LeSueur River Watershed Monitoring and Assessment Report

Minnesota Pollution Control Agency

March 2012

Acknowledgements

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CLEAN WATER LAND & LEGACY AMENDMENT

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Executive Summary

This assessment report is the first in a series of reports for watershed work being conducted in the LeSueur River watershed. The results of surface water monitoring activities in the LeSueur River watershed are reported here. Subsequent reports will explain stressor identification, Total Maximum Daily Loads (TMDLs), and restoration and protection plans for the watershed.

The LeSueur River Watershed (07020011) covers 710,832 acres in south central Minnesota within the Minnesota River Basin. Since European settlement in the 1860s the LeSueur has undergone considerable land use modification, including the plowing of its native prairies, harvesting of its hardwood forests, draining of its wetlands and modifications to its natural stream courses. Agriculture accounts for the majority of land use activities within the watershed. Farm land within the LeSueur Watershed is highly tiled for drainage purposes. The watershed's wealth of surface waters is a valuable resource for aquatic recreation and its health is essential to resident aquatic life. In 2008 the Minnesota Pollution Control Agency (MPCA) undertook an intensive watershed monitoring effort of the LeSueur River Watershed's surface waters. Ninety-nine (99) sites were sampled for biology at the outlets of variable sized sub-watersheds within the LeSueur River watershed. These locations included the mouth of the LeSueur River, the outlets of its major tributaries and the outlets of headwater tributaries. As part of this effort, MPCA also joined with the Minnesota State University Mankato Water Resources Center (WRC) who completed stream water chemistry sampling at the outlets of the LeSueur River's eight major subwatersheds. In 2010, a holistic approach was taken to assess all of the watershed's surface water bodies for aquatic life, recreation and fish consumption use support, where data was available. Seventy-two streams reaches were sampled for fish, and 63 stream reaches were sampled for macroinvertebrates in the LeSueur River watershed during the assessment window. Twenty (20) streams were assessed for aquatic life support and 11 lakes were assessed for aquatic recreation in this effort. Not all lake and streams were able to be assessed due to insufficient data, modified channel condition or having status as limited resources waters.

Only two stream reaches were found to be fully supporting of aquatic life use in the LeSueur River Watershed. Aquatic biological impairments are found throughout the entire watershed where assessments were made. Twenty-five (25) new impairments of aquatic life have been added to the LeSueur River watershed during the 2010 assessment cycle. Eight reaches were able to be assessed for aquatic recreation and only one was found to be fully supporting. Aquatic consumption impairments span the entire length of the LeSueur River main stem due to the presence of polychlorinated biphenyl (PCBs). Channelized streams throughout the watershed are generally in poor biological condition. Habitat assessments also indicate that there many problems in the watershed. Water chemistry impairments involving low dissolved oxygen and high bacteria concentrations are common across the watershed's tributaries.

Despite past improvements to point source discharges and land conservation efforts taken to improve water quality, both point and non-point sources of pollution continue to be pervasive and impact surface water quality in the watershed. Land use modification and hydrologic alteration including drainage and field tiling may be contributing factors to the observed poor water quality conditions. While some areas of the watershed have shown more resilience than others, additional monitoring, restoration, and protection strategies are needed to improve conditions and attain water quality standards. Considering that the problems are so ubiquitous, strategies for restoration should be targeted to areas that will yield the greatest amount of environmental improvement from implementation investments.

I. 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. MPCA's water management efforts are tied to the 1972 Federal Clean Water Act (CWA) requiring 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 the state's surface waters and to develop a list of water bodies that do not meet established standards. Such waters are referred to as "impaired waters" and the state must take appropriate actions to restore these waters, including the development of TMDLs. A TMDL is a comprehensive study identifying all pollution sources causing or contributing to impairment and the reductions needed to restore a water body so that it can 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 be successful preventing and addressing problems, decision makers need good information about the status of the resources, potential and actual threats, options for addressing the threats, and data on how effective management actions have been. 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 (CWLA) of 2006 provided a policy framework and initial resources to state and local governments to accelerate efforts to monitor, assess, restore, and protect surface waters. Funding from the Clean Water Fund created by the passage of the Clean Water, Land, and Legacy Amendment to the state constitution allows a continuation of this work. In response, the MPCA has developed a watershed monitoring strategy which uses an effective and efficient integration of water monitoring programs to provide a more comprehensive assessment of water quality and expedite the restoration and protection process. This has permitted the MPCA to establish a goal to assess the condition of Minnesota's surface waters via a 10-year cycle, and provides an opportunity to more fully integrate MPCA water resource management efforts in cooperation with local government and stakeholders, to allow for coordinated development and implementation of water quality restoration and improvement projects.

