvertebrates. Although this station had a fair MSHA score (63.4, Appendix 5), it still displayed several good habitat attributes. Coarse gravel, cobble, vegetation, woody debris and under-cut banks provided good cover for small fishes and macroinvertebrates. Several sensitive fish species (Peal Dace, Longnose Dace), larger riverine species (Golden Redhorse), and macroinvertebrate taxa were captured. IBI scores for both assemblages were good, coinciding with the positive habitat features. Limited chemistry data is available; sediment and phosphorus were both elevated on occasion during the sampling period as a result of rain events. While not indicative of an immediate problem, it would be important to protect against increases in overland runoff and flow.

Bacteria samples collected at monitoring station S007-791 indicate that this stream reach has one of the highest individual exceedance rates within the entire Wild Rice River Watershed. Five individual samples exceed the standard, and three months where a geometric mean could be calculated all exceed the monthly standard. These data indicate that bacteria concentrations are chronically, and often times severely, elevated; this reach does not support recreation and will be newly listed for *E. coli* bacteria.

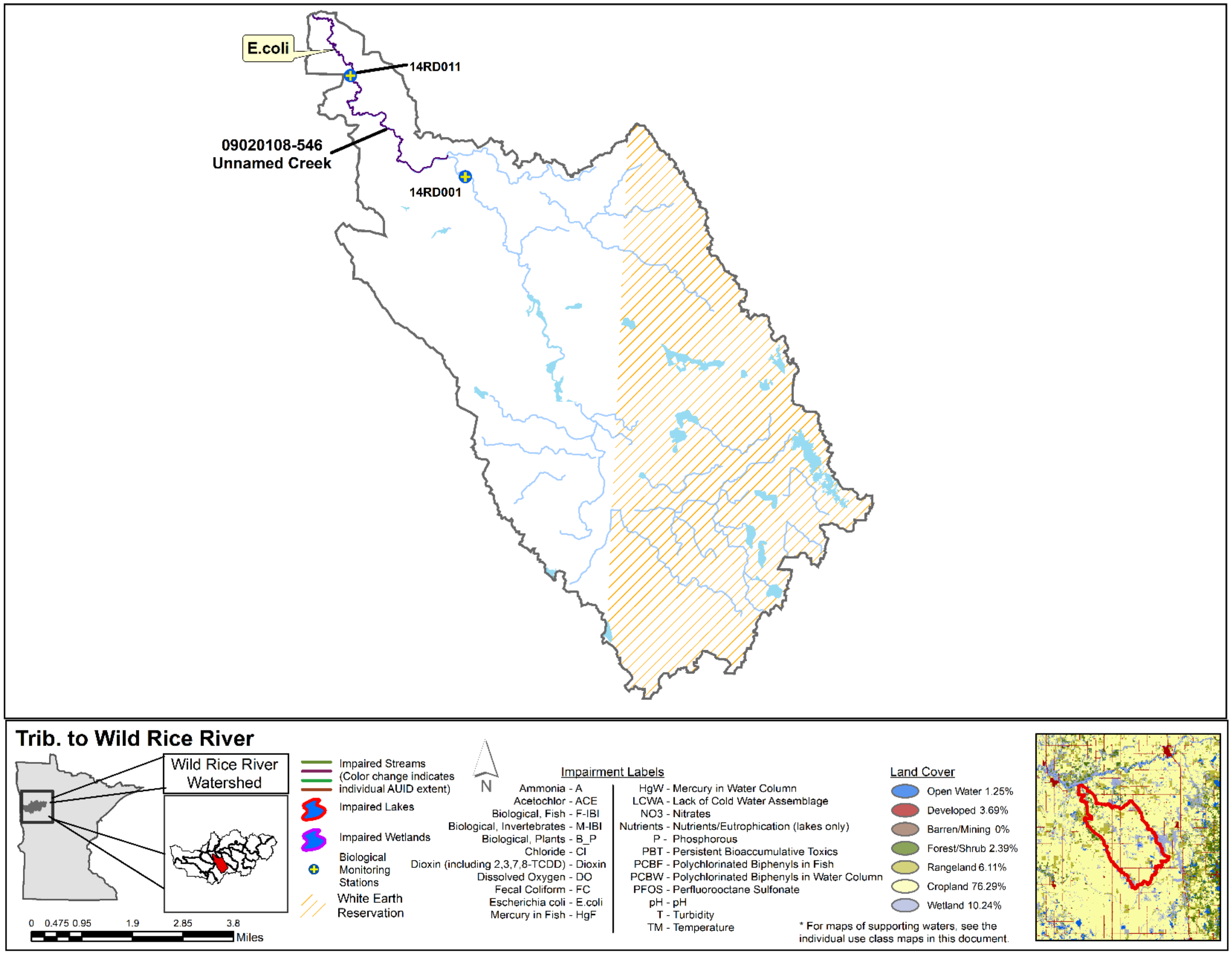

Figure 40. Currently listed impaired waters by parameter and land use characteristics in the Trib. to Wild Rice River Aggregated 12-HUC.

Lower South Branch Wild Rice River Aggregated 12-HUC HUC 0902010810-01

The Lower South Branch Wild Rice River Subwatershed is located within Norman, Clay, and Becker Counties, encompassing 115 square miles. As the name implies this subwatershed contains the lower portion of the Wild Rice River, South Branch. The Wild Rice River, South Branch within this subwatershed originates at the confluence of Stiner Creek, 1-mile west of Ulen, and flows for 34 miles until it reaches its confluence with the Wild Rice River, 8 miles northeast of Perley. The section of river from the CSAH 40 crossing to just downstream of the T-246 crossing has been channelized to aid drainage. Most of the unassessed tributaries within the subwatershed have also been channelized. The land use within the Lower South Branch Wild Rice River Subwatershed is dominated by cropland (80%), but barren land (8%) and wetlands (7%) are also present. Four intensive water chemistry stations were established (S003-164, S003-165, S003-308, and S007-787) within the subwatershed on the Wild Rice River, South Branch.

Table 22. Aquatic life and recreation assessments on stream reaches: Lower South Branch Wild Rice River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:**										**Aquatic Life**	**Aquatic Rec. (Bacteria)**
				Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication		
09020108-662 ***Wild Rice River, South Branch*** *Unnamed Creek to Unnamed Creek*	14RD042 05RD069 94RD012	23.79	WWg	MTS	EXS	MTS	IF	IF	MTS	MTS	MTS	--	IF	IMP	IMP
09020108-557 ***Unnamed Creek,*** *Unnamed ditch to S Br Wild Rice River*	--	2.12	WWg	--	--	IF	- -	IF	- -	IF	- -	--	- -	IF	- -
09020108-659 ***Wild Rice River, South Branch*** *T-246 to Wild Rice River*	14RD047 14RD049 07RD010 14RD012[1]	8.27	WWg	MTS	MTS	IF	MTS	MTS	MTS	MTS	MTS	--	IF	SUP	IMP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
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Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.
1: 14RD012 is included within this subwatershed as it lies on 09020108-659, but was sampled across the subwatershed boundary

Summary

The Lower South Branch Wild Rice River Subwatershed contains three stream reaches (09020108-662, 09020108-557, and 09020108-659). A majority of the subwatershed remains natural; however, one isolated stream segment in the headwaters portion of 09020108-659 has been channelized to aid drainage. MSHA scores (Appendix 5) indicate a trend of decreasing habitat quality from upstream to downstream. The headwaters portion of the watershed contains good channel development and stability, with coarse gravel, cobble, vegetation, woody debris, and under-cut banks providing good cover for small fishes and macroinvertebrates. As the Wild Rice River, South Branch reaches the outlet of the subwatershed, MSHA scores indicate poor habitat quality, as evidenced by declines in channel stability and development paired with the loss of coarse substrate and increase in siltation. The most upstream reach on the Wild Rice River, South Branch (09020108-662) contains three biological stations (14RD042, 05RD069, 94RD012) that were sampled for fish and macroinvertebrates. The fish community is utilizing the good habitat features available within the headwaters of this subwatershed. The reach has sensitive fish species (Longnose Dace, Pearl Dace) and larger riverine species (Golden Redhorse) and a FIBI score that is above the threshold. Contrary to the fish community results, the macroinvertebrate community is showing signs of stress, indicated by an MIBI score that was below the threshold at 14RD012 and within the confidence interval at 94RD012. Bank failure, direct cattle access, and elevated chemical parameters are likely stressing the macroinvertebrate community. Chemistry data collected by MPCA staff as well as Norman/Mahnomen County SWCDs at stations S003-308 and S003-165 suggest problematic conditions exist in this portion of the South Branch Wild Rice River. Data reviewed for the aquatic life use assessment suggest that suspended solids have the potential to adversely affect the aquatic communities; both TSS and Secchi transparency datasets have numerous exceedances of their regional standards (often times following rain events, which is testament to the easily erodible soils in the watershed). Phosphorus is also elevated; while there is not a noticeable increase in suspended algae, there is elevated oxygen flux – this is often a sign of increased productivity. Additional DO flux data is needed to confirm eutrophication is present and adversely affecting the aquatic communities.

Bacteria data collected on this reach do not exceed the individual bacteria standard; however, three months where geometric means were calculated all exceed the monthly standard. These data indicate that this reach does not support recreation and will be newly listed for *E. coli* bacteria. Chronically elevated bacteria levels can lead to increased risk of illness from water contact during recreation.

The next downstream reach is an Unnamed Creek (09020108-557), which was not sampled for biology. Chemistry data collected on Unnamed Creek do not meet minimum data requirements for assessment purposes. Transparency and pH were measured and available data does meet applicable standards.

The most downstream reach of the Wild Rice River, South Branch (09020108-659) is the outlet of the subwatershed, which contains three biological stations (14RD047, 14RD049, 07RD010) that were sampled for fish and macroinvertebrates. The habitat throughout this stream reach is poor, as indicated by low MSHA scores (Appendix 5) at each of the three biological stations. The fish community contained a combination of sensitive species (Rock Bass) and tolerant species (Common Carp), with an FIBI score that was above the threshold. The macroinvertebrate community also contained a combination of sensitive and tolerant taxa, and had MIBI scores that were at, or above the threshold at 14RD047 and 14RD049. Due to difficult sampling conditions (i.e., deep water) less weight was put on the sample collected at 07RD010. Norman/Mahnomen SWCDs and MPCA staff collected chemistry data at stations S007-787 and S003-164Phosphorus was elevated; the overall average was just below the water quality standard; response data was limited (suspended algae and oxygen flux) but did not show that eutrophication (excess productivity) was occurring in the stream. Sediment, ammonia, and pH all met their standards. It should be noted that there is a roughly seven-mile long stretch of unassessed channelized ditch system separating this reach from the upstream reach that was assessed (09050108-662).

Bacteria data collected at two separate stations on this reach meet the individual bacteria standard; however, monthly geometric mean calculations for two months exceed the monthly standard. This indicates that bacteria concentrations are chronically elevated and may pose a risk to human health. This reach of the Wild Rice River, South Branch does not support aquatic recreation and will be newly listed for *E. coli* bacteria.

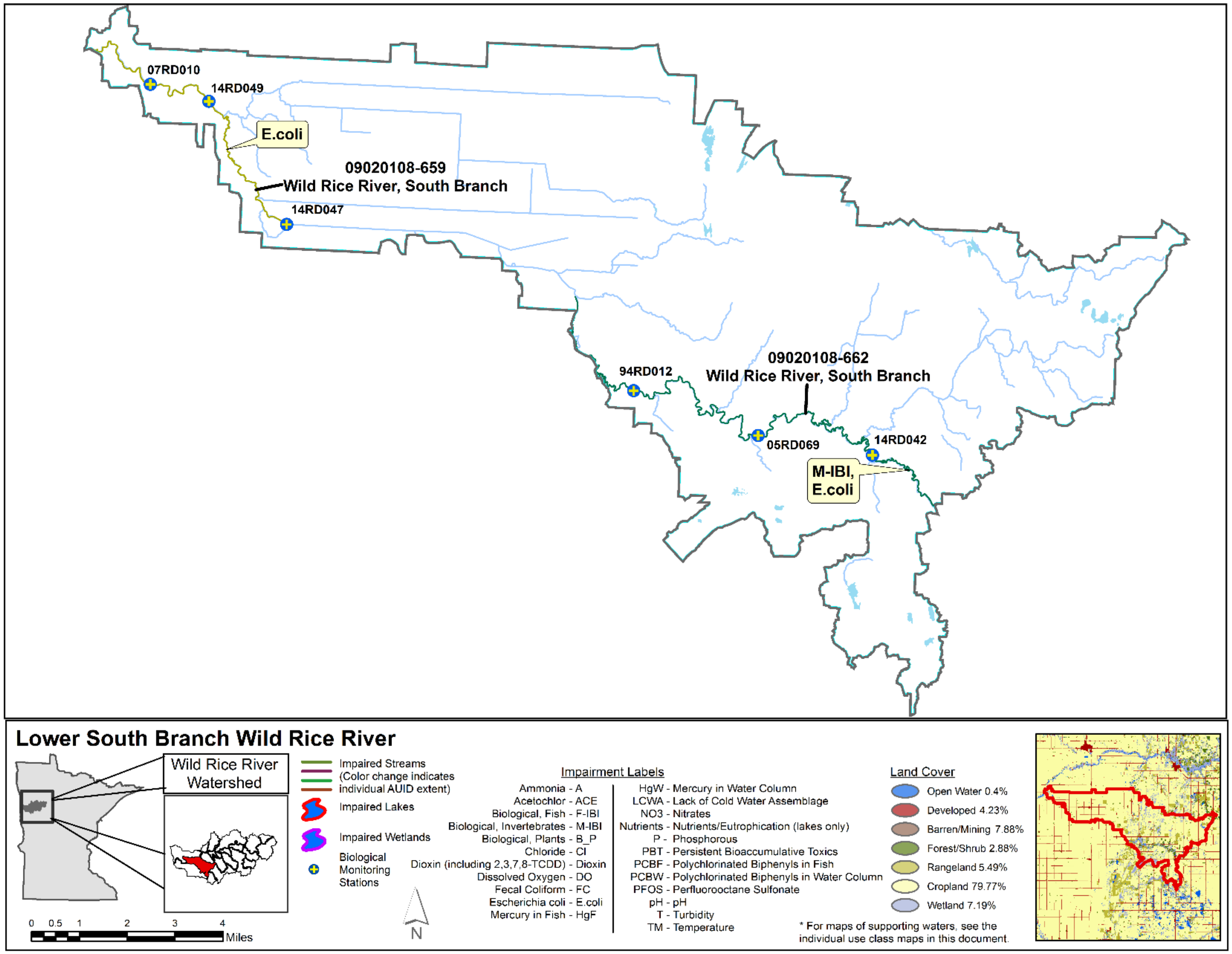

Figure 41. Currently listed impaired waters by parameter and land use characteristics in the Lower South Branch Wild Rice River Aggregated 12-HUC.

Upper South Branch Wild Rice River Aggregated 12-HUC HUC 0902010810-02

The Upper South Branch Wild Rice River Subwatershed is mostly located within Becker County, but the margins of the subwatershed also cross Clay, Norman, and Mahnomen County lines. The subwatershed encompasses 102 square miles with over half of the subwatershed within the White Earth Indian Reservation. This subwatershed contains the headwaters and upper portion of the Wild Rice River, South Branch. The river originates in Otto Lake, 1 mile southeast of Ogema, and flows for 45 miles until it reaches its confluence with Stiner Creek located just east of Ulen. One assessable tributary, Spring Creek, is located 4 miles east of Ogema. Most of the watercourses with the subwatershed have been historically channelized to aid in drainage, including over 50% of the Wild Rice River, South Branch and the entire Spring Creek system. Over half of the land use within the subwatershed is cropland (76%), but wetlands (8%) and Rangeland (6%) are also present.

Table 23. Aquatic life and recreation assessments on stream reaches: Upper South Branch Wild Rice River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

				Aquatic Life Indicators:											
AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-540 ***Spring Creek,*** *Headwaters to Wild Rice River, South Branch*	14RD025	5.9	WWg	MTS	MTS	IF	IF	IF	--	IF	IF	--	--	SUP	--
09020108-660 ***Wild Rice River, South Branch*** *Otto Lake to -96.1406, 47.0658*	--	16.42	WWg	--	--	--	--	MTS	--	--	--	--	--	IF	--
09020108-661 ***Wild Rice River, South Branch*** *-96.1406, 47.0658 to Unnamed Creek*	14RD081 07RD028	5.03	WWm	EXS	IF	IF	IF	IF	--	IF	IF	--	--	IMP	--

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Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
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*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

The Upper South Branch Wild Rice River Subwatershed contains four stream reaches (09020108-540, 09020108-660, 09020108-661, and 09020108-662). A majority of the subwatershed has not been channelized, with the exception of the centrally located reach on the Wild Rice River, South Branch (09020108-661). The most upstream reach within the subwatershed is Spring Creek (09020108-540) which contains one biological station (14RD025) that was sampled for fish and macroinvertebrates. Spring Creek features relatively poor habitat noted by low MSHA scores (MSHA=35, Appendix 5). The fish community contained sensitive species (Pearl Dace) and had an FIBI score that was above the threshold. The macroinvertebrate community had an MIBI score that was just below the threshold, but only one habitat type (overhanging bank vegetation) was available to sample. The sample contained some cold-water taxa (*Eukiefferiella*, *Gammarus*) which suggests there is some groundwater influence in this reach. Chemistry data for this reach are limited to one-time grab samples at the biological visit, and does not meet minimum data requirements for assessment purposes.

The next downstream reach is on the Wild Rice River, South Branch (09020108-660) which was not sampled for biology due to insufficient flow conditions. This reach does not have sufficient chemistry data for assessment purposes; however, Secchi transparency data were collected on the Wild Rice River, South Branch, and does meet the regional standard.

Downstream of the insufficient flow conditions, is the next reach on the Wild Rice River, South Branch (09020108-661) which contains two biological stations (14RD081, 07RD028) that were sampled for fish. A macroinvertebrate sample was not collected due to low flow conditions. This is a channelized stream that was designated as modified (i.e., habitat limited) due to the presence of severely embedded substrates and compromised channel development. Fish samples were taken within this reach in 2007 and 2015. In 2007, larger riverine species were present (Carmine Shiner, Redhorses), but these were absent from the 2015 sample. In 2015, the fish community was comprised of tolerant fish species (Fathead Minnow, Brook Stickleback) and had an FIBI score that was below the threshold. Hydrologic connectivity could be an issue that is impeding fish migration, isolating this reach from the Wild Rice River, and inhibiting fish passage. Chemistry data for this reach are limited to one-time grab samples at the biological visit, and does not meet minimum data requirements for assessment purposes.

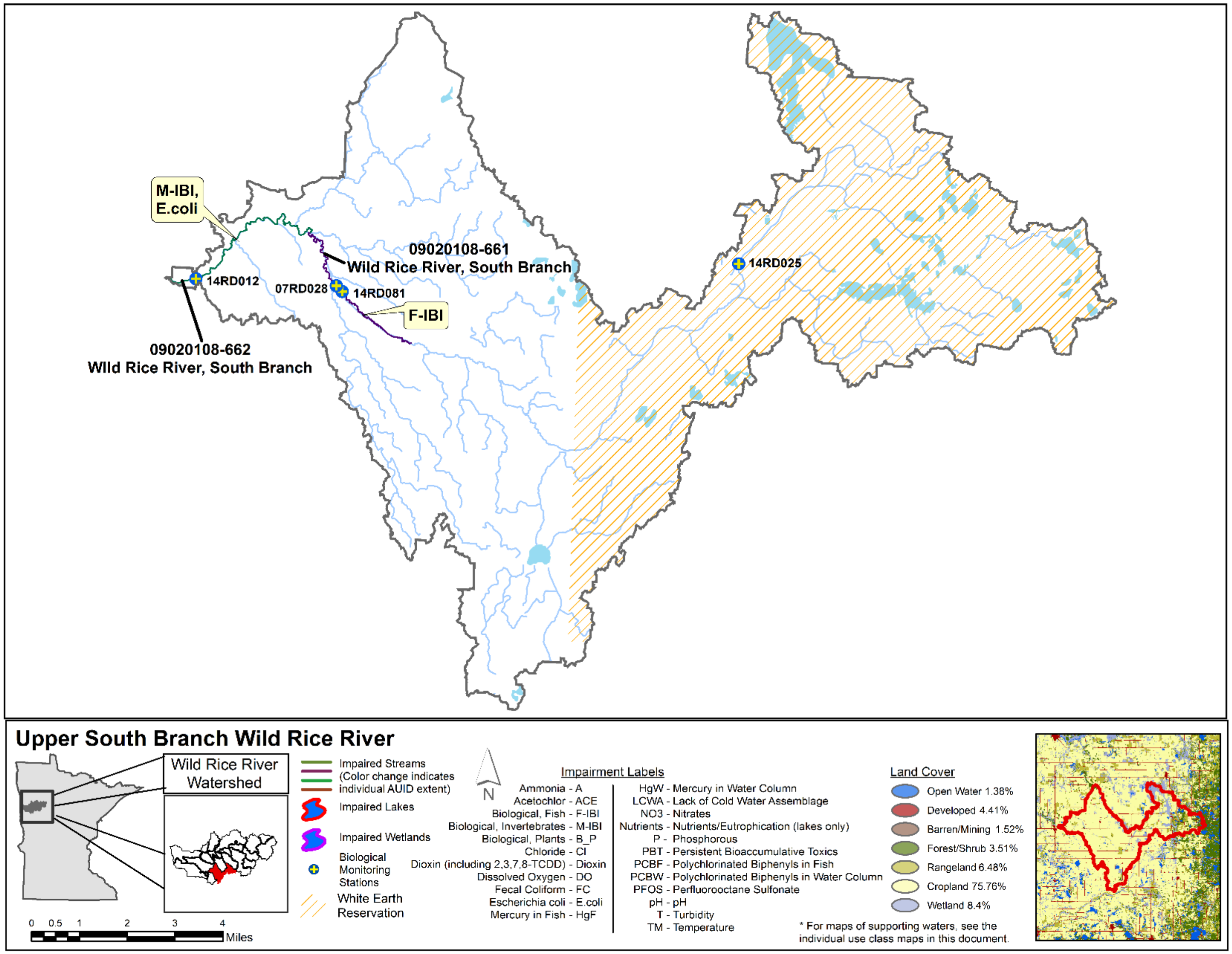


Figure 42. Currently listed impaired waters by parameter and land use characteristics in the Upper South Branch Wild Rice River Aggregated 12-HUC. (*14RD012 is displayed within this map, as the downstream AUID (09020108-662) crosses the subwatershed boundary)

Stiner Creek Aggregated 12-HUC — HUC 0902010810-03

The Stiner Creek Subwatershed is located within Clay and Becker counties, encompassing 41 square miles. As the name suggests, this subwatershed contains Stiner Creek, which flows for 4 miles. The headwaters of Stiner Creek originate 4 miles southeast of Ulen and the creek flows until it reaches its confluence with the Wild Rice River, South Branch, just east of Ulen. Stiner Creek is natural, but all of the unassessed tributaries flowing into Stiner Creek have been channelized to aid drainage. Over half of the land use within the subwatershed is cropland (80%), but wetlands (8%) are also present. The intensive water chemistry station (S003-121) within the Stiner Creek Subwatershed was located off the culvert at the CSAH 34 crossing.