The rationale behind the watershed approach is to intensively monitor the 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 efforts. This monitoring strategy was first implemented in the state of Minnesota, in the North Fork Crow River Watershed beginning in the summer of 2007. This report provides a summary of all water quality assessment results, and incorporates all data available for the assessment process including watershed monitoring, volunteer monitoring, and monitoring conducted by local government units. Consequently, there is an opportunity to begin to address most, if not all, impairments through a coordinated TMDL process at a watershed scale, rather than the reach-by-reach and parameter-by-parameter approach often historically employed. A 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, restoring, and preserving the quality of Minnesota's water resources.

II. The Watershed Monitoring Approach

The watershed approach is a 10-year rotation for assessing waters of the state on the level of Minnesota's 81 major watersheds (Figure 1). The primary feature of the watershed approach is that it provides a unifying focus on the water resources within a watershed as the starting point for water quality assessment, planning, implementation, and results measures. 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 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).

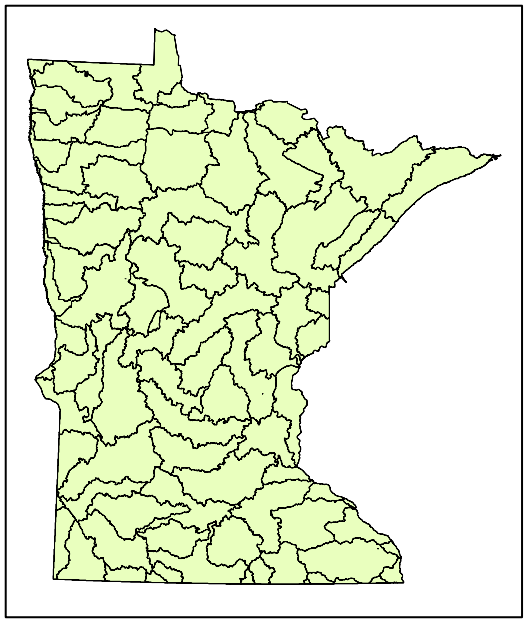

Figure 1. Major watersheds within Minnesota (8-Digit HUC).

Load monitoring network

The first component of this effort is the Major Watershed Load Monitoring Program (MWLMP), which involves permanent flow and water chemistry monitoring stations on Minnesota's major rivers, including the Red, Minnesota, Mississippi, and Rainy rivers, and the outlets of major tributaries (also referred to as outlets of each of the state's major watersheds). MWLMP staff and program cooperators monitor water quality at many of these outlets and at various locations along Minnesota's major rivers. Initiated in 2007 and funded with appropriations from Minnesota's Clean Water Fund, the MWLMP's multi-agency monitoring approach combines site specific stream flow data from United States Geological Survey (USGS) and Minnesota Department of Natural Resources (DNR) flow gauging stations. This partnership effort, along with water quality data collected by the Metropolitan Council Environmental Services (MCES), and local monitoring organizations, is a cornerstone of the watershed approach.

Water quality samples are collected year round at all MWLMP monitoring sites. Approximately 30-35 mid-stream grab samples are collected per site per year. Sample collection intensity is greatest during periods of moderate and high flow due to the importance these samples carry in pollutant load calculations. Sampling also occurs during low flow periods, but at a lower frequency. Water quality and discharge data are combined in the "Flux32 Pollutant Load Model" to create concentration/flow regression equations to estimate pollutant concentrations and loads on days when samples are not collected. Primary outputs from Flux32 include pollutant loads and flow weighted mean concentrations (FWMC). A pollutant load is defined as the amount (mass) of a pollutant passing a stream location over a given unit of time. The flow weighted mean concentration is used to estimate the overall quality of water passing this point, computed by dividing the pollutant load by the total flow volume that passed the stream location over the same given unit of time. Annual pollutant loads are calculated for total suspended solids (TSS), total phosphorus (TP), dissolved orthophosphate (DOP), and nitrate plus nitrite-nitrogen (nitrate-N). Primary outputs from Flux32 include pollutant loads (Table 1) and FWMC. When

fully implemented, the MWLMP will monitor and compute pollutant loads at 78 stream sites across the State.

Table 1. Annual Pollutant Loads by Parameter Calculated for the LeSueur River.

	2007	2008	2009
Parameter	**Mass (kg)**	**Mass (kg)**	**Mass (kg)**
Total Suspended Solids	184,870,862	88,494,162	36,798,178
Total Phosphorus	346,880	102,639	77,464
Ortho Phosphorus	136,622	29,347	25,020
Nitrate + Nitrite Nitrogen	7,299,217	4,447,932	1,422,467

The on-going monitoring performed by the program is designed to measure and compare regional differences and long-term trends in water quality. This will be particularly helpful in putting the intensive watershed monitoring data for a given watershed (see below) into a longer-term context, given that the intensive monitoring will occur only once every 10 years. The load monitoring network will also provide critical information for identifying baseline or acceptable loads for maintaining and protecting water resources. In the case of impaired waters, the data collected through these efforts will be used to aid in the development of TMDL studies, implementation of plans, assist watershed modeling efforts, and provide information to watershed research projects.

Intensive watershed monitoring

The intensive watershed monitoring strategy utilizes a nested watershed design allowing the aggregation of watersheds from large to fine scale. The foundation of this comprehensive approach are the 81 major watersheds within Minnesota. Sampling occurs in each major watershed once every 10 years. In this approach, intermediate-sized (approximately 11-digit HUC and “minor” (14-digit HUC) watersheds are sampled along with the major watershed outlet to provide a complete assessment of water quality (Figure 2).