Table 24. Aquatic life and recreation assessments on stream reaches: Stiner Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:** Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-542 ***Stiner Creek,*** *Unnamed Creek to Wild Rice River, South Branch*	14RD013	1.19	WWg	MTS	MTS	IF	IF	MTS	MTS	MTS	MTS	--	IF	SUP	IF

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 25. Lake assessments: Stiner Creek Aggregated 12-HUC.

Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Assessment Method	Ecoregion	Secchi Trend	Aquatic Life Indicators:			Aquatic Recreation Indicators:			Aquatic Life Use	Aquatic Recreation Use
							Fish IBI	Chloride	Pesticides	Total Phosphorus	Chlorophyll-a	Secchi		
Rustad	03-0653-00	136	6	Shallow Lake	NCHF	- -	- -	- -	- -	IF	- -	- -	- -	IF
Tilde	14-0004-00	248	13	Shallow Lake	NCHF	- -	- -	MTS	- -	MTS	MTS	MTS	IF	FS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains
Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: = existing impairment, listed prior to 2014 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

The Stiner Creek Subwatershed contains one reach (09020108-542) with one biological station (14RD013) that was sampled for fish and macroinvertebrates. Aquatic habitat available to fish and macroinvertebrates is fair with coarse gravel, cobble, vegetation, and woody debris that provides good cover for small fishes and macroinvertebrates (Appendix 5). Several sensitive fish species (Longnose Dace, Iowa Darter) and macroinvertebrate taxa were captured. IBI scores for both assemblages were good, coinciding with the positive habitat features. This portion of Stiner Creek was intensively monitored for aquatic life and recreation chemistry parameters at station S003-121. Those data show that nutrient concentrations in the creek are elevated. Additionally, an unusually high concentration of ammonia-nitrogen was observed following the spring melt in 2014 resulting in a single exceedance of the unionized ammonia toxic standard (one of the only exceedances of this parameter in the entire Wild Rice River Watershed). All other conventional aquatic life use chemistry parameters meet their standards. Work to reduce nutrient inputs from this watershed should be a local priority to prevent the creek from becoming impaired.

This stream reach was not flowing during all sampling events. This impacted the bacteria sampling and resulted in fewer samples collected than necessary to assess for recreation. For the data collected, the concentrations were all below the individual standard; more data will be necessary to determine if recreation is adequately protected against bacteria.

Only one lake, Tilde Lake, in the Stiner Creek Subwatershed has chemistry data suitable for an assessment of aquatic recreation. The lake easily meets the NCHF ecoregion eutrophication standard. Secchi transparency depth was often limited by lake depth or submerged macrophyte growth. Chloride concentrations easily meet the standard for aquatic life; no fish survey was available to determine the health of the fish community.

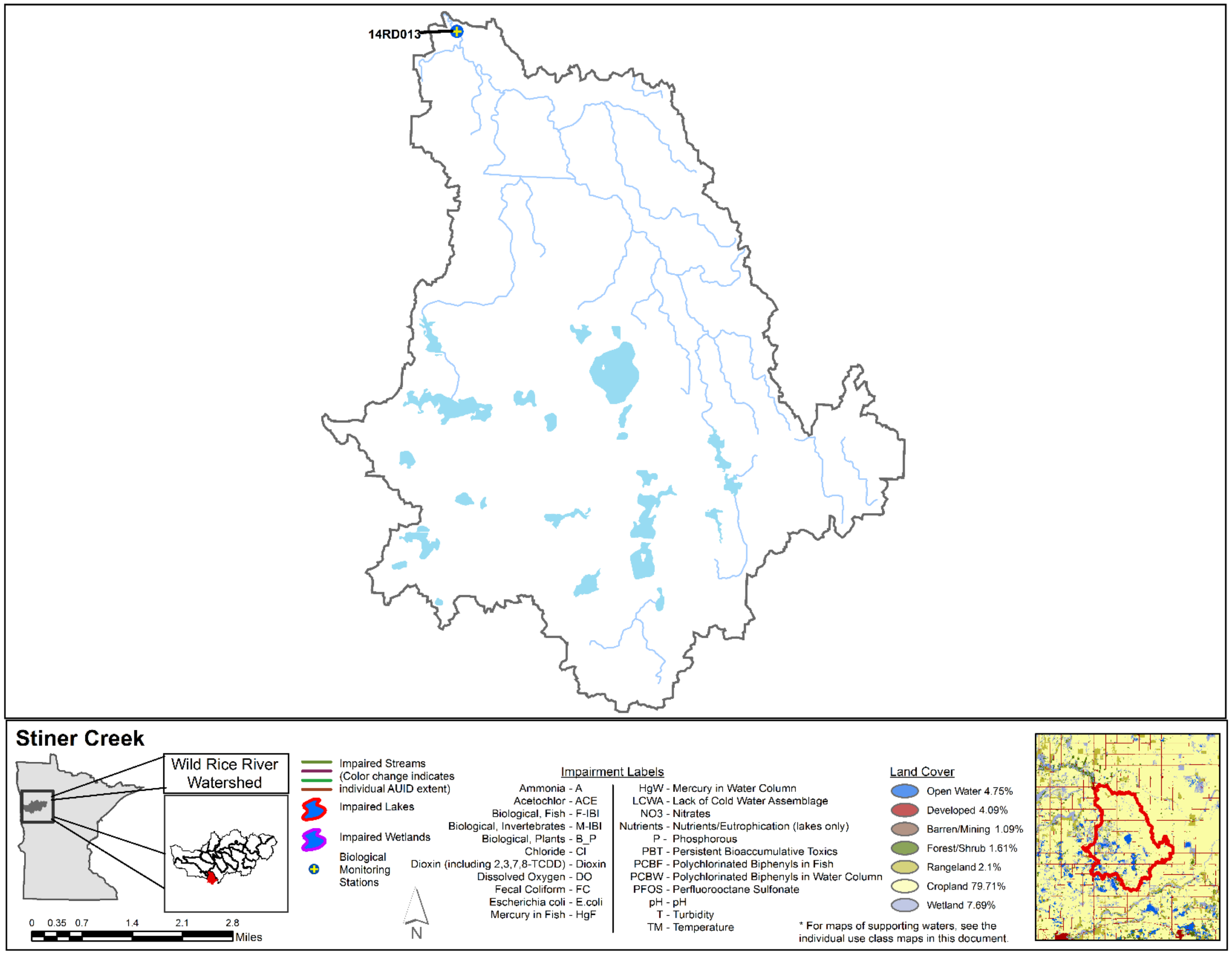


Figure 43. Currently listed impaired waters by parameter and land use characteristics in the Stiner Creek Aggregated 12-HUC

Felton Creek Aggregated 12-HUC

HUC 0902010811-01

The Felton Creek Subwatershed is located within Norman and Clay counties, encompassing 146 square miles. This subwatershed contains Felton Creek, which flows for 31.15 miles. The headwaters of Felton Creek begin within Unnamed Lake (14-0082-00) located 4 miles southwest of Ulen; the headwaters include County Ditch 19/Felton Creek before becoming County Ditch 45 at the 150th St N crossing. The stream enters the Wild Rice River 4 miles east of Perley. The majority of the subwatershed has been historically channelized to aid drainage, leaving one small natural portion of the creek 7 miles) from 200th St to 150th St N. A large majority of the land use within the subwatershed is cropland (85%), but rangeland (5%) is also present. Two intensive water chemistry stations (S003-158 and S006-194) were established in this subwatershed.

Table 26. Aquatic life and recreation assessments on stream reaches: Felton Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name,* *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:** Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-653 ***Felton Creek/ County Ditch 19,*** *Headwaters (Unnamed LK 14-0082-00) to 200th St.*	--	6.33	CWg	--	--	NA	--	IF	--	IF	--	--	--	IF	--
09020108-654 ***Felton Creek/ County Ditch 45,*** *200th St to T141 R46W S14, west line*	10RD080 15RD012 15RD035 14RD046	6.68	CWg	EXS	EXS	IF	IF	IF	--	MTS	MTS	--	IF	IMP	--
09020108-553 ***County Ditch 45,*** *Unnamed Ditch to Unnamed Ditch*	14RD051	2.85	WWm	MTS	MTS	IF	MTS	IF	MTS	MTS	MTS	--	MTS	SUP	IMP
09020108-541 ***Unnamed Creek,*** *Unnamed Ditch to Wild Rice River*	07RD011	3.15	WWm	MTS	MTS	IF	IF	EXS	MTS	MTS	MTS	--	MTS	SUP	SUP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

The Felton Creek Subwatershed contains four stream reaches (09020108-653, 09020108-654, 09020108-553, and 09020108-541). A majority of the subwatershed has been channelized. The small stretch of natural stream within the headwaters of the subwatershed has fair habitat, but it becomes poor/degraded in the ditched section. The most upstream reach within the subwatershed is Felton Creek/County Ditch 19 (09020108-653) which was not sampled for biology due to the wetland conditions. This reach does not have sufficient chemistry data for assessment purposes however, Secchi transparency and pH data were collected on Felton Creek/ County Ditch 19 (09020108-653), and do meet their respective standards.

The next downstream reach within the subwatershed is Felton Creek/County Ditch 45 (09020108-654), which contained four biological stations (10RD080, 15RD012, 15RD035, 14RD046) that were sampled for fish and macroinvertebrates. This portion of Felton Creek is a designated trout stream (2A) and following conversations between the DNR (Detroit Lakes office) and MPCA staff, the DNR has historically managed this stream for trout; and temperature data collected by the MPCA indicates this stream has coldwater potential.

Habitat at the two upstream stations (10RD080, 15RD012) is fair (Appendix 5) and provides the best habitat within the subwatershed. Excellent channel development, paired with coarse gravel, vegetation, woody debris, under-cut banks, and deep pools provided good cover for small fishes and macroinvertebrates. These stations also have good buffers and canopy cover. However, the downstream portion of the reach (15RD035, 14RD046) has been channelized and habitat degradation is apparent. This portion of the reach exhibits a deeply incised channel and a loss of coarse substrates. The poor channel stability evident throughout this reach may be related to a lack of adequate buffers.

The fish community within Felton Creek/County Ditch 45 is poor; all of the samples have FIBI scores that are below the threshold. FIBI scores are linked to the habitat loss, as FIBI scores within the upstream portion of the reach are higher than scores in the downstream portion. The biological response to the habitat loss within the downstream portions of the reach is also evident within the macroinvertebrate community. MIBI scores are below the general use thresholds; however, some sensitive coldwater obligate macroinvertebrate taxa occur mainly in the upstream portions. Felton Creek is a unique stream for this portion of the state, as there are not many other coldwater trout streams in this region. Given the lack of coldwater stations/streams in this part of the state, it is plausible that the coldwater IBI may not adequately characterize its fish community. However, the macroinvertebrate community is clearly responding to habitat degradation, driving the low IBI scores in Felton Creek.

This reach does not have sufficient chemistry data for an aquatic life use assessment; however, toxics datasets (pH and unionized ammonia) both meet their cold-water standards with zero exceedances of either standard. No bacteria data exist on this stream reach for a recreational use assessment.

The next stream reach is County Ditch 45 (09020108-553) which contains one biological station (14RD051) that was sampled for fish and macroinvertebrates. This stream is designated as modified (i.e., habitat limited) due to the channelization which has compromised channel development increased siltation. The fish community consisted of sensitive species (Pearl Dace, Iowa Darter) and larger riverine species (Golden Redhorse, Shorthead Redhorse) with an FIBI score that was above the modified use threshold. The macroinvertebrate community was dominated by tolerant taxa, with an MIBI above the modified use threshold. Chemistry data all meet their individual/regional standards and suggest current conditions fully support aquatic life. Seasonal mean total phosphorus and chl-a concentrations both easily meet the south nutrient region standards. Bacteria data collected at the intensive chemistry monitoring site show three exceedances of the individual bacteria standard. Additionally, both months that had enough samples to calculate a geometric mean exceed the monthly standard. These bacteria data indicate this reach of County Ditch 45 has chronically (sometimes severely) elevated bacteria concentrations and may pose a human health risk through bodily contact. This stream reach does not currently support aquatic recreation and will be newly listed for *E. coli* bacteria.

The final stream reach within the subwatershed before the confluence with the Wild Rice River, is Unnamed Creek (09020108-541) which contained one biological station (07RD011) that was sampled for fish and macroinvertebrates. Unnamed Creek is separated from the previous assessed upstream reach (09020108-553) by roughly seven miles of mostly channelized ditches. This stream is designated as modified (i.e., habitat limited) due to the channelization. Fish and macroinvertebrate communities score above the modified use threshold, indicating that Unnamed Creek supports aquatic communities that are within expectations for channelized streams. This reach has sufficient chemistry data to assess for both aquatic life and recreation. Phosphorus concentrations are low in this watershed. Sediment is near the threshold, and during rain events, this reach does become turbid. Oxygen concentrations adequate to support game fish communities.

Bacteria data collected at the intensive chemistry monitoring site meet both the individual and calculated monthly geometric mean standards. Two of the calculated monthly geometric means are approaching the standard, but currently meet it with more than the minimum number of observations required. This outlet reach at the end of the County Ditch 45 system fully supports aquatic recreation.

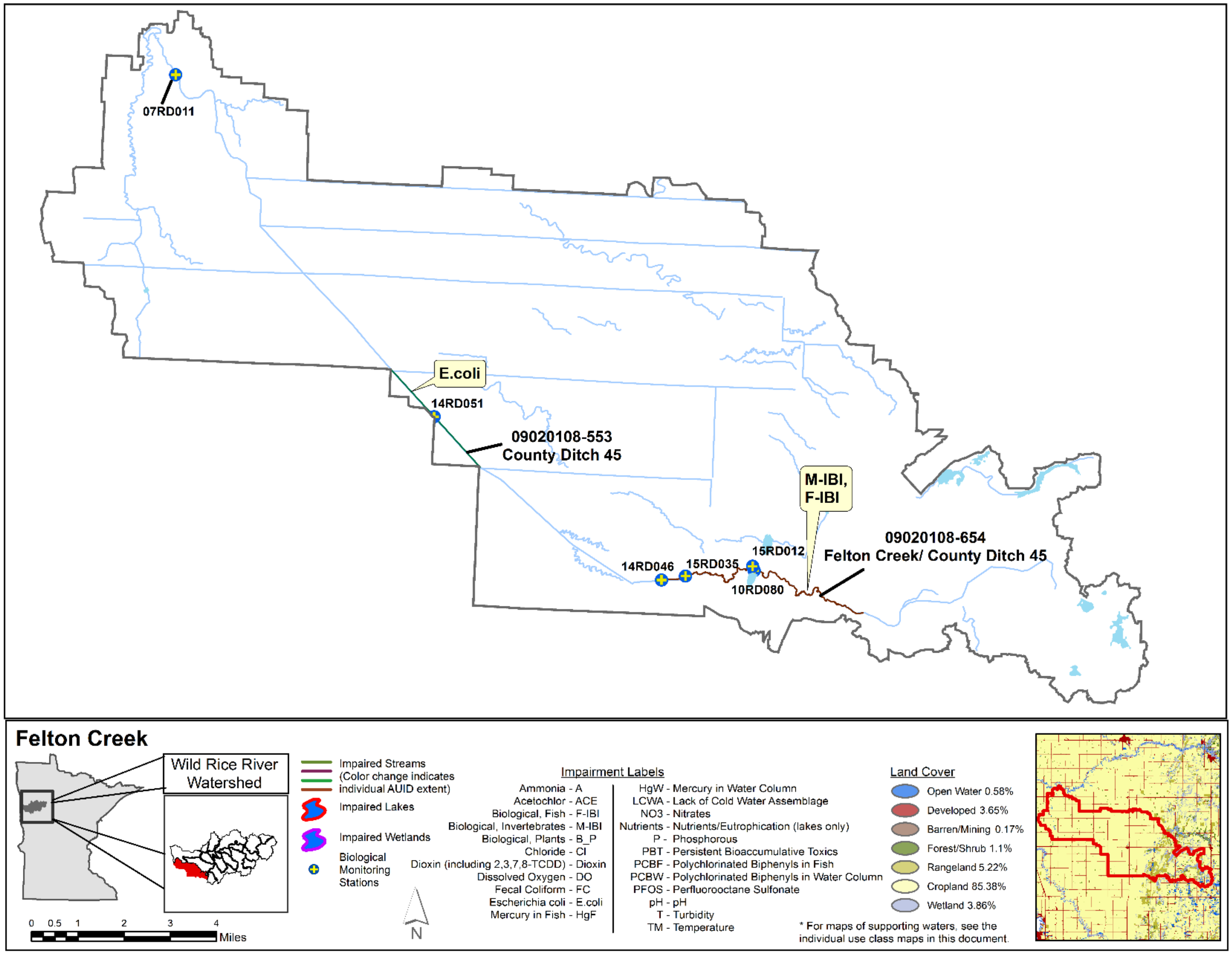


Figure 44. Currently listed impaired waters by parameter and land use characteristics in the Felton Creek Aggregated 12-HUC.

Outlet Wild Rice River Aggregated 12-HUC HUC 0902010812-01

The Outlet Wild Rice River Subwatershed is located within Norman and Clay Counties, encompassing 148 square miles. This subwatershed contains the most downstream portion of the Wild Rice River. The Wild Rice River within this subwatershed originates at the confluence of the Marsh River dike, located 4 miles southeast of Ada, and flows for 47 miles before reaching its confluence with the Red River of the North, 2 miles south of Halstad. The Wild Rice River within this subwatershed has been channelized from the confluence with the Marsh River to just upstream of CR 103, to aid drainage. Most of the tributaries within the subwatershed have been channelized as well. Most of the land use within this subwatershed is cropland (90%) however; developed land (5%) and barren land (4%) are also present. Two intensive water chemistry station were established within the subwatershed on the Wild Rice River (S004-201 and S000-216).

Table 27. Aquatic life and recreation assessments on stream reaches: Outlet Wild Rice River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name,* *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:** Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
09020108-644 ***Wild Rice River,*** *Unnamed Creek to Wild Rice River, South Branch*	14RD033 14RD048 14RD053	16.74	WWg	MTS	MTS	IF	EXS	EXS	MTS	MTS	MTS	--	MTS	IMP	IMP
09020108-501 ***Wild Rice River,*** *Wild Rice River, South Branch to Red River of the North*	14RD055 05RD036 05RD112 14RD019	30.53	WWg	MTS	MTS	MTS	EXS	EXS	MTS	MTS	MTS	--	IF	IMP	SUP

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Summary

The Outlet Wild Rice River Subwatershed contains two stream reaches (09020108-644 and 09020108-501). A majority of this subwatershed has been channelized to aid drainage. The habitat throughout the subwatershed is poor due to the lack of coarse substrate and compromised channel development (Appendix 5). The upstream reach on the Wild Rice River (09020108-644) contained three biological stations (14RD033, 14RD048, 14RD053) that were sampled for fish and macroinvertebrates. Several larger riverine species (Golden Redhorse, Shorthead Redhorse, and Silver Redhorse) and sensitive macroinvertebrate taxa were captured. The FIBI and MIBI scores were above their respective thresholds.

This segment of the Wild Rice River has an existing turbidity listing that was first noted in 2010. Review of new TSS and Secchi transparency data indicate that suspended solids are still problematic and have the continued potential to adversely affect the aquatic communities. All other conventional and eutrophication aquatic life use parameters meet their standards where sufficient data exist. Bacteria data collected by the Red River Watershed Management Board and MPCA staff at three different monitoring sites show two exceedances of the individual bacteria standard out of 47 total samples collected. However, the calculated monthly geometric means for two months exceed the monthly standard, which suggests that bacteria concentrations are chronically elevated and may pose a risk to human health. As such, this river reach does not support aquatic recreation and will be newly listed for E. coli bacteria.

The downstream reach of the Wild Rice River (09020105-501) is the portion of the river that outlets into the Red River of the North, draining the entire Wild Rice River Watershed. This reach contained four biological stations (14RD055, 05RD036, 05RD112, 14RD019) that were sampled for fish and macroinvertebrates. This section of the river remains natural, but due to the upstream alteration, the stream habitat is poor (Appendix 5). Fine sediments, heavy siltation, and poor channel stability were noted within the MSHA scores at each station (Appendix 5). Although the habitat was poor, the FIBI and MIBI scores were above their respective thresholds. The fish community contains sensitive species (Rock Bass, Iowa Darter) and larger riverine species (Golden Redhorse, Silver Redhorse, Shorthead Redhorse) and the macroinvertebrate community contained a diverse mixture of sensitive Ephemeroptera, Plecoptera, and Tricoptera taxa.

This reach of the Wild Rice River was originally listed for turbidity in 2006. New TSS and Secchi transparency data support the previous listing for turbidity, with high exceedance rates within both datasets (TSS exceedance rate is >70% of all samples; Secchi exceedance rate is >35%). All other conventional chemistry parameters meet their respective water quality standards. River eutrophication data show that seasonal mean total phosphorus exceeds the regional standard, but three 'response' parameters (i.e., chl-a, BOD5, and DO flux) all meet their own individual standards. Excess productivity is not likely impacting the biological community on this portion of the river. Bacteria data collected at S000-216 and S002-102 all meet the individual and monthly geometric mean standards. Based on these data, this reach of the Wild Rice River fully supports aquatic recreation.