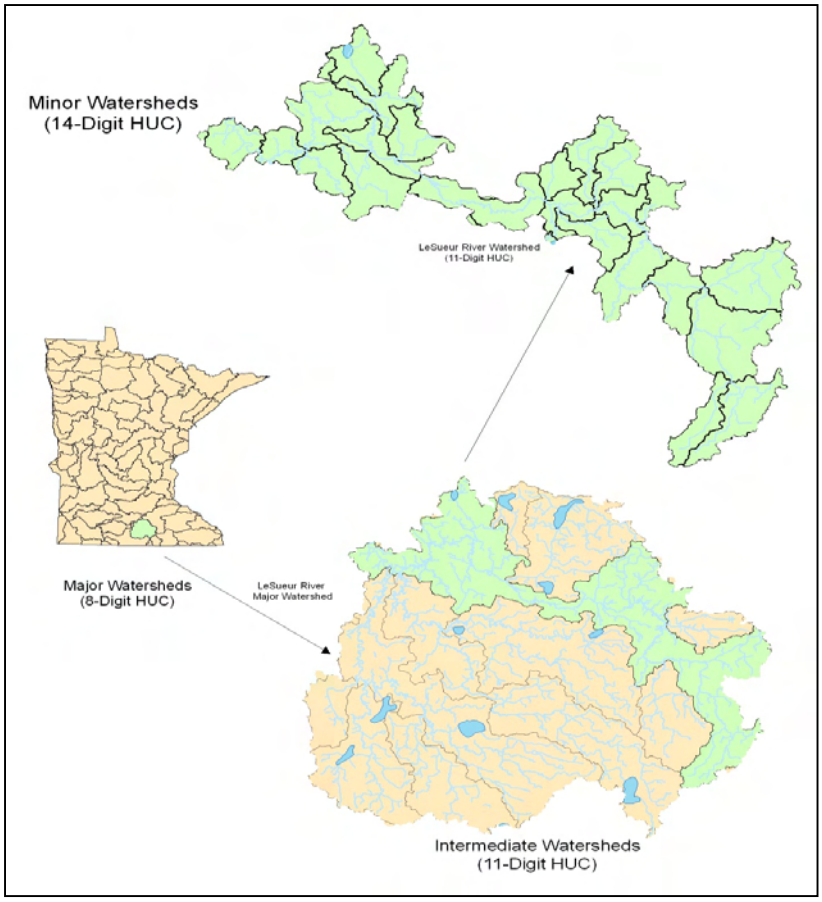

Figure 2. Map of the LeSueur River watershed approach

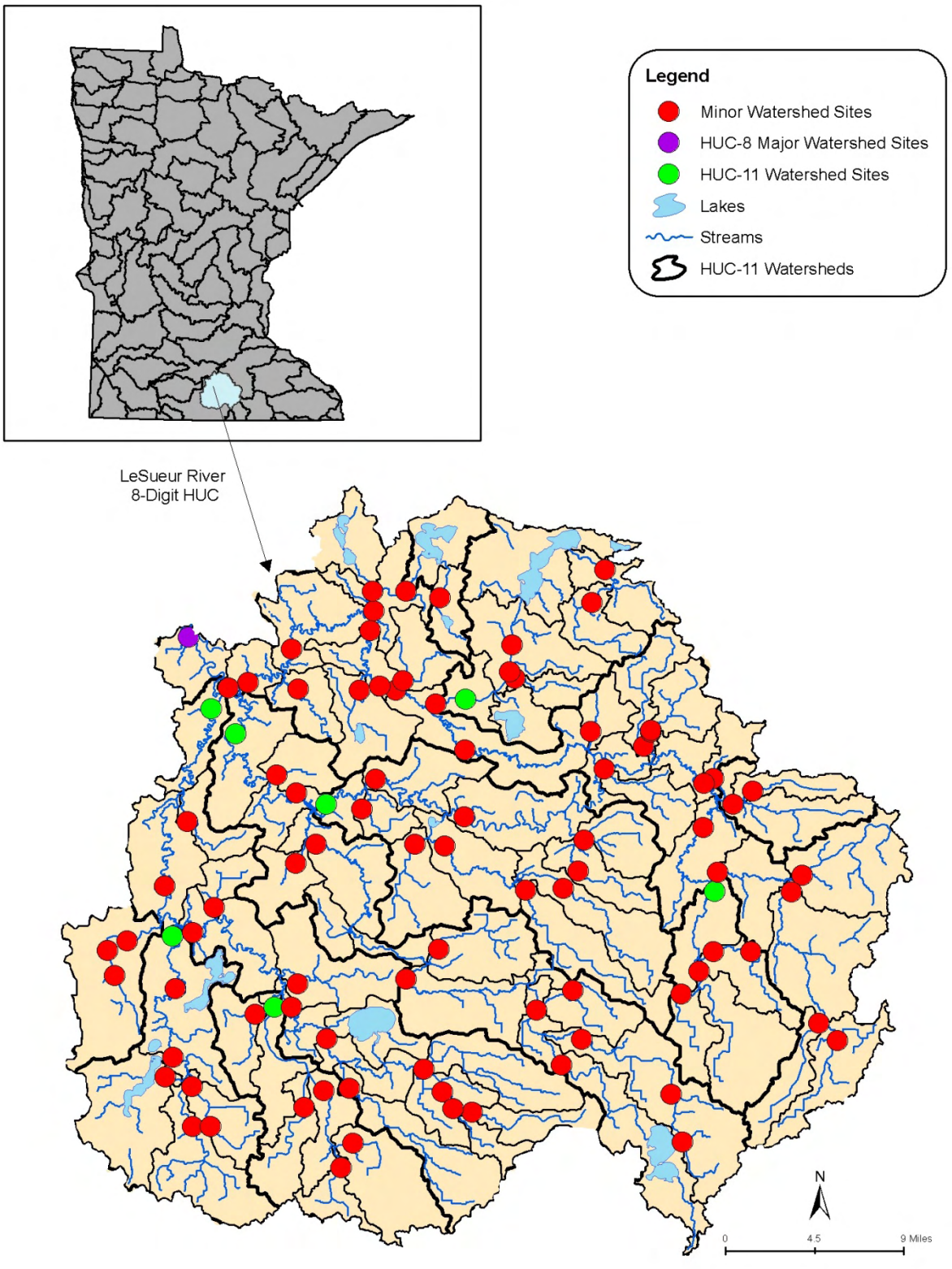

Figure 3. Intensive watershed monitoring stations in the LeSueur River Watershed

River/stream sites are selected near the outlet at all watershed scales. This approach provides holistic assessment coverage of rivers and streams without monitoring every single stream reach (See Figure 3 for an illustration of the monitoring site coverage within the LeSueur River major watershed).