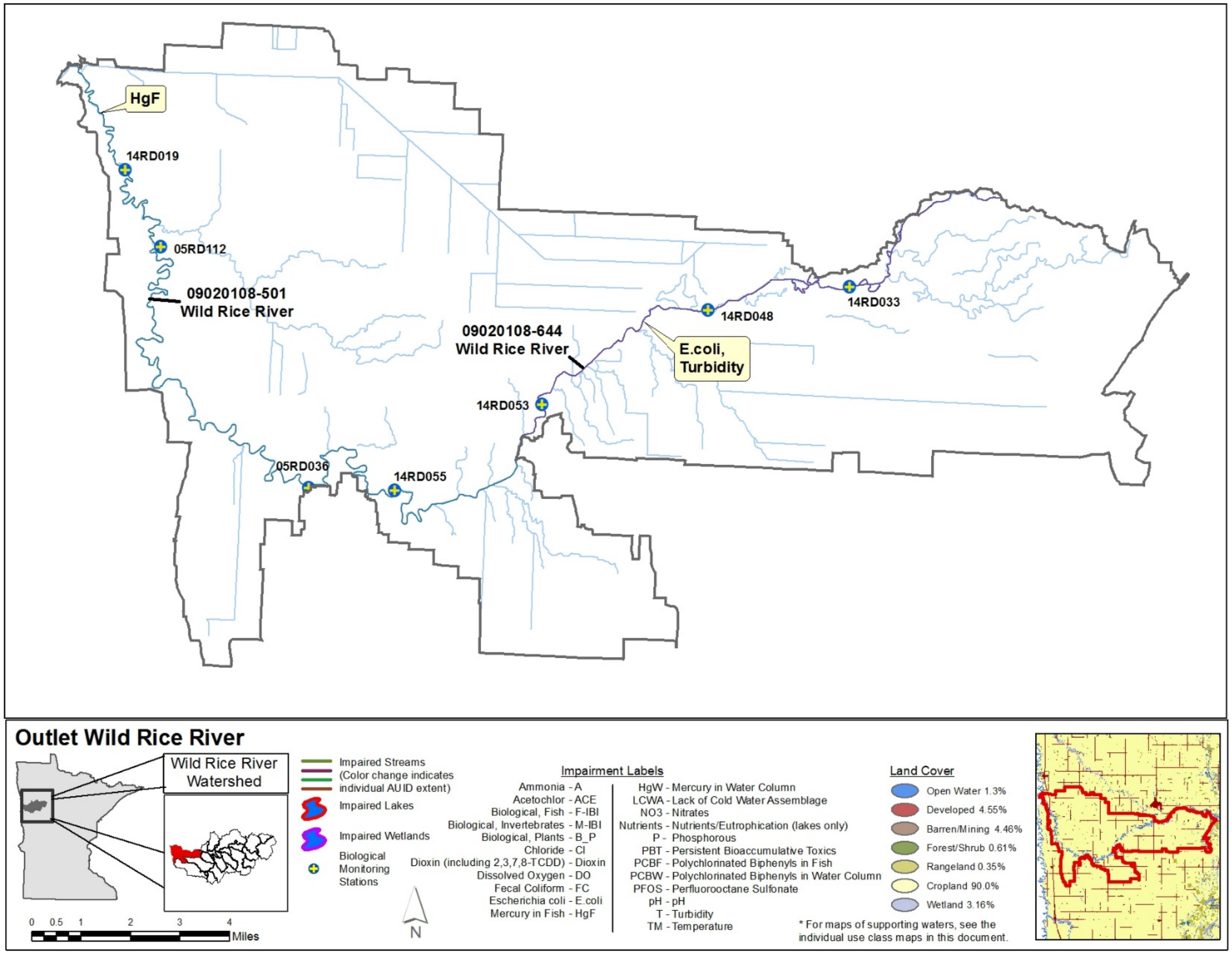


Figure 45. Currently listed impaired waters by parameter and land use characteristics in the Outlet Wild Rice River Aggregated 12-HUC.

Watershed-wide results and discussion

Assessment results and data summaries are included below for the entire 8-HUC watershed unit of the Wild Rice River, grouped by sample type. Summaries are provided for lakes, streams, and rivers in the watershed for the following: aquatic life and recreation uses, aquatic consumption results, load monitoring data results, transparency trends, and remote sensed lake transparency. Additionally, groundwater and wetland monitoring results are included where applicable.

Following the results are a series of graphics that provide an overall summary of assessment results by designated use, impaired waters, and fully supporting waters within the entire Wild Rice River Watershed.

Stream water quality

Forty-three of the 169 uniquely identified stream/river reaches in the Wild Rice River Watershed were assessed in 2016 (Table 28). Of the assessed streams, only 22 streams are determined to fully support aquatic life, while 10 streams fully support aquatic recreation. There were 11 stream reaches that met one intended use, but failed to meet the other; most often in these instances, stream reaches fully support aquatic life use but do not support aquatic recreation due to excessive bacteria.

Watershed-wide,13 stream reaches do not support aquatic life based on biological or chemistry impairments (chemistry impairments are limited to TSS or turbidity), and 15 reaches do not support aquatic recreation based on current *E. coli* bacteria data.

Impairments to recreational stream use from excessive bacteria were commonplace during the 2016 assessment process; many of them were on the main stem sections of the Wild Rice River branches. The headwaters and outlet of the watershed were supporting recreational use; however, large portions of the middle and lower reaches of the watershed have too much bacteria and pose an increased risk for illness.

Chemistry related impairments to aquatic life were less prevalent, but elevated nutrients and suspended sediment concentrations are (as expected) prevalent and may act as potential stressors to the aquatic communities that were identified as impaired.

There are no stream reaches in this watershed that are classified as limited resource waters.

Table 28. Assessment summary for stream water quality in the Wild Rice River Watershed.

				Supporting		Non-supporting			
Watershed	**Area (acres)**	**# Total AUIDs**	**# Assessed AUIDs**	**# Aquatic Life**	**# Aquatic Recreation**	**# Aquatic Life**	**# Aquatic Recreation**	**Insufficient Data**	**# Delistings**
09020108	**1,047,069**	**169**	**43**	**22**	**10**	**12**	**15**	**11**	**0**
0902010801-01	*85,391*	26	3	2	1	1	- -	- -	- -
0902010801-02	*26,132*	4	1	- -	1	- -	- -	1	- -
0902010802-01	*66,855*	16	2	2	2	- -	- -	- -	- -
0902010803-01	*39,627*	17	2	1	- -	- -	1	1	- -
0902010804-01	*87,734*	5	2	- -	- -	1	2	1	- -

				Supporting		Non-supporting			
Watershed	**Area (acres)**	**# Total AUIDs**	**# Assessed AUIDs**	**# Aquatic Life**	**# Aquatic Recreation**	**# Aquatic Life**	**# Aquatic Recreation**	**Insufficient Data**	**# Delistings**
0902010804-02	*31,436*	10	1	- -	1	- -	- -	1	- -
0902010805-01	*44,127*	2	2	1	- -	1	1	- -	- -
0902010806-01	*51,741*	9	3	2	1	1	1	- -	- -
0902010807-01	*106,437*	*8*	4	4	1	--	1	- -	--
0902010808-01	*47,396*	*10*	3	1	- -	2	1	- -	- -
0902010809-01	*37,140*	*8*	1	- -	- -	1	1	- -	- -
0902010809-02	*31,051*	*6*	3	3	- -	- -	2	- -	- -
0902010809-03	*38,799*	*3*	3	2	1	- -	1	2	- -
0902010810-01	*73,382*	*8*	3	1	- -	1	2	1	- -
0902010810-02	*65,492*	*7*	3	- -	- -	1	- -	2	- -
0902010810-03	*26,362*	*4*	1	1	- -	- -	- -	1	- -
0902010811-01	*93,440*	*5*	4	2	1	1	1	1	- -
0902010812-01	*94,720*	*2*	2	- -	1	2	1	- -	- -

Lake water quality

The Wild Rice River Watershed has roughly 440 waterbodies greater than 10-acres in size that are classified as a lake/pond by the DNR protected waters inventory (PWI). More than 80% of those waterbodies in the PWI are found in the eastern part of the watershed (i.e., east of an imaginary line drawn between the cities of Bejou to Ogema) and many are very small. This watershed contains three distinct ecoregions, each with its own set of water quality standards for lakes (e.g., NCHF, NLF and Red River Valley ecoregions). Twenty-six lakes in this watershed were assessed for aquatic life and/or aquatic recreation. In general, where data exists, the lake water quality was good, both for aquatic recreation (exposure to algae) and aquatic life (healthy fish community) (Table 29).

Aquatic life use assessments

Sixteen lakes were sampled for aquatic life, using newly implemented fish IBI surveys conducted by the DNR (the assessments were supplemented by plant IBI and chloride data if they were available). Of those 16 lakes, 10 were assessed and found to fully support aquatic life. The other 6 lakes did not have assessment decisions due to sampling issues; either winter kill lakes or in difficulty getting a good fish sample. No lakes in the watershed were assessed as impaired for aquatic life.

Aquatic recreational use assessments

Thirteen lakes were assessed for aquatic recreation using ecoregion specific standards for total phosphorus, chlorophyll-a and Secchi transparency data. These standards are designed to minimize the number of days that lake users are exposed to nuisance algal blooms and to promote rooted aquatic vegetation. Of those 13 lakes, 11 fully support recreation in their respective ecoregions; only 2 lakes were determined to not support recreation.

Rockstad Lake will be newly listed for excessive nutrients based on the 2016 assessment; all three eutrophication parameters exceed the NLF ecoregion standards. Tulaby Lake was previously listed for excessive nutrients in 2010 and will remain listed. Newer data for Tulaby confirm that the seasonal mean for total phosphorus still exceeds the standard and mean chl-a concentrations are nearly double the standard.

Table 29. Assessment summary for lake water chemistry in the Wild Rice River Watershed.

			Supporting		Non-supporting			
Watershed	**Area (acres)**	**Lakes >10 Acres**	**# Aquatic Life**	**# Aquatic Recreation**	**# Aquatic Life**	**# Aquatic Recreation**	**Insufficient Data**	**# Delistings**
09020108	**1,047,096**	**26**	**10**	**11**	**0**	**2**	**16**	**0**
0902010801-01	*85,391*	6	- -	3	- -	1	5	- -
0902010802-01	*66,855*	3	2	- -	- -	- -	3	- -
0902010803-01	*39,627*	4	4	3	- -	- -	- -	- -
0902010804-01	*87,734*	3	2	2	- -	- -	1	- -
0902010804-02	*31,436*	3	2	2	- -	1	- -	- -
0902010809-03	*38,799*	2	- -	- -	- -	- -	2	- -

			Supporting		Non-supporting			
Watershed	Area (acres)	Lakes >10 Acres	# Aquatic Life	# Aquatic Recreation	# Aquatic Life	# Aquatic Recreation	Insufficient Data	# Delistings
0902010810-01	*73,382*	1	- -	- -	- -	- -	1	- -
0902010810-02	*65,492*	2	- -	- -	- -	- -	2	- -
0902010810-03	*26,362*	2	- -	1	- -	- -	2	- -

Fish contaminant results

Mercury was analyzed in fish tissue samples collected from the Wild Rice River and eight lakes in the watershed. Polychlorinated biphenyls (PCBs) were measured in fish from the river and Minerva Lake. Fifteen fish species were tested for contaminants. A total of 357 fish were collected for contaminant analysis between 2007 and 2014.

Contaminant concentrations are summarized by waterway, fish species, and year (Table 30). "Total Fish" indicates the total number of fish analyzed and "N" indicates the number of samples. The number of fish exceeds the number of samples when fish are combined into a composite sample. This was typically done for panfish, such as bluegill sunfish and yellow perch. "Anatomy" refers to the type of sample; since 1989, most of the samples have been skin-on fillets (FILSK) or for fish without scales (catfish and bullheads), skin-off fillets (FILET).

The Wild Rice River Watershed was listed as impaired for mercury in fish tissue in MPCA's 2016 Draft Impaired Waters List. As indicated in Table 30, Minerva Lake and four other lakes are impaired for mercury in fish; however only Minerva is listed because the other four lakes are within the White Earth Reservation, giving them "Wholly Tribal Designation." They cannot be approved or disapproved for listing by the USEPA. The MPCA includes a separate tab in the Impaired Waters List spreadsheet for these tribal lakes. Minerva has been added to the Statewide Mercury TMDL. Two lakes—Roy and Tulaby—had mercury concentrations low enough to not constitute impairments.

None of the waters in this watershed are listed as impaired for PCBs in fish tissue. All of the PCB concentrations in fish tissue were below the reporting limit (0.01 - 0.035 mg/kg). The PCB samples for northern pike and walleye from Minerva Lake were composites of three and five fish; therefore, the concentrations represent an average of the fish within each sample. Fish consumption advice, developed by the MDH, has meal advice of "unrestricted" for PCBs in fish less than or equal to 0.05 mg/kg.

Overall, mercury concentrations in fish from the tested lakes within the watershed are very low, compared to other waters of the state. The Fish Contaminant Monitoring Program will continue to retest the fish from impaired waters to assess if mercury levels are changing.

Table 30. Summary of fish length, mercury, and PCBs, by waterway-species-year.

AUID/DOW	Waterway	Species	Year	Anat-omy[1]	Total Fish	No. Sam-ples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL
09020108-501**	WILD RICE R.	Channel catfish	2014	FILSK	5	5	17.9	14.9	20.7	0.230	0.159	0.325	5	0.035	0.035	Y
		Walleye	2014	FILSK	4	4	15.7	13.4	18.7	0.803	0.592	1.088	4	0.035	0.035	Y
		Silver redhorse	2014	FILSK	5	5	16.2	12.8	20.4	0.269	0.206	0.377	5	0.035	0.035	Y
15007900*	MINERVA	Brown bullhead	1995	FILET	8	1	11.3	11.3	11.3	0.017	0.017	0.017				
		Northern pike	1995	FILSK	13	3	21.7	17.7	25.8	0.101	0.072	0.130	1	0.01	0.01	Y
		Pumpkinseed sunfish	1995	FILSK	10	1	5.9	5.9	5.9	0.025	0.025	0.025				
		Walleye	1995	FILSK	17	5	19.9	12	28.6	0.261	0.059	0.620	1	0.01	0.01	Y
44000100	ROY	Bluegill sunfish	2012	FILSK	5	1	5.9	5.9	5.9	0.049	0.049	0.049				
		Largemouth bass	2012	FILSK	5	5	13.3	12.5	14.5	0.148	0.123	0.174				
		Northern pike	2012	FILSK	4	4	19.7	18.2	21	0.127	0.112	0.143				
		Walleye	2012	FILSK	5	5	17	13.8	22.9	0.124	0.100	0.171				
		White sucker	2012	FILSK	5	1	19.5	19.5	19.5	0.046	0.046	0.046				
44000300	TULABY	Walleye	2011	FILSK	7	7	13.8	13.5	14.3	0.070	0.058	0.078				
		White sucker	2011	FILSK	3	1	12.1	12.1	12.1	0.010	0.010	0.010				
		Yellow perch	2011	FILSK	10	2	8.25	7.7	8.8	0.026	0.019	0.032				
44000600***	BIG BASS	Bluegill sunfish	2013	FILSK	5	1	7.5	7.5	7.5	0.050	0.050	0.050				
		Black crappie	2013	FILSK	5	1	10.1	10.1	10.1	0.088	0.088	0.088				
		Largemouth bass	2013	FILSK	4	4	12.5	11.0	15.8	0.214	0.123	0.399				
		Northern pike	2013	FILSK	7	7	18.0	15.2	20.2	0.270	0.227	0.353				
		Smallmouth bass	2013	FILSK	2	2	12.4	12.1	12.6	0.231	0.209	0.252				
		Walleye	2013	FILSK	6	6	16.2	14.6	18.2	0.226	0.185	0.320				
		Yellow bullhead	2013	FILET	5	1	10.0	10.0	10.0	0.120	0.120	0.120				
44001400***	SOUTH TWIN	Bluegill sunfish	2007	FILSK	10	1	6.7	6.7	6.7	0.053	0.053	0.053				
			2008	FILSK	12	2	6.5	6.4	6.6	0.032	0.031	0.033				
		Black crappie	2007	FILSK	4	1	10.0	10.0	10.0	0.159	0.159	0.159				
		Cisco (Lake herring)	2007	FILSK	7	1	13.8	13.8	13.8	0.095	0.095	0.095				

AUID/DOW	Waterway	Species	Year	Anatomy[1]	Total Fish	No. Samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL
			2008	FILSK	6	1	15.0	15.0	15.0	0.051	0.051	0.051				
		Largemouth bass	2007	FILSK	6	6	14.2	11.3	16.9	0.334	0.175	0.553				
			2008	FILSK	6	6	9.6	8.7	11.5	0.143	0.121	0.189				
		Northern pike	2007	FILSK	6	6	19.3	15.6	23.8	0.225	0.123	0.351				
			2008	FILSK	30	30	18.4	11.5	21.8	0.158	0.055	0.338				
			2014	FILSK	15	15	19.1	15.7	24.1	0.206	0.143	0.282				
		Rock bass	2008	FILSK	2	1	9.3	9.3	9.3	0.201	0.201	0.201				
			2014	FILSK	3	1	7.8	7.8	7.8	0.100	0.100	0.100				
		Pumpkinseed sunfish	2008	FILSK	6	1	6.7	6.7	6.7	0.043	0.043	0.043				
		Walleye	2007	FILSK	6	6	18.6	14.7	22.6	0.311	0.202	0.449				
			2008	FILSK	8	8	15.8	14.0	18.7	0.187	0.136	0.254				
		Yellow perch	2008	FILSK	3	1	4.8	4.8	4.8	0.049	0.049	0.049				
44002300***	NORTH TWIN	Bluegill sunfish	2009	FILSK	10	2	7.1	6.7	7.5	0.051	0.048	0.053				
		Largemouth bass	2009	FILSK	3	3	17.0	16.3	17.9	0.238	0.184	0.273				
		Northern pike	2009	FILSK	7	7	24.5	20.9	28.0	0.231	0.122	0.350				
		Walleye	2009	FILSK	6	6	18.8	15.2	22.1	0.116	0.073	0.194				
44003800***	ISLAND	Bluegill sunfish	2010	FILSK	10	2	7.4	6.7	8.0	0.053	0.049	0.056				
		Brown bullhead	2010	FILET	4	1	14.8	14.8	14.8	0.013	0.013	0.013				
		Northern pike	2010	FILSK	8	8	22.9	19.7	25.1	0.236	0.109	0.308				
		Walleye	2010	FILSK	8	8	22.5	16.4	27.5	0.357	0.218	0.622				
44004500***	SNIDER	Bluegill sunfish	2009	FILSK	10	2	7.1	6.5	7.6	0.078	0.073	0.083				
		Cisco (Lake herring)	2009	FILSK	4	1	14.2	14.2	14.2	0.165	0.165	0.165				
		Largemouth bass	2009	FILSK	7	7	14.7	13.8	17.5	0.432	0.286	0.709				
		Northern pike	2009	FILSK	8	8	21.1	17.3	27.8	0.300	0.131	0.450				
		Walleye	2009	FILSK	7	7	20.4	18.4	24.7	0.302	0.173	0.354				

*** Impaired for mercury in fish tissue as of 2016 Draft Impaired Waters List; categorized as EPA Class 4a for waters covered by the Statewide Mercury TMDL.**

**** Impaired for mercury in fish tissue as of 2014 Draft Impaired Waters List; categorized as EPA Class 5 for waters needing a TMDL.**

***** Lakes within White Earth Reservation; "Wholly Tribal Designation" is a separate list in the Impaired Waters List spreadsheet submitted to EPA, because EPA does not approve or disapprove of tribal waters impairments**

1 Anatomy codes: FILSK – edible fillet, skin-on; FILET—edible fillet, skin-off; PLUG—dorsal muscle piece, without skin; WHORG—whole organism

Pollutant load monitoring

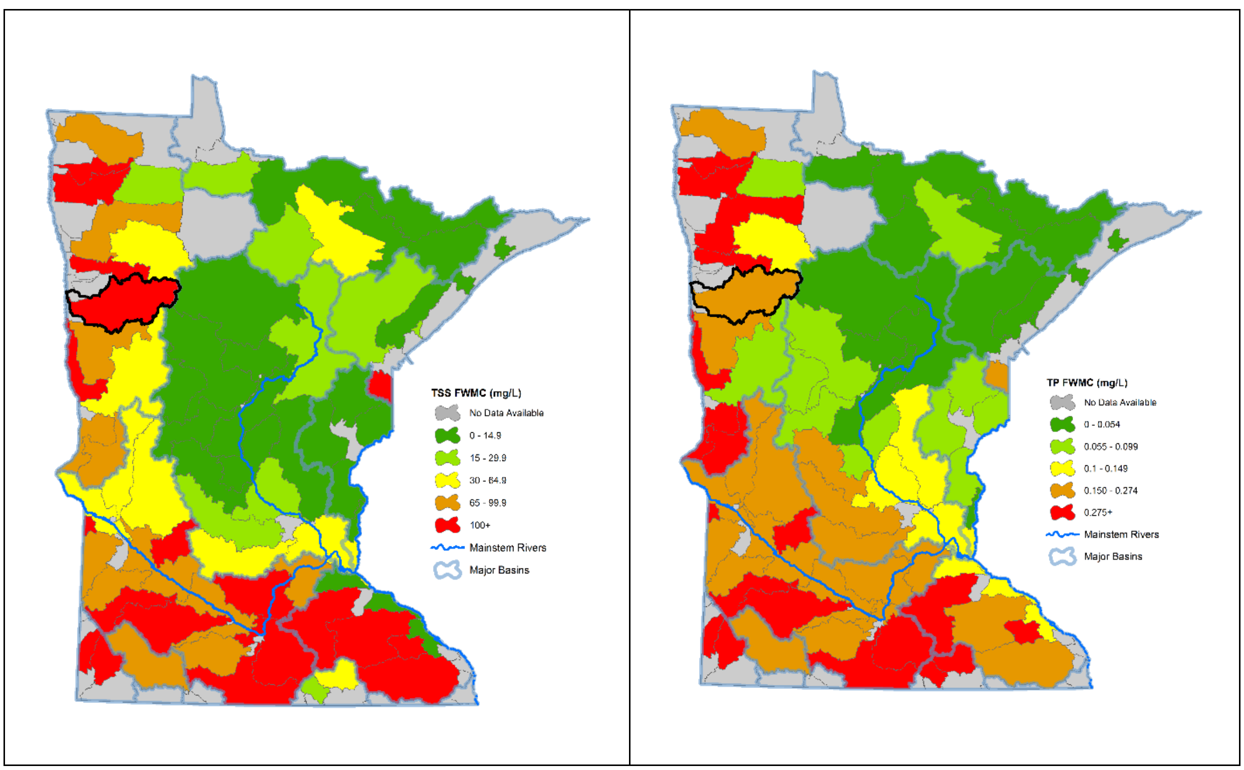
The WPLMN has four sites within the Wild Rice River Watershed as shown in Table 31.

Table 31. WPLMN Stream Monitoring Sites for the Wild Rice River Watershed

Site Type	Stream Name	USGS ID	DNR/MPCA ID	EQuIS ID
Major Watershed	Wild Rice River nr Hendrum, CSAH25	05064000	E60112001	S002-102
Subwatershed	Wild Rice River nr Mahnomen, CSAH25	NA	H60029001	S007-619
Subwatershed	Wild Rice River nr Twin Valley, CSAH29	05062001	E60088001	S001-155
Subwatershed	SB Wild Rice River nr Felton, CR27	05063398	E60124001	S003-309

Average annual FWMCs of TSS, TP, and NO_3+NO_2-N for major watershed stations statewide are presented below, with the Wild Rice River Watershed highlighted. Water runoff, a significant factor in pollutant loading, is also shown. Water runoff is the portion of annual precipitation that makes it to a river or stream; this can be expressed in inches.

As a general rule, elevated levels of TSS and NO_3+NO_2-N are regarded as “non-point” source derived pollutants originating from many small diffuse sources such as urban or agricultural runoff. Excess TP can be attributed to both non-point as well as point sources such as industrial or wastewater treatment plants. Major “non-point” sources of phosphorus include dissolved phosphorus from fertilizers and phosphorus adsorbed to and transported with sediment during runoff. Excessive TSS, TP, and NO_3+NO_2-N in surface waters impacts fish and other aquatic life, as well as fishing, swimming, and other recreational uses. Elevated levels of NO_3+NO_2-N is a concern for drinking water.



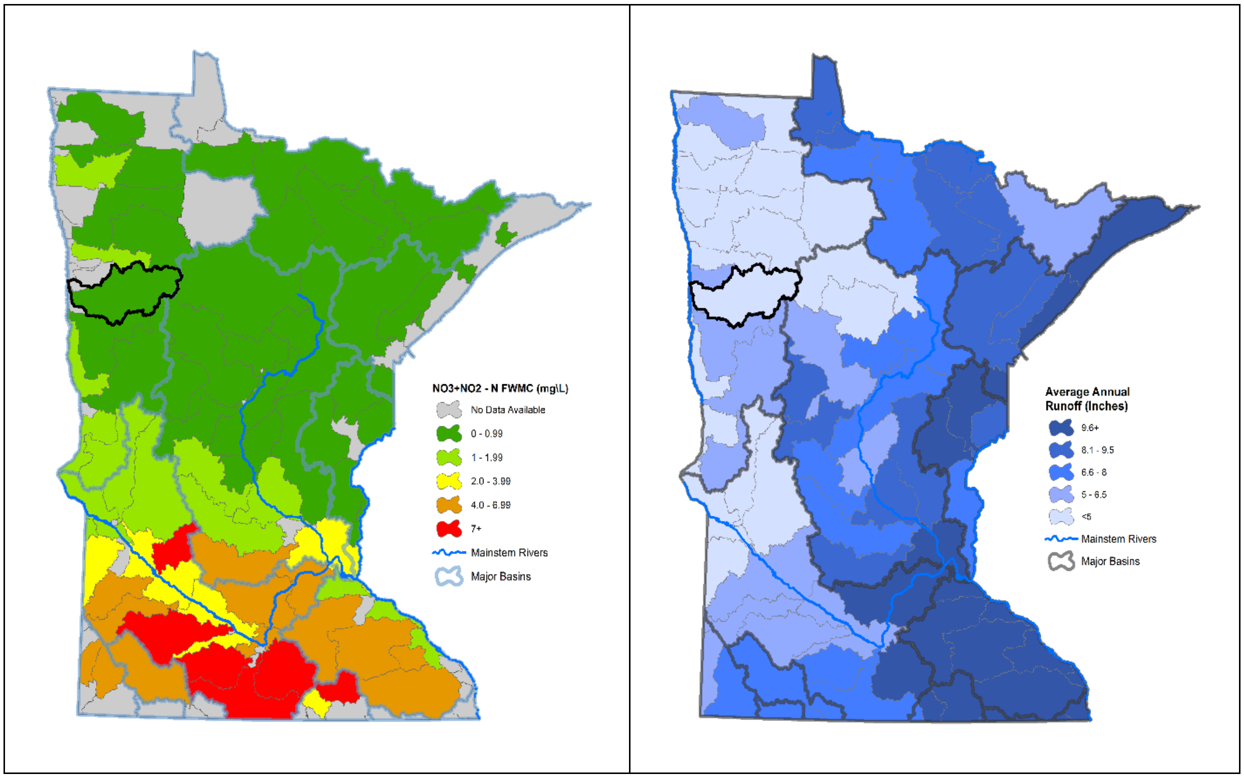


Figure 46. 2007-2012 Average annual TSS, TP, and NO3-NO2-N flow weighted mean concentrations, and runoff by major watershed.

When compared with other major watersheds throughout the state, Figure 46 shows the average annual TSS and TP FWMCs to be several times higher for the Wild Rice River Watershed than watersheds in north central and northeast Minnesota, but in line with the agriculturally rich watersheds found in the northwest and southern regions of the state. NO_3+NO_2-N FWMCs are more in line with the watersheds in north central and northeast Minnesota but are expected to trend upward as subsurface drainage practices increase.

More information, including results for subwatershed stations, can be found at the WPLMN website.

Substantial year-to-year variability in water quality occurs for most rivers and streams, including the Wild Rice River. Results for individual years are shown in the charts below.

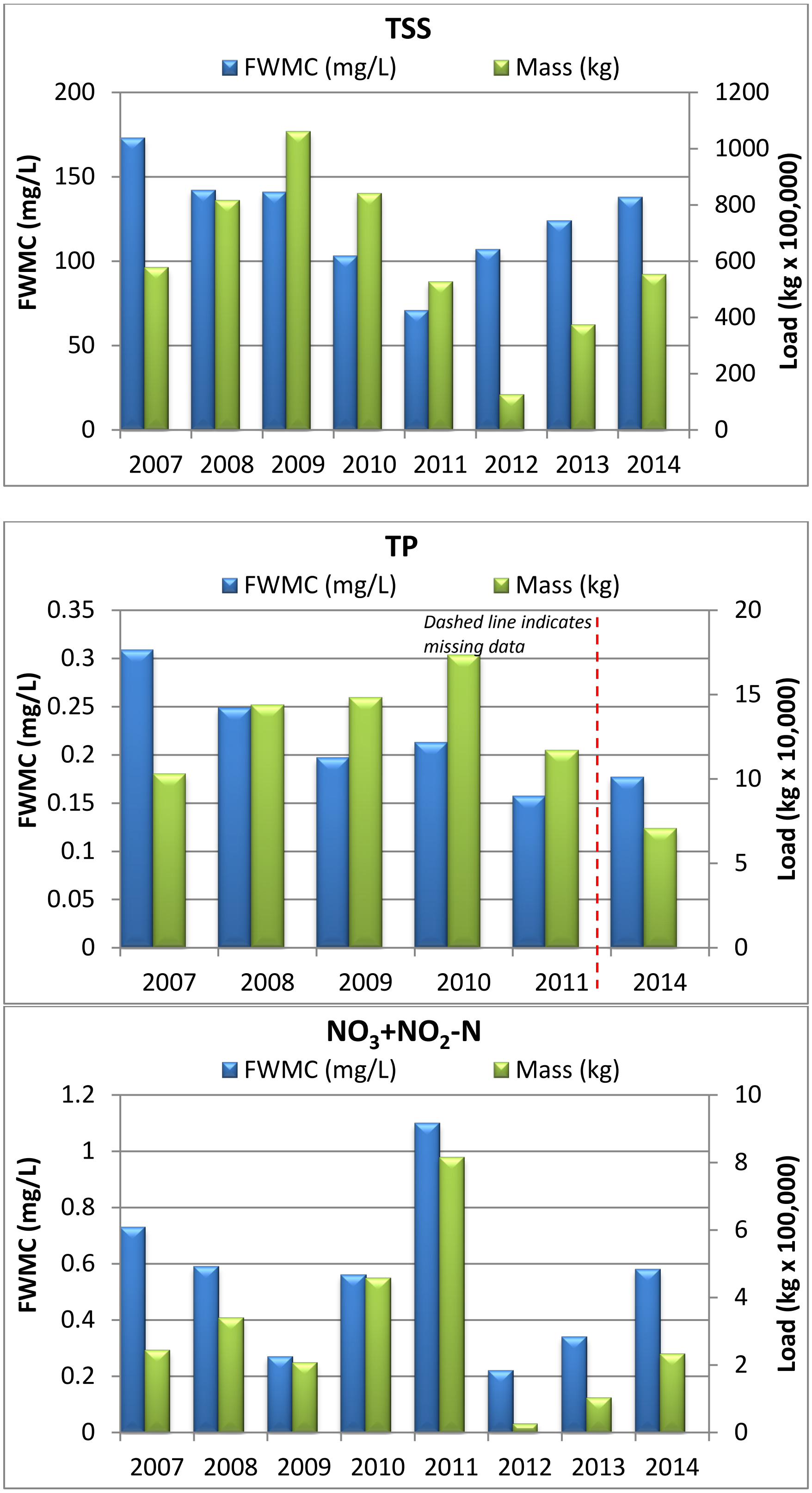


Figure 47. TSS, TP, and NO3+NO2-N flow weighted mean concentrations and loads for the Wild Rice River near Hendrum, Minnesota.

Stream flow

Stream flow data from the United States Geological Survey's real-time streamflow gaging stations for two rivers in the Wild Rice River Watershed were analyzed for annual mean discharge and summer monthly mean discharge (July and August). Figure 48 (*left*) is a display of the annual mean discharge for the Wild Rice River at Hendrum, Minneosta for water years 1995 to 2014. The data shows that although streamflow appears to be decreasing over the last 20 years, there is no statistically significant trend. Figure 48 (*right*) displays July and August mean flows for the same time frame, for the same water body. Graphically, the data appear to be decreasing in July ($p<0.1$) and remaining constant for August. Figure 49 is the annual (*left*) and monthly (*right*) mean streamflow for Wild Rice River at Twin Valley, Minnesota for 1994 to 2014, with the exception of 2002 due to lack of data. Annual and monthly streamflow for July and August all appear to be declining, but none at a significant rate. By way of comparison at a state level, summer month flows have declined at a statistically significant rate at a majority of streams selected randomly for a study of statewide trends (Streitz, 2011). For additional streamflow data throughout Minnesota, please visit the USGS website: http://waterdata.usgs.gov/mn/nwis/rt.

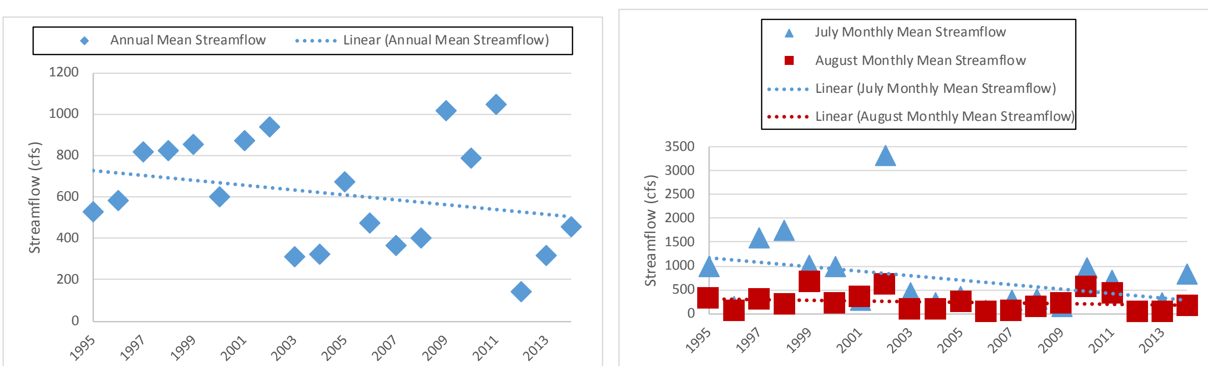


Figure 48. Annual mean (left) and monthly mean (right) streamflow for Wild Rice River at Hendrum, Minnesota (Source: USGS, 2016b)

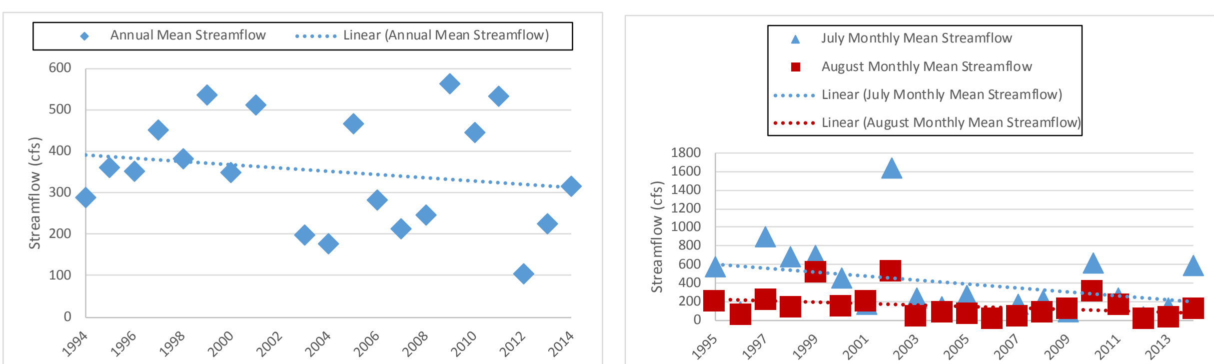


Figure 49. Annual mean (left) and monthly mean (right) streamflow for Wild Rice River at Twin Valley, Minnesota (Source: USGS, 2016c)

Wetland condition

Wetland vegetation quality is generally high in Minnesota (Table 32). This is driven by the large share of wetlands located in the Mixed Wood Shield (i.e., northern forest) Ecoregion where development and resulting stressors are much less widespread (and wetland condition is largely intact) compared to the rest of the state. Wetlands in exceptional or good biological condition have few (if any) changes in their expected native species composition or abundance distribution. Wetland vegetation quality is largely degraded in the remainder of the state, where non-native invasive plant species (most notably Reed canary grass and Narrow leaf or Hybrid cattail) have replaced native wetland plant communities over the majority of the remaining wetland extent (MPCA, 2015). High abundance of non-native invasive plant species is associated with a broad spectrum of wetland stressors and may also occur in the absence of stressors.

Table 32. Biological wetland condition statewide and by major ecoregions according to vegetation. Vegetation results are expressed by extent (i.e., percentage of wetland acres) and include virtually all wetland types (MPCA 2015).

Vegetation Condition in All Wetlands

Condition Category	**Statewide**	**Mixed Wood Shield**	**Mixed Wood Plains**	**Temperate Prairies**
Exceptional	49%	64%	6%	7%
Good	18%	20%	12%	11%
Fair	23%	16%	42%	40%
Poor	10%		40%	42%

The overall macroinvertebrate quality of natural depressional wetlands in the Mixed Wood Plains and Temperate Prairies Ecoregions (where depressional wetlands are more prevalent) is moderate (Table 32, Table 33). Approximately 41% - 46% of natural depressional wetland basins (man-made ponds were excluded from the results) are in good macroinvertebrate condition between the two ecoregions. Natural depressional wetlands have much higher rates of good macroinvertebrate condition compared to the rate of exceptional-good vegetation condition in this part of Minnesota.

Table 33. Macroinvertebrate results representing natural depressional wetlands (e.g., prairie potholes) that typically have open water and are expressed as the percentage of wetland basins (Genet 2015).

Macroinvertebrate Condition in Depressional Wetlands

Condition Category	**Mixed Wood Plains + Temperate Prairies**	**Mixed Wood Plains**	**Temperate Prairies**
Good	45%	46%	41%
Fair	33%	34%	30%
Poor	22%	20%	27%

Wetland quality in the Wild Rice River Watershed is expected to vary from east to west as it crosses over all three of Minnesota's major ecoregions (Figure 23, Table 32, and Table 33). The large majority of the wetlands located within the Mixed Wood Shield Ecoregion portion of the watershed, likely are in exceptional-good vegetation condition. Wetlands with degraded vegetation are probably limited to localized impacts in this area. Conversely, the large majority of wetlands in the Mixed Wood Plains portion of the watershed likely have fair poor (or degraded) vegetation condition. Natural depressional wetlands are numerous in this part of the watershed (as it coincides with a terminal moraine) and likely of moderate overall macroinvertebrate condition. Finally, the few remaining wetlands in the Temperate Prairies Ecoregion portion of the watershed are likely in degraded vegetation condition, with intact plant communities limited to specific locations (e.g., calcareous fens in the glacial lake beach ridges). Depressional wetlands in this part of the watershed decrease from east to west (as the moraine landform gives way to the glacial lake plain) and are expected to have moderate overall macroinvertebrate condition.

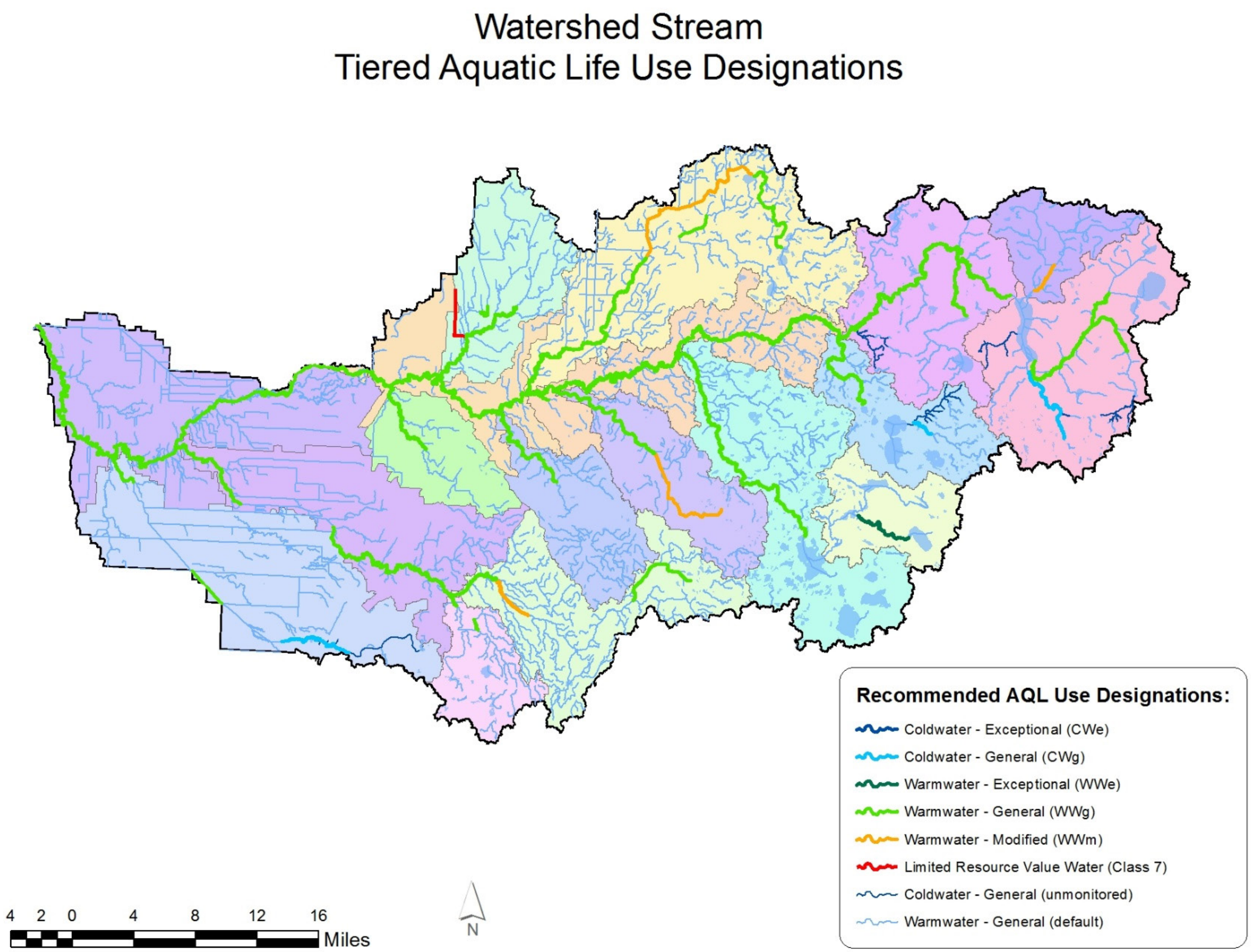


Figure 50. Stream tiered aquatic life use designations in the Wild Rice River Watershed.