The outlet of the major watershed (purple dot in Figure 3) is sampled for biology, water chemistry, and fish contaminants to allow for the assessment of aquatic life, aquatic recreation, and aquatic consumption use-support. Each 11-digit HUC outlet (green dots in Figure 3) is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use-support. Watersheds at this scale generally consist of major tributary streams with drainage areas ranging from 75 to 150 square miles. Lastly, most minor watersheds (typically 10-20 square miles) are sampled for biology (fish and macroinvertebrates) to assess for aquatic life use-support (red dots in Figure 3). Specific locations for sites sampled as part of the intensive monitoring effort in the LeSueur River Watershed can be found in Appendix 1. While most intensive watershed monitoring is conducted by MPCA staff, Clean Water Funding is also passed through to our local partners through Surface Water Assessment Grants (SWAGs) for the purpose of monitoring water chemistry at some of the 11-digit HUC sites, and for water chemistry monitoring at other stream sites within a given watershed.

The second step of the intensive watershed monitoring effort consists of follow-up monitoring at areas determined to have impaired waters. This follow-up monitoring is designed to collect the information needed to initiate the stressor identification process, in order to identify the source(s) and cause(s) of impairment to be addressed in TMDL development and implementation.

Lake monitoring

The MPCA conducts and supports lake monitoring for a variety of objectives. Lake condition monitoring activities are focused on assessing the recreational use support of lakes and identifying trends over time. The MPCA also assesses lakes for aquatic consumption use support, based on fish-tissue and water-column concentrations of toxic pollutants. Lake monitoring was also brought into the watershed monitoring framework in 2009.

Even when pooling MPCA and local resources, the MPCA is not able to monitor all lakes in Minnesota. The primary focus of MPCA monitoring is lakes $\geq$500 acres in size (“large lakes”). These resources typically have public access points, they generally provide the greatest aquatic recreational opportunity to Minnesota’s citizens, and these lakes collectively represent 72 percent of the total lake area (greater than 10 acres) within Minnesota. Though the primary focus is on monitoring and assessing larger lakes, the MPCA is also committed to directly monitoring, or supporting the monitoring of, the majority of lakes between 100-499 acres (“small lakes”) for assessment purposes.

Citizen and local monitoring

Citizen monitoring is an important components of the watershed monitoring approach. The MPCA coordinates two programs aimed at encouraging citizen surface water monitoring: the Citizen Lake Monitoring Program (CLMP) and the Citizen Stream Monitoring Program (CSMP). Like the permanent load monitoring network, sustained citizen monitoring can provide the long-term picture needed to help evaluate current status and trends. The advance identification of lake and stream sites that will be sampled by agency staff provides an opportunity to actively recruit volunteers to monitor those sites too, so that water quality data collected by volunteers are available for the years before and after the intensive monitoring effort by MPCA staff. This citizen-collected data helps agency staff interpret the results from the intensive monitoring effort, which only occurs one out of every 10 years. It also allows

interested parties to track any water quality changes that occur in the years between the intensive monitoring events. Coordinating with volunteers to focus monitoring efforts where it will be most effective for planning and tracking purposes will help local citizens/governments see how their efforts are being used to inform water quality management decisions and affect change. Figure 4 provides an illustration of citizen monitoring data used for assessment in the LeSueur River Watershed.

The MPCA also passes through funding via SWAGs to local groups such as counties, soil and water conservation districts (SWCDs), watershed districts, nonprofits, and educational institutions to monitor lake and stream water quality. These local partners greatly expand our overall capacity to conduct sampling. Many SWAG grantees invite citizen participation in their monitoring projects.