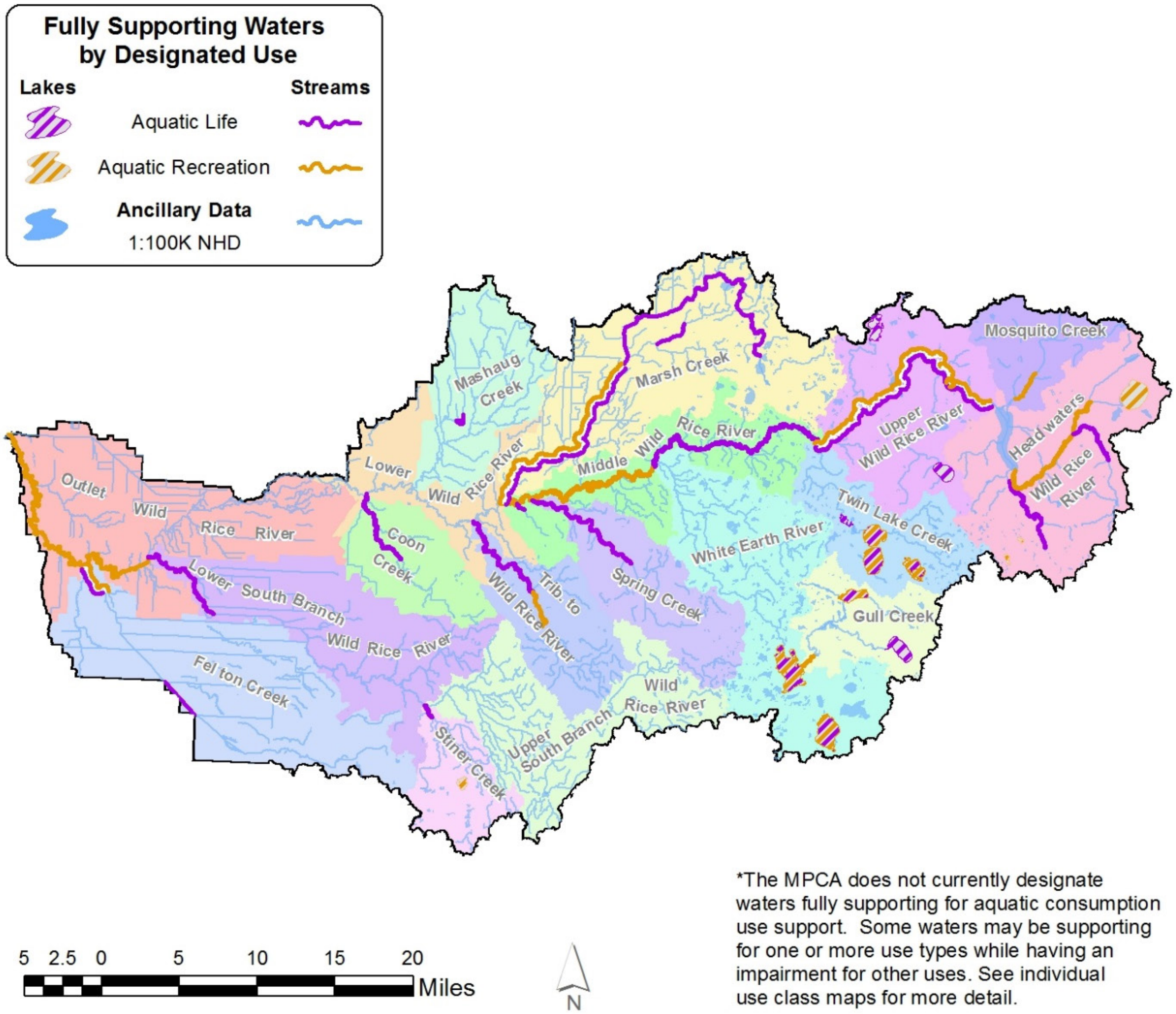


Figure 51. Fully supporting waters by designated use in the Wild Rice River Watershed.

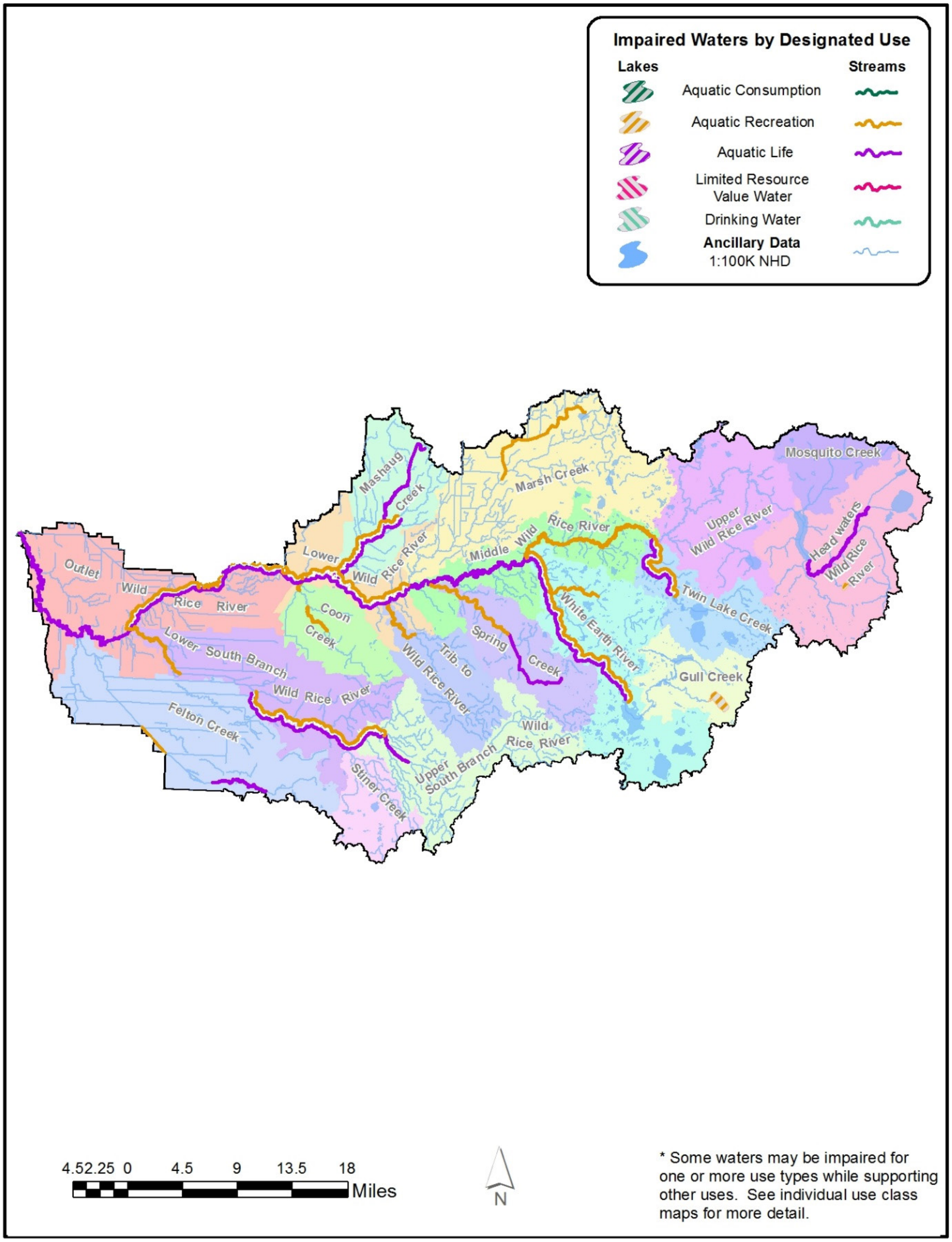


Figure 52. Impaired waters by designated use in the Wild Rice River Watershed.

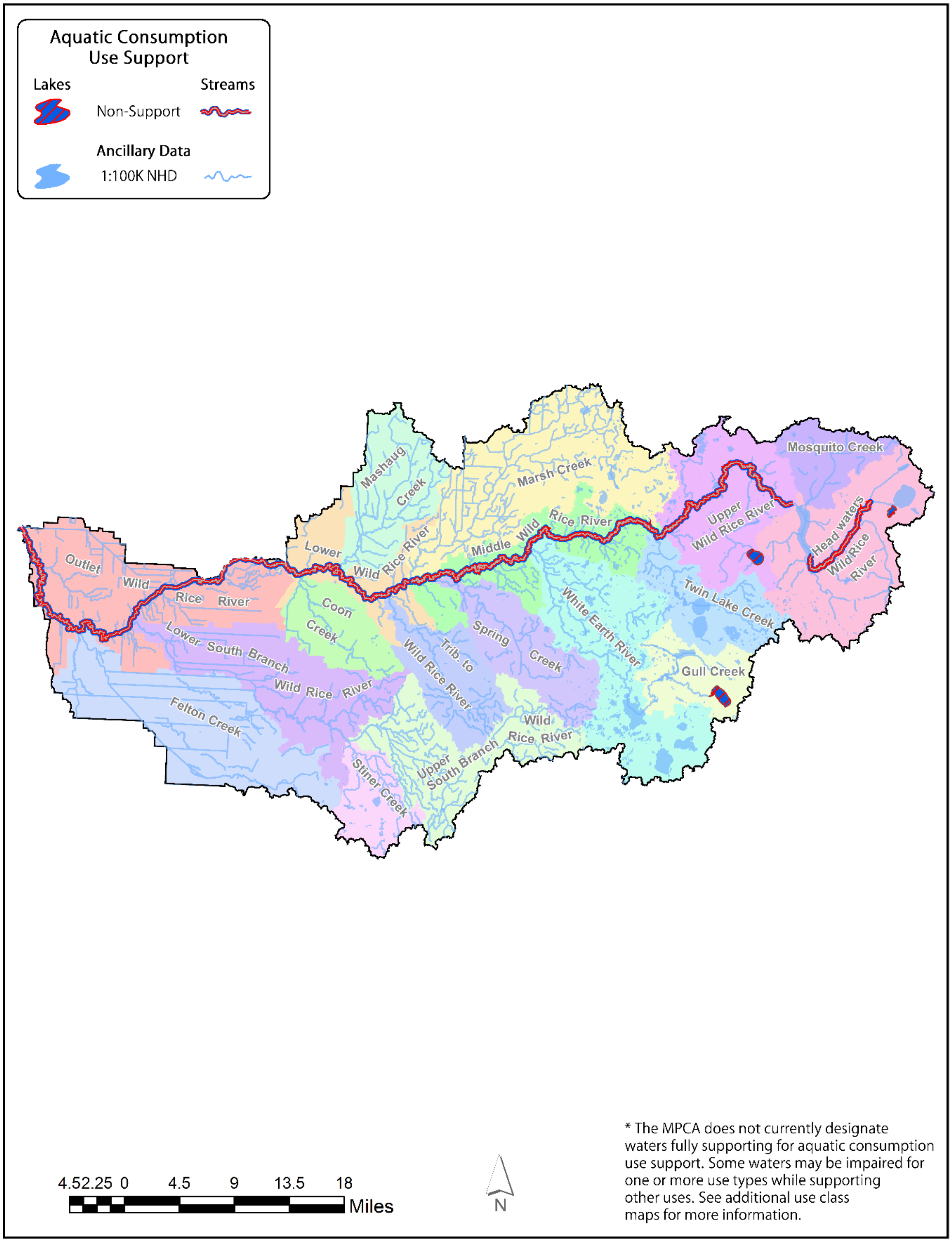


Figure 53. Aquatic consumption use support in the Wild Rice River Watershed.

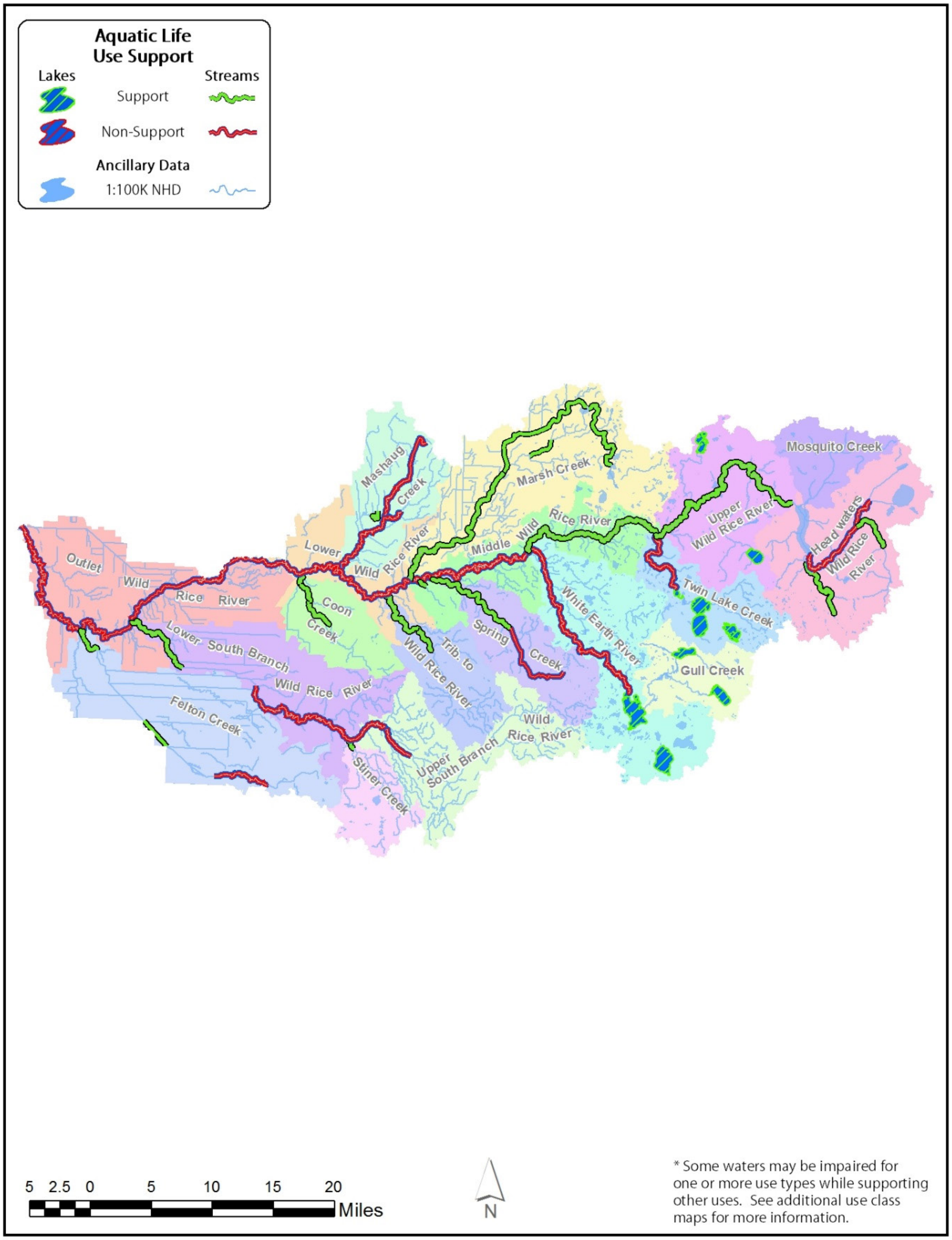


Figure 54. Aquatic life use support in the Wild Rice River Watershed.

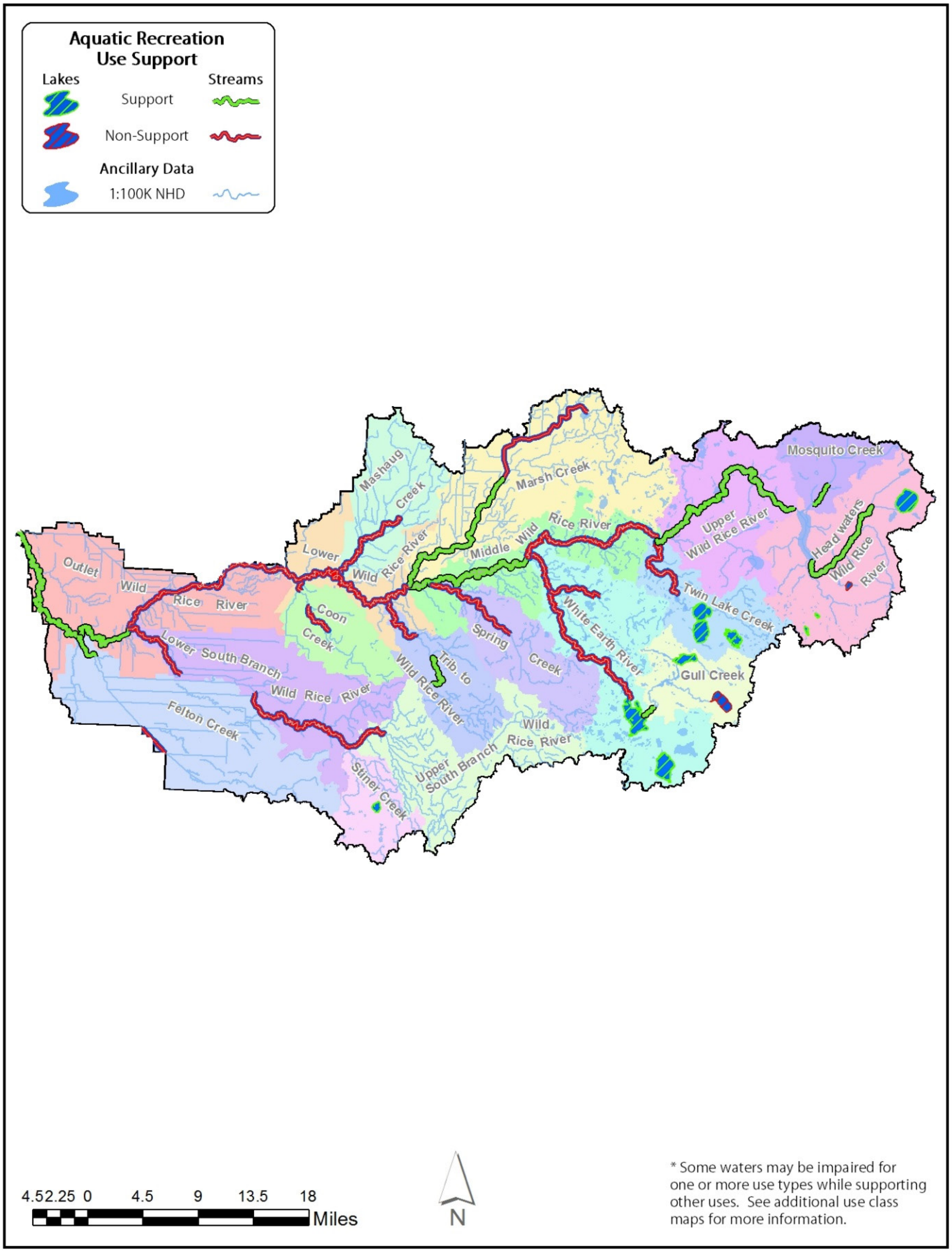


Figure 55. Aquatic recreation use support in the Wild Rice River Watershed.

Transparency trends for the Wild Rice River Watershed

MPCA completes annual trend analyses on lakes and streams across the state based on long-term transparency measurements. Data collection for this work relies heavily on lake and stream monitoring volunteers across the state, but also incorporates any agency/partner data submitted to EQuIS.

The trends are calculated using a Seasonal Kendall statistical test for waters with a minimum of eight years of transparency data; Secchi disk measurements are used in lakes and Secchi tube measurements are used in streams.

For the most recent monitoring year when data were finalized (2015), citizen volunteer monitoring occurred at six stream sites and seven lakes in the watershed. Two lakes (North Twin and White Earth Lakes) show a statistical increase/improvement in Secchi transparency; only one lake (Roy Lake) shows a statistical decrease/decline in transparency. The other four lakes monitored by volunteers also have sufficient transparency records for trend analysis, but all show no statistical increase or decrease in transparency (i.e., no trend was detected).

All six stream sites monitored by volunteers lack the required amount of data to perform a transparency trend analysis.

Table 34. Water clarity trends at citizen stream monitoring sites.

Wild Rice River HUC: 09020108	Citizen Stream Monitoring Program	Citizen Lake Monitoring Program
number of sites w/ increasing trend	0	2
number of sites w/ decreasing trend	0	1
number of sites w/ no trend	0	4

In June 2014, the MPCA published its final trend analysis of river monitoring data located statewide based on the historical Milestones Network. The network is a collection of 80 monitoring locations on rivers and streams across the state with good, long-term water quality data. The period of record is generally more than 30 years, through 2010, with monitoring at some sites going back to the 1950s. While the network of sites is not necessarily representative of Minnesota's rivers and streams as a whole, they do provide a valuable and widespread historical record for many of the state's waters. Starting in 2017, the MPCA will switch to the Watershed Pollutant Load Monitoring Network (WPLMN) for long term trend analysis on rivers and streams. The WPLMN has a much more robust sampling program that will cover over 100 sites across the state and incorporates many of the Milestone sites.

Remote sensing for lakes in the Wild Rice River Watershed

The University of Minnesota, in partnership with MPCA, conducts remote satellite sensing of lake transparency. The satellite data provide a snapshot of water transparency during late summer over a span of 30 years. Secchi disk transparency data is paired with satellite imagery to come up with estimates of water clarity across the state. While there are, limitations to the data, such as cloud cover, vegetation, or stained water altering the estimated Secchi transparency, it does provide information to help prioritize monitoring and protection efforts on lakes, which do not have water quality data, or are inaccessible for conventional monitoring practices.

Satellite estimation of lake transparencies are categorized (e.g. meeting; exceeding; or within +/- 10% of respective ecoregions standards) and are shown in Figure 56 below.

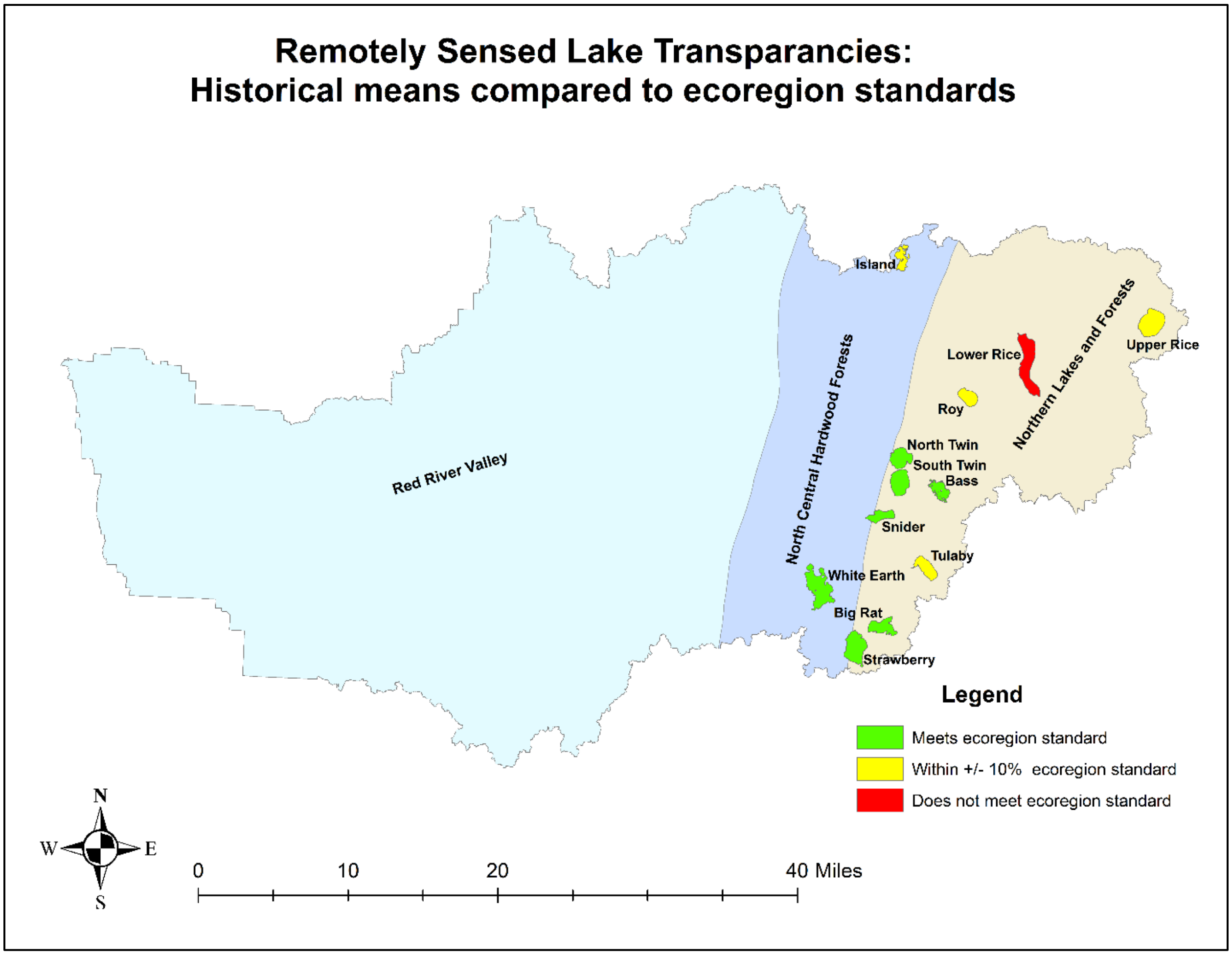


Figure 56. Remotely sensed secchi transparency on lakes in the Wild Rice River Watershed.