The annual SWAG Request for Proposal (RFP) indentifies the major watersheds that are scheduled for upcoming intensive monitoring activities. HUC-11 stream outlet chemistry sites and lakes less than 500 acres that need monitoring are identified in the RFP and local entities are invited to request funds to complete the sampling. SWAG grantees conduct detailed sampling efforts following the same established monitoring protocols and quality assurance procedures used by the MPCA. All of the lake and stream monitoring data from SWAG projects are combined with the MPCA's monitoring data to assess the condition of Minnesota lakes and streams.

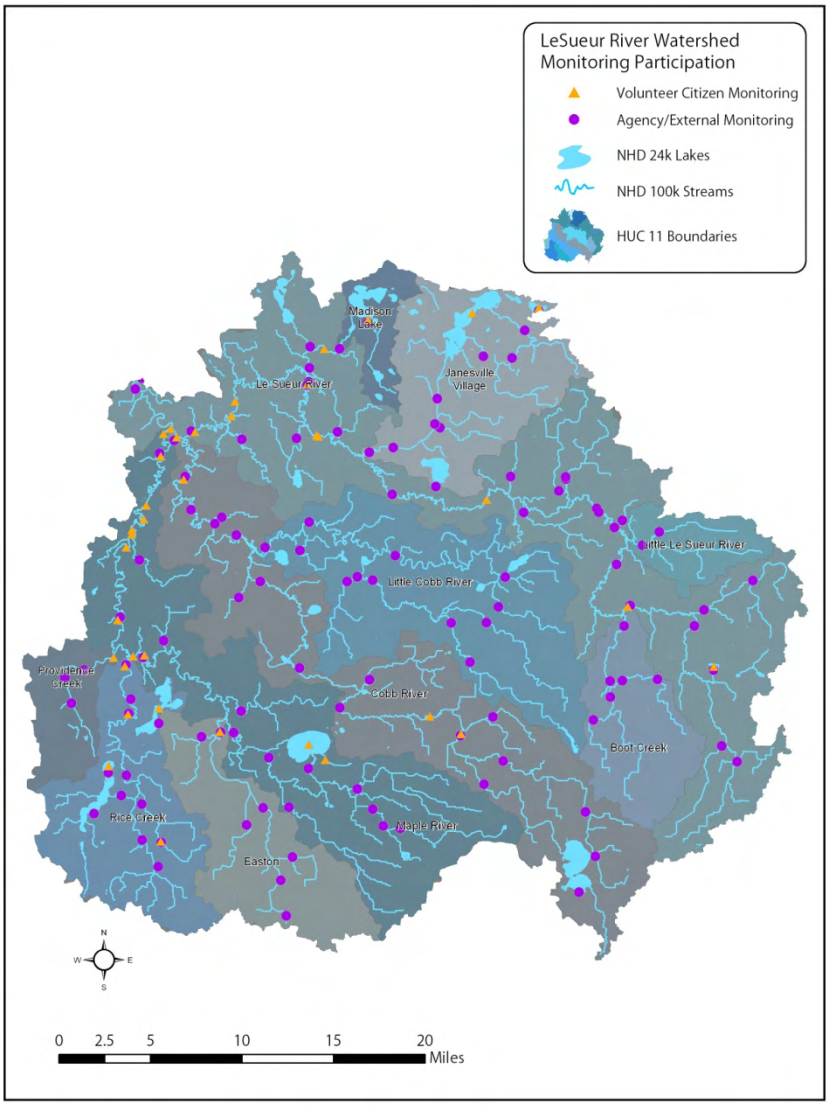

Figure 4. Monitoring locations of local groups, citizens, and MPCA staff in the LeSueur River Watershed

III. Assessment Methodology

The Clean Water Act 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. 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 methodology see: *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List* (MPCA 2012). http://www.pca.state.mn.us/index.php/view-document.html?gid=8601

Water quality standards

Water quality standards are the fundamental benchmarks by which the quality of surface waters are measured and used to determine impairment. Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by Minnesota Water Quality Standards (Minn. R. 7050 2008) (https://www.revisor.leg.state.mn.us/rules/?id=7050). 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. Protection of aquatic life means the maintenance of healthy, diverse and successfully reproducing populations of aquatic organisms, including fish and invertebrates. Protection of recreation means the maintenance of conditions suitable for swimming and other forms of water recreation. Protection of consumption means protecting citizens who eat fish inhabiting Minnesota waters or receive their drinking water from water bodies protected for this use.