Summaries and recommendations

Rivers and streams flowing through several unique ecoregions, abundant lakes, vast prairies, and numerous shallow wetlands once covered the landscape of the Wild Rice River Watershed. These distinctive traits defined the watershed that formed from the remnants of historic Lake Agassiz. Many changes have occurred within the watershed within the last 150 years. Since early settlement, most of the watershed has been managed for agricultural production. The headwaters of the watershed contain soils that fall just out of the Red River Valley; they lack the rich soil content that was left by historic Lake Agassiz. This sub-optimal soil along with the abundance of lakes in the area inhibited the ability to farm the land. Although the headwaters lack optimal conditions for agricultural production, early settlers took advantage of the rich soils within the remaining portions of the watershed. As the land was claimed throughout the watershed, and farmsteads were built, it was realized that inadequate natural drainage was a major issue that impeded the growth of agriculture. Extensive drainage ditch networks were developed within the Wild Rice River Watershed, aiding in the drainage of many streams and wetlands, optimizing crop growth and aiding in flood relief. Today, approximately 61% of the steams within the watershed have been altered (Figure 9).

Although drainage networks can boost crop yields, the practice can have a negative impact on aquatic life. Drainage can alter flow regimes that impact aquatic life, often creating stream conditions that are unable to support larger riverine fish species, and sensitive fishes and macroinvertebrates. Water control structures and drainage ditch networks within the Wild Rice River Watershed have also altered hydrologic connectivity, creating fish barriers that obstruct migratory fishes from the Red River of the North. Larger riverine fish species such as Redhorses, cannot pass even small control structures and dams. Stream connectivity is crucial to riverine fishes; the shallow tributaries located high up in the watershed are often utilized for spawning. If this connection is broken, spawning success is greatly diminished. Drainage ditch networks are meant to drain the land as quickly as possible which can lead to a lack of water in the stream during drought periods. The lack of base flow on streams within agriculturally drained watersheds is a major source of stress on fish and macroinvertebrate communities. During periods of little to no stream flow, crucial habitat may not be submerged, DO is subject to extreme fluctuations, and water temperatures increase dramatically.

Throughout the watershed, stream habitat is highly variable. In general, the headwaters of the watershed have remained natural and provide excellent habitat for aquatic life. In contrast, the altered portions of the watershed, and most of the lower portions of the Wild Rice River, provide relatively poor stream habitat. High turbidity and TSS values increase dramatically in the western portion of the watershed, and the resulting excess sediment load, fills interstitial space in riffles and coarse substrate that is utilized by sensitive lithophilic spawning fish and macroinvertebrates. Remaining clay and fine sediments left over by Lake Agassiz are easily erodible, and with the addition of the drainage ditch networks, the additional flow cuts into the stream banks, carrying more sediment load. In the Wild Rice River Watershed, 13 stream reaches do not support aquatic life based on biological or chemistry impairments. TSS and turbidity are the leading driver for 12 of the 13 impairments.

In addition to the aquatic life impairments, 15 reaches will be newly listed for *E. coli* bacteria, including main stem sections of the Wild Rice River. The headwater areas of the subwatershed occasionally exceed the standards, but overall the new listings are concentrated in the central and lower portions of the watershed.

Although multiple impairments have been identified throughout the watershed, the Wild Rice River and its tributaries support extensive fish and macroinvertebrate populations. Throughout the watershed, 62 unique fish species (Appendix 4.1) were captured at51 biological stations during a total of 83 visits (Appendix 3.2) and over 300 unique macroinvertebrate taxa (Appendix 4.2) were captured at

54 biological stations during a total of 71 visits (Appendix 3.3). No endangered or species of special concern were identified during IWM sampling. Some actions that can be done to protect and promote a higher species diversity within the Wild Rice River Watershed include:

- Restoring historic flow patterns that naturally attenuate peak flows and augment base flow
- Creating or strengthening buffers along the riparian zone of streams and ditches using native vegetation and trees.
- Utilizing practices that reduce flooding and increase drainage without compromising the hydrologic connectivity.

The headwaters of the Wild Rice Watershed have a population of lakes that support both a healthy fish community and recreation use. Protecting resources in these areas are key – keeping forested and wetland areas intact and working with shoreland owners to implement best management practices to keep near shore habitat intact. While two lakes are impaired, Rockstad and Tulaby. Rockstad, a shallow lake, will benefit from any actions to reduce nutrient inputs – shallow lakes are susceptible to internal loading, which continually mixes phosphorus in the water column. Tulaby has known populations of Northern Cisco, a coldwater species. Work to minimize nutrient inputs will be critical to preventing oxygen depletion in coldwater areas of the lake. Keeping shoreline vegetation intact and reducing watershed contributions of phosphorus will be important.

Additional protections should also be considered for groundwater, to aid in both the quantity and quality of the groundwater within the watershed. Groundwater quantity is based on the amount of water withdrawn versus the amount of water being recharged to the aquifer. Groundwater withdrawals in the watershed were relatively constant from 1994 to 2011, averaging approximately 176 million gallons withdrawn. However, that average was nearly doubled in 2012 and 2013 with over 300 million gallons of groundwater withdrawn. This correlates to a dramatic increase in agricultural irrigation, which averaged approximately 20 million gallons per year (1994-2011), but multiplied by five in 2012, and nine times in 2013. On average over the last 20 years (1994-2013), the primary source of groundwater withdrawal had been for water supply (municipal/public), but that changed due to the sudden increase in withdrawal for agricultural irrigation. Additionally, although there has not been a statistically significant change in water supply demand, permits for non-crop irrigation began reporting withdrawals in 2006, which may be related to increased development in some areas of the watershed, where farms, timberland, and lakeshore are being converted to recreation, lake, or country homes (USDA NRCS, 2007).

There is limited amount of groundwater quality data available specifically for the Wild Rice River Watershed at this time. Baseline water quality data indicated that the northwest region has higher concentrations of chemicals in the sand and gravel aquifers; however, this is primarily associated with Cretaceous bedrock, which is not present within the Wild Rice River Watershed. There were relatively high numbers of exceedances of the arsenic MCL for drinking water in private wells for this area. Arsenic is primarily naturally occurring and can be linked to presence of a clay layer and low DO levels, often associated with the Des Moines glacial lobe till, which is abundant in this region. Although the majority of the watershed is not sensitive to groundwater contamination, there are some areas with moderate to high pollution sensitivity. While it may appear that this watershed is at risk for groundwater contamination, it is important to continue to monitor potentially sensitive sites in order to identify possible water pollution.

Additional and continued monitoring will increase our understanding of the health of the watershed, its groundwater resources, and aid in identifying the extent of the issues present and risk associated. Increased localized monitoring efforts will help accurately define the risks and extent of any issues within the watershed. Adoption of best management practices will benefit both surface and groundwater.

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Appendix 1 – Water chemistry definitions

Dissolved oxygen (DO) - Oxygen dissolved in water required by aquatic life for metabolism. Dissolved oxygen enters into water from the atmosphere by diffusion and from algae and aquatic plants when they photosynthesize. Dissolved oxygen is removed from the water when organisms metabolize or breathe. Low DO often occurs when organic matter or nutrient inputs are high, and light inputs are low.

Escherichia coli **(*E. coli*)** - A type of fecal coliform bacteria that comes from human and animal waste. *E. coli* levels aid in the determination of whether or not fresh water is safe for recreation. Disease-causing bacteria, viruses and protozoans may be present in water that has elevated levels of *E. coli*.

Nitrate plus nitrite – Nitrogen - Nitrate and nitrite-nitrogen are inorganic forms of nitrogen present within the environment that are formed through the oxidation of ammonia-nitrogen by nitrifying bacteria (nitrification). Ammonia-nitrogen is found in fertilizers, septic systems and animal waste. Once converted from ammonia-nitrogen to nitrate and nitrite-nitrogen, these species can stimulate excessive levels of algae in streams. Because nitrate and nitrite-nitrogen are water soluble, transport to surface waters is enhanced through agricultural drainage. The ability of nitrite-nitrogen to be readily converted to nitrate-nitrogen is the basis for the combined laboratory analysis of nitrate plus nitrite-nitrogen (nitrate-N), with nitrite-nitrogen typically making up a small proportion of the combined total concentration. These and other forms of nitrogen exist naturally in aquatic environments; however, concentrations can vary drastically depending on season, biological activity, and anthropogenic inputs.

pH - A measure of the level of acidity in water. Rainfall is naturally acidic, but fossil fuel combustion has made rain more acid. The acidity of rainfall is often reduced by other elements in the soil. As such, water running into streams is often neutralized to a level acceptable for most aquatic life. Only when neutralizing elements in soils are depleted, or if rain enters streams directly, does stream acidity increase.

Total phosphorus (TP) - Nitrogen (N), phosphorus (P) and potassium (K) are essential macronutrients and are required for growth by all animals and plants. Increasing the amount of phosphorus entering the system therefore increases the growth of aquatic plants and other organisms. Excessive levels of Phosphorous over stimulate aquatic growth and resulting in the progressive deterioration of water quality from overstimulation of nutrients, called eutrophication. Elevated levels of phosphorus can result in: increased algae growth, reduced water clarity, reduced oxygen in the water, fish kills, altered fisheries and toxins from cyanobacteria (blue green algae) which can affect human and animal health.

Total suspended solids (TSS) – TSS and turbidity are highly correlated. Turbidity is a measure of the lack of transparency or "cloudiness" of water due to the presence of suspended and colloidal materials such as clay, silt, finely divided organic and inorganic matter and plankton or other microscopic organisms. The greater the level of TSS, the murkier the water appears and the higher the measured turbidity.

Higher turbidity results in less light penetration, which may harm beneficial aquatic species and may favor undesirable algae species. An overabundance of algae can lead to increases in turbidity, further compounding the problem.

Unionized ammonia (NH3) - Ammonia is present in aquatic systems mainly as the dissociated ion $NH4^+$, which is rapidly taken up by phytoplankton and other aquatic plants for growth. Ammonia is an excretory product of aquatic animals. As it comes in contact with water, ammonia dissociates into $NH4^+$ ions and ^-OH ions (ammonium hydroxide). If pH levels increase, the ammonium hydroxide becomes toxic to both plants and animals.

Appendix 2.1 – Intensive watershed monitoring MPCA water chemistry stations in the Wild Rice River Watershed

EQuIS ID	Biological Station ID	AUID	Waterbody Name	Location	Aggregated 12-digit HUC
S005-131	95RD005	09020108-646	Wild Rice River	WILD RICE R AT CR-103, 1.25 MI NW OF ZERKEL	0902010801-01
S007-895	--	09020108-657	Mosquito Creek	MOSQUITO CK AT CSAH-35, 9 MI SW OF BAGLEY, MN.	0902010801-02
S005-130	14RD004	09020108-510	Wild Rice River	WILD RICE R ON TWP RD 62 (210TH ST), 4 MI E OF BEAULIEU	0902010802-01
S007-896	14RD003	09020108-512	Wild Rice River	WILD RICE R AT CSAH-7, 8 MI SE OF LENGBY, MN.	0902010802-01
S007-788	14RD005	09020108-509	Twin Lake Creek	TWIN LAKE CREEK AT MN-200, 4 MI E OF BEAULIEU, MN	0902010803-01
S003-162	14RD006	09020108-505	White Earth River	WHITE EARTH R AT CR-25, 2.3 MI SE OF MAHNOMEN	0902010804-01
S003-161	14RD007	09020108-648	Spring Creek	SPRING CK AT CSAH-40, 8 MI SW OF MAHNOMEN	0902010805-01
S006-197	14RD008	09020108-504	Wild Rice River	WILD RICE R AT CSAH-29, SW OF FAITH.	0902010806-01
S003-163	94RD518	09020108-506	Wild Rice River	WILD RICE R ON MN-200, 1.2 MI NE OF MAHNOMEN	0902010806-01
S007-789	14RD009	09020108-652	Marsh Creek	MARSH CREEK AT CSAH-29, 5 MI NE OF TWIN VALLEY, MN	0902010807-01
S007-793	14RD014	09020108-650	Mashaug Creek	MASHAUG CREEK AT CR-160, 2.5 MI N OF TWIN VALLEY, MN	0902010808-01
S001-155	05RD115	09020108-643	Wild Rice River	WILD RICE RIVER BRIDGE AT CSAH-29 AT TWIN VALLEY	0902010809-01
S003-157	14RD015	09020108-544	Coon Creek	COON CK AT CSAH-28, 4 MI W OF TWIN VALLEY	0902010809-02
S007-791	14RD011	09020108-546	Unnamed creek	UNNAMED CREEK AT CSAH-31, 4 MI SE OF TWIN VALLEY, MN	0902010809-03
S007-787	07RD010	09020108-659	Wild Rice River, South Branch	WILD RICE RIVER, SOUTH BRANCH, US OF CR-128, 5 MI NW OF BORUP	0902010810-01
S003-308	14RD012	09020108-662	Wild Rice River, South Branch	WILD RICE R S BR AT UNN GRAVEL RD, 1.25 MI ENE OF ULEN	0902010810-02
S003-121	14RD013	09020108-542	Stiner Creek	STINER CK AT CSAH-34 CROSSING, 0.6 MI E OF ULEN	0902010810-03
S003-158	07RD011	09020108-541	Unnamed creek	UNN DT (AKA FELTON DITCH) AT TOWNSHIP ROAD, 3.8 MI NE PERLEY	0902010811-01
S000-216	14RD019	09020108-501	Wild Rice River	WILD RICE R. USH-75 N OF HENDRUM	0902010812-01
S004-201	07RD009	09020108-644	Wild Rice River	WILD RICE R AT CSAH-24, 4.4 MI E OF ADA	0902010812-01

Appendix 2.2 – Intensive watershed monitoring biological monitoring stations in the Wild Rice River Watershed

AUID	Biological Station ID	Waterbody Name	Biological Station Location	County	Aggregated 12-digit HUC
09020108-501	05RD036	Wild Rice River	Directly downstream of CR 191, 4.5 miles NE of Perley	Norman	Outlet Wild Rice River
09020108-662	05RD069	Wild Rice River, South Branch	~ 3.5m N of Ulen , downstream of CR 111	Clay	Lower South Branch Wild Rice River
09020108-534	05RD100	Buckboard Creek	Downstream of Buckboard Creek Rd, 16 mi. S of Bagley.	Clearwater	Headwaters Wild Rice River
09020108-501	05RD112	Wild Rice River	0.5 mi E of Hendrum, upstream of County Route 25	Norman	Outlet Wild Rice River
09020108-650	05RD114	Mashaug Creek	Upstream of CR 166, 5 mi. NE of Twin Valley.	Norman	Mashaug Creek
09020108-643	05RD115	Wild Rice River	Upstream of CR 29, NE of Twin Valley	Norman	Lower Wild Rice River
09020108-598	07RD001	Trib. to Marsh Creek	Upstream of confluence at CR 134, 1.5 mi. SE of Bejou	Mahnomen	Marsh Creek
09020108-651	07RD002	Marsh Creek	Downstream of CR 134, 2.5 mi. NE of Bejou	Mahnomen	Marsh Creek
09020108-643	07RD009	Wild Rice River	Upstream of CR 24, 3 mi. E of Ada	Norman	Lower Wild Rice River
09020108-659	07RD010	Wild Rice River, South Branch	Upstream CR 128, 8 mi. E of Perley	Norman	Lower South Branch Wild Rice River
09020108-541	07RD011	County Ditch 45	Downstream of 170th St, 4 mi. E of Perley	Norman	Felton Creek
09020108-656	07RD027	County Ditch 42	Upstream of CR 166, 3 mi. SE of Gary	Norman	Mashaug Creek
09020108-661	07RD028	Wild Rice River, South Branch	Downstream of CR 157, 3.5 mi. E of Ulen	Becker	Upper South Branch Wild Rice River
09020108-504	10EM005	Wild Rice River	Downstream of 140th Ave, S of Mahnomen	Mahnomen	Middle Wild Rice River
09020108-654	10RD080	Felton Creek	At end of CR 108, 4 mi. SE of Felton	Clay	Felton Creek
09020108-545	14RD001	Unnamed creek	Downstream of CSAH 38 7 mi. SW of Twin Valley	Norman	Trib. to Wild Rice River
09020108-512	14RD003	Wild Rice River	Downstream of CSAH 7, 8 mi. SE of Lengby	Clearwater	Upper Wild Rice River
09020108-510	14RD004	Wild Rice River	Upstream of T-62, 13 mi. SW of Lengby	Mahnomen	Upper Wild Rice River
09020108-509	14RD005	Twin Lake Creek	Downstream of Hwy 200, 4 mi. E of Beaulieu	Mahnomen	Twin Lake Creek
09020108-505	14RD006	White Earth River	Upstream of 160th Ave, 1.5 mi. E of Mahnomen	Mahnomen	White Earth River
09020108-648	14RD007	Spring Creek	Downstream of CSAH 40, 6 mi. SW of Mahnomen	Norman	Spring Creek
09020108-504	14RD008	Wild Rice River	Downstream of CSAH 29, 6 mi. SW of Mahnomen	Norman	Middle Wild Rice River
09020108-652	14RD009	Marsh Creek	Downstream of CR 29, 2 mi. W of Faith	Norman	Marsh Creek
09020108-546	14RD011	Unnamed creek	Upstream of CR 31, 4 mi. SE of Twin Valley	Norman	Trib. to Wild Rice River

09020108-662	14RD012	Wild Rice River, South Branch	Downstream of 270th St N, 1 mi. E of Ulen	Clay	Upper South Branch Wild Rice River
09020108-542	14RD013	Stiner Creek	Downstream of CSAH 34, 0.6 mi. E of Ulen	Clay	Stiner Creek
09020108-650	14RD014	Mashaug Creek	Upstream of CR 160, 1 mi. NE of Heiberg	Norman	Mashaug Creek
09020108-544	14RD015	Coon Creek	Upstream of CR 28, 3 mi. W of Twin Valley	Norman	Coon Creek
09020108-506	14RD016	Wild Rice River	Upstream of CSAH 3, 8 mi. NE of Mahnomen	Mahnomen	Middle Wild Rice River
09020108-551	14RD017	Heir Creek	Upstream of CR 105, 16.5 mi. SE of Bagley	Clearwater	Headwaters Wild Rice River
09020108-501	14RD019	Wild Rice River	Upstream of Hwy 75, 1.5 mi. N of Hendrum	Norman	Outlet Wild Rice River
09020108-519	14RD020	Marsh Creek	Upstream of CASH 2, 6 mi. NE of Bejou	Mahnomen	Marsh Creek
09020108-505	14RD021	White Earth River	Downstream of 260th St, 4 mi. SE of Mahnomen	Mahnomen	White Earth River
09020108-647	14RD022	Spring Creek	Upstream of 140th Ave, 3 mi. NW of Wauben	Mahnomen	Spring Creek
09020108-540	14RD025	Spring Creek	Upstream of 360th St, 2.5 mi. W of Ogema	Becker	Upper South Branch Wild Rice River
09020108-591	14RD026	Mosquito Creek	Upstream of 290th St, 4 mi. S of Bagley	Clearwater	Mosquito Creek
09020108-510	14RD030	Wild Rice River	Upstream of CR 4, 3 mi. SW of Pine Bend	Mahnomen	Upper Wild Rice River
09020108-640	14RD031	Unnamed creek	Downstream of CR 173, 6.5 mi. East of Twin Valley	Norman	Middle Wild Rice River
09020108-644	14RD033	Wild Rice River	Upstream of Hwy 9, 2.5 mi S of Ada	Norman	Outlet Wild Rice River
09020108-650	14RD034	Mashaug Creek	Downstream of CSAH 34, 3 mi. E of Gary	Norman	Mashaug Creek
09020108-532	14RD035	Unnamed creek	Upstream of Tibbett's Rd, S of Nay Tah Waush	Mahnomen	Twin Lake Creek
09020108-579	14RD037	Garden Slough	Downstream of CSAH 19, 3 mi. E of Gary	Norman	Mashaug Creek
09020108-643	14RD041	Wild Rice River	Downstream of Hwy 32, in Twin Valley	Norman	Lower Wild Rice River
09020108-662	14RD042	Wild Rice River, South Branch	Upstream of 250th St N, 1.5 mi. NW of Ulen	Clay	Lower South Branch Wild Rice River
09020108-577	14RD044	Coon Creek	Upstream of 355th St, 3.5 mi. SW of Twin Valley	Norman	Coon Creek
09020108-654	14RD046	Felton Creek	Upstream of 150th St N, 3.5 mi. SE of Felton	Clay	Felton Creek
09020108-659	14RD047	Wild Rice River, South Branch	Downstream of CR 138, 3 mi. SW of Borup	Norman	Lower South Branch Wild Rice River
09020108-644	14RD048	Wild Rice River	Downstream of CSAH 20, 2 mi. SW of Ada	Norman	Outlet Wild Rice River
09020108-659	14RD049	Wild Rice River, South Branch	Downstream of CR 193, 4 mi. W of Borup	Norman	Lower South Branch Wild Rice River
09020108-553	14RD051	County Ditch 45	Upstream of 160th Ave N, 4 mi. W of Felton	Clay	Felton Creek
09020108-644	14RD053	Wild Rice River	Upstream of CSAH 33, 6 mi. NW of Borup	Norman	Outlet Wild Rice River

09020108-501	14RD055	Wild Rice River	Upstream of CSAH 10, 5.2 mi. NE of Perley	Norman	Outlet Wild Rice River
09020108-578	14RD080	Coon Creek	Upstream of 170th Ave, 3 mi. W of Twin Valley	Norman	Coon Creek
09020108-661	14RD081	Wild Rice River, South Branch	Upstream of CR 157, 3.5 mi. E of Ulen	Becker	Upper South Branch Wild Rice River
09020108-652	14RD082	Marsh Creek	Downstream off of CR 136 onto 210th St, 4 mi. NW of Mahnomen	Mahnomen	Marsh Creek
09020108-654	15RD012	Felton Creek	Downstream of private drive off of CR 108, 4 mi. SE of Felton	Clay	Felton Creek
09020108-654	15RD035	Felton Creek	Upstream of 150th St, 4 mi. SE of Felton	Clay	Felton Creek
09020108-532	15RD100	Unnamed creek	Downstream of Badboy Creek Rd, 1 mi. SW of Naytahwaush	Mahnomen	Twin Lake Creek
09020108-504	15RD207	Wild Rice River	Upstream of CSAH 25, 0.25 mi. E of Mahnomen	Mahnomen	Middle Wild Rice River
09020108-662	94RD012	Wild Rice River, South Branch	Downstream of CSAH 27, 6.5 mi. NW of Ulen	Clay	Lower South Branch Wild Rice River
09020108-506	94RD518	Wild Rice River	Downstream of CSAH 200, 1 mi. NE of Mahnomen	Mahnomen	Middle Wild Rice River
09020108-505	95RD004	White Earth River	Upstream of CR 113, 5 mi. E. of Waubun	Mahnomen	White Earth River
09020108-646	95RD005	Wild Rice River	Downstream of CR 103, 1.5 mi. NW of Zerkel	Clearwater	Headwaters Wild Rice River
09020108-504	95RD011	Wild Rice River	Downstream of 130th Ave, 1.5 mi. SW of Mahnomen	Mahnomen	Middle Wild Rice River
09020108-643	95RD014	Wild Rice River	Upstream of CSAH 2, 4 mi. NW of Twin Valley	Norman	Lower Wild Rice River

Appendix 3.1 – Minnesota statewide IBI thresholds and confidence limits

Class #	Class Name	Use Class	Exceptional Use Threshold	General Use Threshold	Modified Use Threshold	Confidence Limit
Fish						
1	Southern Rivers	2B, 2C	71	49	NA	±11
2	Southern Streams	2B, 2C	66	50	35	±9
3	Southern Headwaters	2B, 2C	74	55	33	±7
10	Southern Coldwater	2A	82	50	NA	±9
4	Northern Rivers	2B, 2C	67	38	NA	±9
5	Northern Streams	2B, 2C	61	47	35	±9
6	Northern Headwaters	2B, 2C	68	42	23	±16
7	Low Gradient	2B, 2C	70	42	15	±10
11	Northern Coldwater	2A	60	35	NA	±10
Invertebrates						
1	Northern Forest Rivers	2B, 2C	77	49	NA	±10.8
2	Prairie Forest Rivers	2B, 2C	63	31	NA	±10.8
3	Northern Forest Streams RR	2B, 2C	82	53	NA	±12.6
4	Northern Forest Streams GP	2B, 2C	76	51	37	±13.6
5	Southern Streams RR	2B, 2C	62	37	24	±12.6
6	Southern Forest Streams GP	2B, 2C	66	43	30	±13.6
7	Prairie Streams GP	2B, 2C	69	41	22	±13.6
8	Northern Coldwater	2A	52	32	NA	±12.4
9	Southern Coldwater	2A	72	43	NA	±13.8

Appendix 3.2 – Biological monitoring results – fish IBI (assessable reaches)

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Fish Class	Threshold	FIBI	Visit Date
Headwaters Wild Rice River: 0902010801-01							
09020108-534	05RD100	Buckboard Creek	9.77	Northern Headwaters	42	46.59	10-Jun-14
09020108-551	14RD017	Heir Creek	17.40	Northern Headwaters	42	64.48	09-Jun-14
09020108-646	95RD005	Wild Rice River	65.08	Northern Streams	47	41.13	31-Jul-14
Upper Wild Rice River: 0902010801-02							
09020108-510	14RD004	Wild Rice River	278.53	Northern Streams	47	63.25	19-Aug-14
09020108-510	14RD030	Wild Rice River	247.41	Northern Streams	47	51.07	18-Aug-14
09020108-512	14RD003	Wild Rice River	180.38	Northern Streams	47	55.85	18-Aug-14
Twin Lake Creek: 0902010802-01							
09020108-509	14RD005	Twin Lake Creek	60.69	Northern Streams	47	45.67	03-Sep-14
09020108-509	14RD005	Twin Lake Creek	60.69	Northern Streams	47	43.98	16-Jun-15
09020108-532	14RD035	Unnamed creek	16.28	Northern Coldwater	35	42.97	10-Jun-14
09020108-532	14RD035	Unnamed creek	16.28	Northern Coldwater	35	38.54	22-Jun-15
09020108-532	15RD100	Unnamed creek	16.39	Northern Coldwater	35	18.14	22-Jun-15
09020108-532	15RD100	Unnamed creek	16.39	Northern Coldwater	35	40.07	23-Jun-16
White Earth River: 0902010804-01							
09020108-505	14RD006	White Earth River	184.55	Northern Streams	47	54.10	28-Jul-14
09020108-505	14RD021	White Earth River	144.33	Northern Streams	47	40.34	19-Aug-14
09020108-505	14RD021	White Earth River	144.33	Northern Streams	47	45.95	18-Aug-15
09020108-505	95RD004	White Earth River	118.10	Northern Streams	47	49.92	19-Aug-14
Spring Creek: 0902010805-01							
09020108-647	14RD022	Spring Creek	47.17	Northern Headwaters	23	63.35	22-Jul-14
09020108-648	14RD007	Spring Creek	68.26	Northern Streams	47	54.19	22-Jul-14

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Fish Class	Threshold	FIBI	Visit Date
Middle Wild Rice River:0902010806-01							
09020108-504	10EM005	Wild Rice River	573.79	Northern Rivers	38	54.78	12-Jul-10
09020108-504	10EM005	Wild Rice River	573.79	Northern Rivers	38	55.51	03-Aug-15
09020108-504	10EM005	Wild Rice River	573.79	Northern Rivers	38	56.83	07-Jul-15
09020108-504	14RD008	Wild Rice River	594.55	Northern Rivers	38	47.45	20-Aug-14
09020108-504	15RD207	Wild Rice River	568.32	Northern Rivers	38	56.22	18-Aug-15
09020108-504	95RD011	Wild Rice River	575.95	Northern Rivers	38	53.17	20-Aug-14
09020108-506	14RD016	Wild Rice River	348.86	Northern Streams	47	63.62	20-Aug-14
09020108-506	94RD518	Wild Rice River	380.41	Northern Rivers	38	59.72	29-Jul-14
09020108-640	14RD031	Unnamed creek	10.27	Northern Headwaters	42	73.66	24-Jun-14
Marsh Creek: 0902010807-01							
09020108-519	14RD020	Marsh Creek	38.74	Low Gradient	42	53.31	23-Jun-15
09020108-598	07RD001	Trib. to Marsh Creek	9.10	Northern Headwaters	23	19.76	21-Aug-07
09020108-651	07RD002	Marsh Creek	55.65	Northern Streams	35	34.98	07-Aug-07
09020108-652	14RD009	Marsh Creek	166.16	Northern Streams	47	69.01	23-Jul-14
09020108-652	14RD082	Marsh Creek	126.43	Northern Streams	47	50.68	29-Jul-14
Mashaug Creek: 0902010808-01							
09020108-579	14RD037	Garden Slough	8.69	Northern Headwaters	42	16.13	11-Jun-14
09020108-650	05RD114	Mashaug Creek	27.21	Northern Headwaters	42	43.12	04-Aug-14
09020108-650	14RD014	Mashaug Creek	68.24	Northern Streams	47	45.11	16-Jul-14
09020108-650	14RD014	Mashaug Creek	68.24	Northern Streams	47	41.64	14-Jul-15

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Fish Class	Threshold	FIBI	Visit Date
09020108-650	14RD034	Mashaug Creek	14.33	Northern Headwaters	42	45.34	24-Jun-14
09020108-656	07RD027	County Ditch 42	22.50	Northern Headwaters	42	40.88	08-Aug-07
Lower Wild Rice River: 0902010809-01							
09020108-643	05RD115	Wild Rice River	926.28	Northern Rivers	38	53.47	26-Jul-06
09020108-643	05RD115	Wild Rice River	926.28	Northern Rivers	38	55.74	06-Aug-14
09020108-643	05RD115	Wild Rice River	926.28	Northern Rivers	38	53.89	06-Jul-16
09020108-643	07RD009	Wild Rice River	1084.22	Southern Rivers	49	51.93	07-Aug-07
09020108-643	07RD009	Wild Rice River	1084.22	Southern Rivers	49	57.57	20-Aug-14
09020108-643	14RD041	Wild Rice River	931.71	Northern Rivers	38	73.57	20-Aug-14
09020108-643	95RD014	Wild Rice River	1082.31	Northern Rivers	38	47.13	21-Aug-14
Coon Creek: 0902010809-02							
09020108-544	14RD015	Coon Creek	45.87	Northern Headwaters	42	61.14	05-Aug-14
09020108-577	14RD044	Coon Creek	25.14	Northern Headwaters	42	85.03	05-Aug-14
09020108-577	14RD044	Coon Creek	25.14	Northern Headwaters	42	65.04	12-Jun-14
09020108-578	14RD080	Coon Creek	32.59	Northern Headwaters	42	53.89	05-Aug-14
09020108-578	14RD080	Coon Creek	32.59	Northern Headwaters	42	60.42	12-Jun-14
Trib. to Wild Rice River: 0902010809-03							
09020108-545	14RD001	Unnamed creek	44.07	Northern Headwaters	42	83.21	27-Aug-14
09020108-546	14RD011	Unnamed creek	59.10	Northern Streams	47	57.06	22-Jul-14

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi2	Fish Class	Threshold	FIBI	Visit Date
Lower South Branch Wild Rice River: 0902010810-01							
09020108-659	07RD010	Wild Rice River, South Branch	256.55	Southern Streams	50	55.00	06-Aug-07
09020108-659	07RD010	Wild Rice River, South Branch	256.55	Southern Streams	50	56.61	20-Aug-14
09020108-659	14RD047	Wild Rice River, South Branch	214.93	Southern Streams	50	57.30	23-Jul-14
09020108-659	14RD049	Wild Rice River, South Branch	253.56	Southern Streams	50	56.28	23-Jul-14
09020108-662	05RD069	Wild Rice River, South Branch	181.22	Northern Streams	47	51.76	25-Jul-06
09020108-662	14RD042	Wild Rice River, South Branch	153.13	Northern Streams	47	51.44	23-Jul-14
09020108-662	94RD012	Wild Rice River, South Branch	195.74	Northern Streams	47	62.64	24-Jul-14
Upper South Branch Wild Rice River: 0902010810-02							
09020108-540	14RD025	Spring Creek	22.13	Northern Headwaters	42	67.45	12-Jun-14
09020108-661	07RD028	Wild Rice River, South Branch	64.32	Northern Streams	35	43.84	06-Aug-07
09020108-661	07RD028	Wild Rice River, South Branch	64.32	Northern Streams	35	22.93	08-Jul-15
09020108-661	14RD081	Wild Rice River, South Branch	64.29	Northern Streams	35	24.38	15-Jun-15
09020108-662	14RD012	Wild Rice River, South Branch	102.16	Northern Streams	47	55.54	24-Jul-14
Stiner Creek: 0902010810-03							
09020108-542	14RD013	Stiner Creek	41.04	Northern Headwaters	42	69.51	20-Aug-14
Felton Creek: 0902010811-01							
09020108-541	07RD011	County Ditch 45	122.56	Southern Streams	35	57.84	07-Aug-07
09020108-553	14RD051	County Ditch 45	52.83	Southern Streams	35	70.90	23-Jul-14
09020108-553	14RD051	County Ditch 45	52.83	Southern Streams	35	59.46	15-Jun-15
09020108-654	10RD080	Felton Creek	24.14	Northern Coldwater	35	20.36	20-Jul-10

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Fish Class	Threshold	FIBI	Visit Date
09020108-654	10RD080	Felton Creek	24.14	Northern Coldwater	35	27.26	08-Sep-15
09020108-654	10RD080	Felton Creek	24.14	Northern Coldwater	35	20.65	15-Jun-15
09020108-654	14RD046	Felton Creek	25.00	Southern Coldwater	50	34.19	17-Jul-14
09020108-654	14RD046	Felton Creek	25.00	Southern Coldwater	50	29.17	08-Jul-15
09020108-654	15RD012	Felton Creek	24.18	Northern Coldwater	35	29.13	15-Jun-15
09020108-654	15RD035	Felton Creek	24.76	Southern Coldwater	50	37.01	08-Jul-15
Outlet Wild Rice River: 0902010812-01							
09020108-501	05RD036	Wild Rice River	1551.28	Southern Rivers	49	78.82	23-Aug-06
09020108-501	05RD112	Wild Rice River	1576.61	Southern Rivers	49	65.37	23-Aug-06
09020108-501	14RD019	Wild Rice River	1603.89	Southern Rivers	49	63.22	21-Aug-14
09020108-501	14RD055	Wild Rice River	1410.23	Southern Rivers	49	80.90	02-Sep-14
09020108-644	14RD033	Wild Rice River	1100.87	Southern Rivers	49	57.13	21-Aug-14
09020108-644	14RD048	Wild Rice River	1106.79	Southern Rivers	49	81.68	28-Aug-14
09020108-644	14RD053	Wild Rice River	1134.33	Southern Rivers	49	63.66	02-Sep-14

Appendix 3.3 – Biological monitoring results-macroinvertebrate IBI (assessable reaches)

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Invert Class	Threshold	MIBI	Visit Date
Headwaters Wild Rice River: 0902010801-01							
09020108-534	05RD100	Buckboard Creek	9.77	Northern Forest Streams GP	51	55.83	05-Aug-14
09020108-551	14RD017	Heir Creek	17.40	Northern Forest Streams GP	51	45.73	19-Aug-14
09020108-551	14RD017	Heir Creek	17.40	Northern Forest Streams GP	51	80.43	06-Aug-15
09020108-646	95RD005	Wild Rice River	65.08	Northern Forest Streams GP	51	56.82	31-Jul-14
Upper Wild Rice River: 0902010802-01							
09020108-512	14RD003	Wild Rice River	180.38	Northern Forest Streams GP	51	25.83	18-Aug-14
09020108-510	14RD004	Wild Rice River	278.53	Southern Streams RR	37	63.78	13-Aug-14
09020108-510	14RD004	Wild Rice River	278.53	Southern Streams RR	37	73.18	19-Aug-14
09020108-510	14RD030	Wild Rice River	247.41	Southern Streams RR	37	35.05	18-Aug-14
Twin Lake Creek: 0902010803-01							
09020108-532	14RD035	Unnamed creek	16.28	Northern Coldwater	32	16.38	07-Aug-14
09020108-532	15RD100	Unnamed creek	16.39	Northern Coldwater	32	19.60	15-Aug-16
White Earth River: 0902010804-01							
09020108-505	14RD006	White Earth River	184.55	Southern Streams RR	37	37.95	28-Jul-14
09020108-505	14RD021	White Earth River	144.33	Prairie Streams GP	41	42.04	07-Aug-14
09020108-505	14RD021	White Earth River	144.33	Prairie Streams GP	41	40.00	18-Aug-15

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Invert Class	Threshold	MIBI	Visit Date
09020108-505	95RD004	White Earth River	118.10	Prairie Streams GP	41	52.58	07-Aug-14
Spring Creek: 0902010805-01							
09020108-648	14RD007	Spring Creek	68.26	Southern Streams RR	37	45.32	05-Aug-14
09020108-648	14RD007	Spring Creek	68.26	Southern Streams RR	37	44.99	05-Aug-14
09020108-647	14RD022	Spring Creek	47.17	Prairie Streams GP	22	14.51	31-Jul-14
Middle Wild Rice River: 0902010806-01							
09020108-504	10EM005	Wild Rice River	573.79	Prairie Forest Rivers	31	48.83	20-Sep-10
09020108-504	10EM005	Wild Rice River	573.79	Prairie Forest Rivers	31	48.19	20-Sep-10
09020108-504	10EM005	Wild Rice River	573.79	Prairie Forest Rivers	31	46.00	13-Aug-15
09020108-504	10EM005	Wild Rice River	573.79	Prairie Forest Rivers	31	52.00	04-Aug-15
09020108-504	14RD008	Wild Rice River	594.55	Prairie Forest Rivers	31	37.11	13-Aug-14
09020108-506	14RD016	Wild Rice River	348.86	Southern Streams RR	37	68.40	19-Aug-14
09020108-640	14RD031	Unnamed creek	10.27	Southern Streams RR	37	38.66	31-Jul-14
09020108-504	15RD207	Wild Rice River	568.32	Prairie Forest Rivers	31	47.00	24-Sep-15
09020108-506	94RD518	Wild Rice River	380.41	Prairie Streams GP	41	58.10	29-Jul-14
09020108-504	95RD011	Wild Rice River	575.95	Prairie Forest Rivers	31	47.27	13-Aug-14
Marsh Creek: 0902010807-01							
09020108-598	07RD001	Trib. to Marsh Creek	9.10	Prairie Streams GP	22	28.72	14-Aug-07
09020108-651	07RD002	Marsh Creek	55.65	Prairie Streams GP	22	45.06	14-Aug-07
09020108-652	14RD009	Marsh Creek	166.16	Southern Streams RR	37	41.29	06-Aug-14

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Invert Class	Threshold	MIBI	Visit Date
09020108-652	14RD009	Marsh Creek	166.16	Southern Streams RR	37	41.65	06-Aug-14
09020108-652	14RD082	Marsh Creek	126.43	Southern Streams RR	37	34.37	29-Jul-14
Mashaug Creek: 0902010808-01							
09020108-650	05RD114	Mashaug Creek	27.21	Prairie Streams GP	41	34.84	05-Aug-14
09020108-656	07RD027	County Ditch 42	22.50	Prairie Streams GP	41	42.10	15-Aug-07
09020108-650	14RD014	Mashaug Creek	68.24	Southern Streams RR	37	29.00	04-Aug-15
Lower Wild Rice River: 0902010809-01							
09020108-643	05RD115	Wild Rice River	926.28	Prairie Forest Rivers	31	26.57	13-Aug-14
09020108-643	07RD009	Wild Rice River	1084.22	Prairie Forest Rivers	31	43.04	15-Aug-07
09020108-643	07RD009	Wild Rice River	1084.22	Prairie Forest Rivers	31	36.79	15-Aug-07
09020108-643	07RD009	Wild Rice River	1084.22	Prairie Forest Rivers	31	41.91	12-Aug-14
09020108-643	14RD041	Wild Rice River	931.71	Prairie Forest Rivers	31	47.12	12-Aug-14
09020108-643	95RD014	Wild Rice River	1082.31	Prairie Forest Rivers	31	31.51	12-Aug-14
Coon Creek: 0902010809-02							
09020108-544	14RD015	Coon Creek	45.87	Southern Streams RR	37	35.95	05-Aug-14
09020108-544	14RD015	Coon Creek	45.87	Southern Streams RR	37	33.83	05-Aug-14
09020108-577	14RD044	Coon Creek	25.14	Southern Streams RR	37	36.03	31-Jul-14
09020108-578	14RD080	Coon Creek	32.59	Prairie Streams GP	41	48.35	05-Aug-14
Trib. to Wild Rice River: 0902010809-03							
09020108-545	14RD001	Unnamed creek	44.07	Southern Streams RR	37	33.64	05-Aug-14
09020108-546	14RD011	Unnamed creek	59.10	Southern Streams RR	37	47.60	31-Jul-14

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
Lower South Branch Wild Rice River: 0902010810-01							
09020108-659	07RD010	Wild Rice River, South Branch	256.55	Prairie Streams GP	41	26.87	16-Aug-07
09020108-659	14RD047	Wild Rice River, South Branch	214.93	Prairie Streams GP	41	49.22	31-Jul-14
09020108-659	14RD049	Wild Rice River, South Branch	253.56	Prairie Streams GP	41	40.06	05-Aug-14
09020108-662	94RD012	Wild Rice River, South Branch	195.74	Southern Streams RR	37	41.60	04-Aug-14
Upper South Branch Wild Rice River: 0902010810-02							
09020108-659	07RD010	Wild Rice River, South Branch	256.55	Prairie Streams GP	41	26.87	16-Aug-07
09020108-659	14RD047	Wild Rice River, South Branch	214.93	Prairie Streams GP	41	49.22	31-Jul-14
09020108-659	14RD049	Wild Rice River, South Branch	253.56	Prairie Streams GP	41	40.06	05-Aug-14
09020108-662	94RD012	Wild Rice River, South Branch	195.74	Southern Streams RR	37	41.60	04-Aug-14
Stiner Creek: 0902010810-03							
09020108-542	14RD013	Stiner Creek	41.04	Prairie Streams GP	41	42.78	06-Aug-14
Felton Creek: 0902010811-01							
09020108-541	07RD011	County Ditch 45	122.56	Prairie Streams GP	22	18.56	16-Aug-07
09020108-541	07RD011	County Ditch 45	122.56	Prairie Streams GP	22	36.77	14-Aug-14
09020108-654	10RD080	Felton Creek	24.14	Northern Coldwater	32	27.35	22-Sep-10
09020108-654	10RD080	Felton Creek	24.14	Northern Coldwater	32	39.89	22-Sep-10
09020108-654	10RD080	Felton Creek	24.14	Northern Coldwater	32	27.45	05-Aug-14
09020108-654	10RD080	Felton Creek	24.14	Northern Coldwater	32	23.85	04-Aug-15
09020108-654	14RD046	Felton Creek	25.00	Northern Coldwater	32	29.21	05-Aug-14

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
09020108-654	14RD046	Felton Creek	25.00	Northern Coldwater	32	40.81	04-Aug-15
09020108-553	14RD051	County Ditch 45	52.83	Prairie Streams GP	22	34.69	04-Aug-14
09020108-654	15RD012	Felton Creek	24.18	Northern Coldwater	32	23.98	04-Aug-15
09020108-654	15RD035	Felton Creek	24.76	Northern Coldwater	32	40.56	04-Aug-15
Outlet Wild Rice River: 0902010812-01							
09020108-644	14RD033	Wild Rice River	1100.87	Prairie Forest Rivers	31	41.69	12-Aug-14
09020108-644	14RD048	Wild Rice River	1106.79	Prairie Forest Rivers	31	36.08	11-Aug-14
09020108-501	14RD055	Wild Rice River	1410.23	Prairie Forest Rivers	31	38.72	11-Aug-14

Appendix 4.1 – Fish species found during biological monitoring surveys

Common Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Bigmouth Buffalo	1	1
Bigmouth Shiner	38	2,053
Black Bullhead	17	148
Black Crappie	12	28
Blackchin Shiner	2	2
Blacknose Dace	50	3,922
Blacknose Shiner	18	109
Blackside Darter	43	883
Bluegill	22	246
Brassy Minnow	20	523
Brook Stickleback	32	483
Brown Bullhead	4	7
Carmine Shiner	30	628
Central Mudminnow	38	984
Channel Catfish	17	117
Chestnut Lamprey	3	4
Common Carp	22	205
Common Shiner	59	9,732
Creek Chub	58	4,912
Emerald Shiner	4	61
Lamprey Family	1	2
Fathead Minnow	41	2,157
Finescale Dace	7	101
Freshwater Drum	5	8
Redhorse Family	13	58
Golden Redhorse	35	1,407
Golden Shiner	4	42
Goldeye	14	68
Green Sunfish	14	287
Hornyhead Chub	34	1508
Hybrid minnow	3	7
Hybrid sunfish	4	10
Iowa darter	18	169
Johnny darter	52	2,509
Lamprey Ammocoete	15	110
Largemouth Bass	10	33
Longnose Dace	31	540
Mimic Shiner	5	70
Mooneye	7	9
Northern Pike	19	87

Common Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Northern Redbelly Dace	35	1,198
Orangespotted Sunfish	2	6
Pearl Dace	28	1,218
Pumpkinseed	5	5
Quillback	15	60
Rock Bass	35	521
Sand Shiner	24	1,488
Sauger	9	29
Shorthead Redhorse	26	334
Silver Lamprey	1	2
Silver Redhorse	20	379
Smallmouth Bass	22	312
Smallmouth Buffalo	1	2
Spotfin Shiner	34	2,644
Stonecat	23	98
Tadpole Madtom	8	47
Trout-Perch	8	62
Walleye	11	23
White Bass	4	5
White Sucker	55	2,537
Yellow Bullhead	2	2
Yellow Perch	21	90

Appendix 4.2 – Macroinvertebrate species found during biological monitoring surveys

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Amphipoda		
Gammarus	1	1
Hyalella	31	538
Architaenioglossa		
Campeloma	1	1
Basommatophora		
Aplexa	1	1
Ferrissia	26	57
Fossaria	3	4
Gyraulus	7	20
Helisoma anceps	1	1
Lymnaea stagnalis	3	3
Lymnaeidae	9	32
Physa	7	110
Physella	39	430
Physidae	3	12
Planorbella	4	24
Planorbidae	2	9
Planorbula	1	1
Promenetus	1	2
Pseudosuccinea columella	1	1
Stagnicola	1	3
Branchiobdellida		
Branchiobdellida	2	2
Coleoptera		
Anacaena	2	2
Dubiraphia	41	281
Dytiscidae	4	5
Elmidae	6	6
Gymnochthebius	1	1
Gyrinus	2	3
Haliplus	5	15
Helichus	13	18
Helophorus	1	1
Hydraena	4	5
Hydraenidae	1	2
Hydrochus	3	4
Hydrophilidae	3	3
Hygrotus	2	2
Laccophilus	2	3

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Liodessus	14	20
Macronychus	5	10
Macronychus glabratus	32	188
Neoporus	2	2
Ochthebius	6	6
Optioservus	26	171
Paracymus	5	5
Peltodytes	3	5
Stenelmis	49	433
Decapoda		
Cambaridae	5	6
Orconectes	33	48
Diptera		
Ablabesmyia	36	122
Aedes	1	2
Anopheles	2	38
Antocha	9	28
Atherix	29	80
Atrichopogon	1	1
Axarus	1	7
Bezzia	2	6
Bezzia/Palpomyia	1	1
Brillia	22	58
Cardiocladius	1	1
Ceratopogoninae	11	17
Chironomini	11	18
Chironomus	9	20
Cladopelma	1	1
Cladotanytarsus	7	9
Conchapelopia	7	8
Corynoneura	14	22
Cricotopus	53	583
Cryptochironomus	9	18
Cryptotendipes	1	2
Culicidae	1	1
Dasyhelea	1	1
Dicranota	3	3
Dicrotendipes	20	156
Diplocladius cultriger	1	3
Dixa	4	8
Dixella	2	2

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Empididae	15	28
Endochironomus	6	127
Ephydridae	6	10
Erioptera	1	1
Eukiefferiella	4	9
Euryhapsis	1	1
Forcipomyia	2	2
Glyptotendipes	10	34
Hemerodromia	22	71
Hexatoma	1	2
Labrundinia	35	88
Limnophyes	8	13
Lopescladius	1	2
Metriocnemus	1	1
Micropsectra	17	77
Microtendipes	22	73
Muscidae	1	1
Nanocladius	9	14
Natarsia	2	3
Neoplasta	4	6
Nilotanypus	5	8
Nilothauma	2	2
Odontomyia	1	1
Orthocladiinae	14	27
Orthocladius	11	53
Parachironomus	5	15
Paracladopelma	4	4
Parakiefferiella	5	25
Paralauterborniella nigrohalterale	2	2
Paramerina	4	6
Parametriocnemus	10	95
Paratanytarsus	28	374
Paratendipes	4	24
Pericoma	1	1
Phaenopsectra	17	49
Polypedilum	63	2014
Potthastia	3	3
Procladius	7	34
Psectrocladius	5	9
Pseudochironomus	1	3
Rheocricotopus	26	89
Rheopelopia	1	1

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Rheotanytarsus	51	841
Saetheria	3	3
Sciomyzidae	2	2
Simulium	44	589
Stempellina	1	1
Stempellinella	13	30
Stenochironomus	21	45
Stictochironomus	2	2
Sublettea coffmani	1	1
Tabanidae	2	2
Tanypodinae	21	38
Tanytarsini	11	23
Tanytarsus	41	288
Thienemanniella	31	70
Thienemannimyia	35	127
Thienemannimyia Gr.	16	116
Tipula	15	37
Tribelos	4	12
Trissopelopia ogemawi	2	2
Tvetenia	29	120
Xenochironomus	1	3
Xenochironomus xenolabis	2	6
Zavrelimyia	5	6
Ephemeroptera		
Acentrella	8	39
Acentrella parvula	19	120
Acentrella turbida	11	31
Acerpenna	13	36
Acerpenna pygmaea	24	146
Anafroptilum	4	14
Anthopotamus	1	3
Baetidae	26	289
Baetis	23	336
Baetis brunneicolor	7	197
Baetis flavistriga	14	163
Baetis intercalaris	33	939
Caenis	11	90
Caenis diminuta	12	74
Caenis hilaris	19	151
Callibaetis	6	8
Ephemerellidae	1	1
Heptagenia	9	37
Heptageniidae	12	47

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Hexagenia	3	6
Isonychia	24	138
Isonychia bicolor	1	2
Iswaeon	26	406
Labiobaetis	3	7
Labiobaetis dardanus	10	45
Labiobaetis frondalis	13	51
Labiobaetis propinquus	31	887
Leptophlebia	2	13
Leptophlebiidae	12	26
Leucrocuta	13	23
Maccaffertium	27	187
Maccaffertium mediopunctatum	4	6
Maccaffertium mexicanum	1	1
Maccaffertium vicarium	1	4
Nixe	1	1
Paracloeodes minutus	3	4
Plauditus	19	127
Procloeon	18	130
Pseudocloeon	3	20
Pseudocloeon propinquum	1	2
Rhithrogena	1	1
Stenacron	17	42
Tricorythodes	45	1144
Haplotaxida		
Enchytraeus	2	2
Henlea	1	3
Nais	3	8
Oligochaeta	29	145
Pristina	2	3
Tubificinae	4	9
Hemiptera		
Belostoma	4	19
Belostoma flumineum	9	9
Belostomatidae	1	1
Corixidae	10	111
Gerridae	2	2
Hesperocorixa	1	1
Merragata	1	1
Metrobates	1	1
Neoplea	1	7
Neoplea striola	6	18

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Palmacorixa	2	2
Ranatra	2	2
Rheumatobates	1	1
Sigara	8	16
Trichocorixa	6	13
Heterostropha		
Valvata	1	1
Megaloptera		
Sialis	6	10
Neotaenioglossa		
Hydrobiidae	26	105
Odonata		
Aeshna	3	3
Aeshna umbrosa	5	7
Aeshnidae	4	8
Anax	2	2
Anax junius	1	1
Argia	2	5
Boyeria vinosa	4	6
Calopterygidae	11	23
Calopteryx	5	9
Calopteryx aequabilis	7	14
Coenagrionidae	19	125
Corduliidae	1	2
Enallagma	2	20
Epitheca canis	1	1
Gomphidae	7	7
Gomphus fraternus	1	1
Hetaerina	1	1
Hetaerina americana	2	2
Hetaerina titia	1	1
Ischnura	1	1
Libellulidae	1	2
Ophiogomphus	2	2
Ophiogomphus rupinsulensis	1	1
Somatochlora	1	1
Plecoptera		
Acroneuria	14	14
Acroneuria abnormis	2	4
Capniidae	1	4
Isoperla	3	24
Paragnetina	1	1
Paragnetina media	7	10

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Perlesta	3	12
Perlidae	4	8
Perlodidae	2	10
Pteronarcys	12	26
Taeniopteryx	3	45
Trichoptera		
Brachycentrus	4	100
Brachycentrus numerosus	19	287
Ceraclea	3	10
Ceratopsyche	21	300
Ceratopsyche alhedra	10	66
Ceratopsyche bronta	8	22
Ceratopsyche morosa	26	248
Ceratopsyche slossonae	7	83
Ceratopsyche sparna	1	4
Cheumatopsyche	39	468
Chimarra	10	16
Glossosoma	1	9
Helicopsyche	2	9
Helicopsyche borealis	14	73
Hydatophylax argus	1	1
Hydropsyche	23	179
Hydropsyche betteni	6	22
Hydropsyche dicantha	1	1
Hydropsyche placoda	2	20
Hydropsyche simulans	6	43
Hydropsychidae	34	651
Hydroptila	40	399
Hydroptilidae	17	86
Lepidostoma	3	10
Leptoceridae	15	21
Limnephilidae	3	6
Mayatrichia ayama	2	2
Micrasema	2	11
Micrasema rusticum	4	19
Nectopsyche	8	106
Nectopsyche candida	4	27
Nectopsyche diarina	28	163
Nectopsyche exquisita	2	3
Neotrichia	1	1
Neureclipsis	3	3
Ochrotrichia	4	8
Oecetis	5	7

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Oecetis avara	7	19
Oecetis furva	1	1
Oecetis testacea	4	5
Oxyethira	1	1
Phryganeidae	1	2
Polycentropodidae	9	24
Polycentropus	5	7
Potamyia	1	5
Protoptila	1	1
Psychomyia flavida	1	1
Ptilostomis	3	3
Pycnopsyche	6	12
Triaenodes	2	2
Trichoptera	2	3
Tubificida		
Stylaria	1	1
Unclassified		
Acari	49	247
Hirudinea	12	21
Nemata	3	3
Nematoda	1	1
Nematomorpha	2	2
Trepaxonemata	2	2
Veneroida		
Pisidiidae	31	88

Appendix 5 – Minnesota Stream Habitat Assessment (MSHA) results

Habitat information documented during each fish sampling visit is provided. This table conveys the results of the Minnesota Stream Habitat Assessment (MSHA) survey, which evaluates the section of stream sampled for biology and can provide an indication of potential stressors (e.g., siltation, eutrophication) impacting fish and macroinvertebrate communities. The MSHA score is comprised of five scoring categories including adjacent land use, riparian zone, substrate, fish cover and channel morphology, which are summed for a total possible score of 100 points. Scores for each category, a summation of the total MSHA score, and a narrative habitat condition rating are provided in the tables for each biological monitoring station. Where multiple visits occur at the same station, the scores from each visit have been averaged. The final row in each table displays average MSHA scores and a rating for the aggregated 12-HUC subwatershed.

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
3	14RD017	Heir Creek	4.6	10.8	16.7	14.6	17	63.7	Fair
2	95RD005	Wild Rice River	5	10	18.2	15	21.5	69.7	Good
2	05RD100	Buckboard Creek	5	11	17.2	13	20.5	66.7	Good
Average Habitat Results: *Headwaters Wild Rice River Aggregated 12 HUC*			**4.86**	**10.6**	**17.36**	**14.2**	**19.66**	**66.7**	**Good**

Qualitative habitat ratings

- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
2	14RD003	Wild Rice River	5	11	19	15	15	65	Fair
3	14RD004	Wild Rice River	2.6	9.3	19.5	14	23.6	69	Good
2	14RD030	Wild Rice River	2.5	11	22	13	13	61.5	Fair
Average Habitat Results: *Upper Wild Rice River Aggregated 12-HUC*			**3.36**	**10.43**	**20.16**	**14**	**17.2**	**65.16**	**Fair**

Qualitative habitat ratings

- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
4	14RD035	Unnamed Creek	5	12.5	14.25	13	18.5	63.25	Fair
3	15RD100	Unnamed Creek	5	13.16	20.75	15.33	22.33	76.57	Good
2	14RD005	Twin Lake Creek	4.38	10	7.5	12.5	12.5	46.88	Fair
Average Habitat Results: *Twin Lake Creek Aggregated 12-HUC*			**4.79**	**11.89**	**14.17**	**13.61**	**17.78**	**62.24**	**Fair**

Qualitative habitat ratings

- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
2	95RD004	White Earth River	0.5	7	19.1	13.5	22	62.1	Fair
4	14RD021	White Earth River	1.25	6.62	11.25	8.75	13	40.87	Poor
2	14RD006	White Earth River	3.5	9.5	20.1	14	17	64.1	Fair
Average Habitat Results: *White Earth River Aggregated 12-HUC*			**1.75**	**11.56**	**16.81**	**12.08**	**17.33**	**59.53**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
2	14RD022	Spring Creek	0.62	9	13.5	7	10.5	40.62	Poor
2	14RD007	Spring Creek	0.75	9	18.1	13	21.5	62.35	Fair
Average Habitat Results: *Spring Creek Aggregated 12-HUC*			**0.685**	**9**	**15.8**	**10**	**16**	**51.485**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
2	14RD016	Wild Rice River	2.5	10.5	18.7	12.5	23	67.2	Good
2	94RD518	Wild Rice River	5	10.25	19.15	13.5	24.5	72.4	Good
2	15RD207	Wild Rice River	4	10	18.7	10	21	63.7	Fair
5	10EM005	Wild Rice River	1.85	8.5	18.15	11.8	19.2	59.5	Fair
2	95RD011	Wild Rice River	2	7.5	12.95	10	21.5	53.95	Fair
2	14RD008	Wild Rice River	4.37	8.5	18.85	12.5	21	65.22	Fair
2	14RD031	Unnamed Creek	0.625	9.5	18.92	9	19.5	57.54	Fair
Average Habitat Results: *Middle Wild Rice River Aggregated 12-HUC*			**2.9**	**9.25**	**17.91**	**11.32**	**21.38**	**62.76**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
2	14RD020	Marsh Creek	0.75	7	9.5	12	7.5	36.75	Poor
1	07RD002	Marsh Creek	0	9.5	18	6	8	41.5	Poor
1	07RD001	Unnamed Creek	2.5	9.5	6	6	18	42	Poor
2	14RD082	Marsh Creek	5	11	16.95	14	20.5	67.45	Good
3	14RD009	Marsh Creek	3.75	6.33	19.15	12.66	24.33	66.22	Good
Average Habitat Results: *Marsh Creek Aggregated 12-HUC*			**2.4**	**8.67**	**13.92**	**10.13**	**15.67**	**50.79**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
1	14RD037	Garden Slough	1.5	12.5	16.6	14	16	60.6	Fair
1	07RD027	County Ditch 42	2.5	11.5	15.85	7	23	59.85	Fair
1	14RD034	Mashaug Creek	2.5	10	14.5	13	21	61	Fair
2	05RD114	Mashaug Creek	0	13	15.4	5	18	51.4	Fair
3	14RD014	Mashaug Creek	3.25	10.5	15.26	10.66	17.66	57.33	Fair
Average Habitat Results: *Mashaug Creek Aggregated 12-HUC*			**1.95**	**11.5**	**15.52**	**9.93**	**19.13**	**58.03**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
2	05RD115	Wild Rice River	1.87	10	18.2	13.5	24	67.57	Good
2	14RD041	Wild Rice River	4.25	7.75	18.65	14.5	23	68.15	Good
2	95RD014	Wild Rice River	1.87	7.75	15.75	12	19.5	56.87	Fair
3	07RD009	Wild Rice River	2.5	8.66	15.3	8.33	13.66	48.45	Fair
Average Habitat Results: *Lower Wild Rice River Aggregated 12-HUC*			**2.62**	**8.54**	**16.97**	**12.08**	**20.04**	**60.25**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
3	14RD044	Coon Creek	1.33	8.5	18.33	12.66	22.33	63.15	Fair
3	14RD080	Coon Creek	0.41	7.16	18.33	13.33	16.33	55.56	Fair
3	14RD015	Coon Creek	0.75	8.83	21.4	12	26.33	69.31	Good
Average Habitat Results: *Coon Creek Aggregated 12-HUC*			**0.83**	**8.16**	**19.35**	**12.66**	**21.66**	**62.66**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
2	14RD001	Unnamed Creek	0	6.25	18.72	9	18	51.97	Fair
2	14RD011	Unnamed Creek	0.75	9	18.65	13.5	21.5	63.4	Fair
Average Habitat Results: *Trib. to Wild Rice River Aggregated 12-HUC*			**0.37**	**7.62**	**18.68**	**11.25**	**19.75**	**57.67**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
1	14RD042	Wild Rice River, South Branch	5	11	19.6	16	25	76.6	Good
1	05RD069	Wild Rice River, South Branch	5	9.5	21.1	13	28	76.6	Good
2	94RD012	Wild Rice River, South Branch	0.5	3.75	19.15	14	22	59.4	Fair
2	14RD047	Wild Rice River, South Branch	1.75	8	11	6	5	31.75	Poor
2	14RD049	Wild Rice River, South Branch	0	6.5	10	6.5	8.5	31.5	Poor
3	07RD010	Wild Rice River, South Branch	0	7.33	7.33	7	6.66	28.32	Poor
Average Habitat Results: *Lower Wild Rice River Aggregated 12-HUC*			**2.04**	**7.68**	**14.69**	**10.41**	**15.86**	**50.68**	**Fair**

Qualitative habitat ratings

= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)

= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)

= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
2	14RD025	Spring Creek	0.75	8.75	7.5	11	7	35	Poor
1	14RD081	Wild Rice River, South Branch	1.25	7	7.9	11	4	31.15	Poor
3	07RD028	Wild Rice River, South Branch	1.66	9.33	16	11	11.66	49.65	Fair
2	14RD012	Wild Rice River, South Branch	0	8.5	19.37	14	20	61.87	Fair
Average Habitat Results: Upper South Branch Wild Rice River Agg 12-HUC			**0.915**	**8.39**	**12.69**	**11.75**	**10.66**	**44.41**	**Poor**

Qualitative habitat ratings
= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
2	14RD013	Stiner Creek	0	11.5	15.25	12	25	63.75	Fair
Average Habitat Results: *Stiner Creek Aggregated 12-HUC*			**0**	**11.5**	**15.25**	**12**	**25**	**63.75**	**Fair**

Qualitative habitat ratings
= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
5	10RD080	Felton Creek	1	10	15.82	14	21.2	62.02	Fair
2	15RD012	Felton Creek	2	10.25	16.57	14	20.5	63.32	Fair
2	15RD035	Felton Creek	0	9.25	12	9.5	12.5	43.25	Poor
4	14RD046	Felton Creek	1.62	8.12	12.65	10.5	12.75	45.64	Fair
3	14RD051	County Ditch 45	0	7.66	7.66	9.66	7.33	32.31	Poor
2	07RD011	County Ditch 45	0	7	14	7	5	33	Poor
Average Habitat Results: *Felton Creek Aggregated 12-HUC*			**0.77**	**8.71**	**13.11**	**10.77**	**13.21**	**46.57**	**Fair**

Qualitative habitat ratings
= Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
= Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
= Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)

# Visits	Biological Station ID	Reach Name	Land Use	Riparian	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
2	14RD033	Wild Rice River	3.25	8.5	10.65	8.5	10.5	41.4	Poor
2	14RD048	Wild Rice River	1.25	9.25	13.5	6	8	38	Poor
1	14RD053	Wild Rice River	2.5	9.5	8	8	13	41	Poor
2	14RD055	Wild Rice River	1.25	9	9.5	6	14	39.75	Poor
1	05RD036	Wild Rice River	0	8.5	10.9	11	27	57.4	Fair
1	05RD112	Wild Rice River	0	9.5	10	11	19	49.5	Fair
1	14RD019	Wild Rice River	0	5	5	8	7	25	Poor
Average Habitat Results: *Outlet Wild Rice River Aggregated 12-HUC*			**1.17**	**8.46**	**9.65**	**8.35**	**14.07**	**41.7**	**Poor**

Qualitative habitat ratings

- = Good: MSHA score above the median of the least-disturbed sites (MSHA>66)
- = Fair: MSHA score between the median of the least-disturbed sites and the median of the most-disturbed sites (45 < MSHA < 66)
- = Poor: MSHA score below the median of the most-disturbed sites (MSHA<45)