Numeric water quality standards represent concentrations of specific pollutants in water that protect a specific designated use. Ideally, if the standard is not exceeded, the use will be protected. However, nature is very complex and variable, therefore the MPCA uses a variety of tools to fully assess designated uses. Assessment methodologies often differ by parameter and designated use. Furthermore, pollutant concentrations may be expressed in different ways such as chronic value, maximum value, final acute value, magnitude, duration and frequency.

Narrative standards are statements of conditions in and on the water, such as biological condition, that protect their designated uses. Interpretations of narrative criteria for aquatic life support in streams are based on multi-metric biological indices including the Fish Index of Biological Integrity (F-IBI), which evaluates the health of the fish community, and the Macroinvertebrate Index of Biological Integrity (M-IBI), which evaluates the health of the aquatic invertebrate community. Biological monitoring is a direct means to assess aquatic life use support, as the aquatic community tends to integrate the effects of pollutants and stressors over time.

Assessment units

Assessments of use support in Minnesota are made for individual water bodies. The water body unit used for river systems, lakes and wetlands is called the "assessment unit identification (AUID)". 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 water body identifier (known as its AUID), comprised of the USGS eight digit hydrologic unit code plus a three character code that is unique within each HUC. Lake and wetland identifiers are assigned by the DNR. The Protected Waters Inventory 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. All data from sampling stations with in this reach are considered as a group. Therefore, any assessments of use support are 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 for 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 status

Conceptually, the process for determining use attainment status of a waterbody is similar for each designated use: comparison of monitoring data to established water quality standards. However, the complexity of that process and the amount of information required to make accurate assessments varies between uses. In part, the level of complexity in the assessment process depends on the strength of the dose-response relationship; i.e., if a chemical exceeds its water quality criterion, how often is the beneficial use truly not being attained. For beneficial uses related to human health, such as drinking water, the relationship is well understood and thus the assessment process is a relatively simple interpretation of 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 5.

The first step in the aquatic life assessment process is a comparison of the monitoring data to water quality standards. This is largely an automated process performed by logic programmed into a database application and the results are referred to as 'Pre-Assessments'. 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 attenuating circumstances that should be considered (e.g., flow, time/date of data collection, habitat).

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 2012) for guidelines and factors to consider when making such determinations. http://www.pca.state.mn.us/index.php/view-document.html?gid=8601.

Any new impairment determination (i.e., waterbody not attaining its beneficial use) is reviewed using GIS to determine if greater than 50 percent of the assessment unit is channelized. Currently, the MPCA is deferring listing any new impairments on channelized reaches until new aquatic life use standards have been developed as part of the tiered aquatic life use framework. For additional information see: Tiered Aquatic Life Use (TALU) Framework. http://www.pca.state.mn.us/nwqh8fb.

The last step in the assessment process is the Professional Judgement Group or PJG 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 have a strong interest in the outcomes of the assessment process. Information obtained during this meeting may be used to revise previous use attainment decisions. The result of this meeting is a compilation of the assessed waters which will be included in the watershed assessment report. 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.

Data management

It is MPCA policy to use all credible and relevant monitoring data to assess surface waters. The MPCA relies on data it collects along with data from other sources, such as sister agencies, local government and volunteers. The data must meet rigorous quality-assurance protocols before being used. The MPCA stores surface monitoring data in U.S. Environmental Protection Agency (EPA's) STORET system and all monitoring data required or paid for by MPCA is entered into EQuIS, MPCA's front end data portal to STORET. Projects funded by MPCA include Clean Water Act Section 319 projects, CWP projects, SWAG projects and more recently, TMDL projects. Many local projects not funded by MPCA choose to submit their data to the MPCA in STORET-ready format so that it may be utilized in the assessment process. Prior to each biennial assessment cycle, the MPCA publishes a "Call for Data" in the State Register and contacts partner organizations directly to request their monitoring data.

Period of record

The MPCA uses data collected over the most recent 10 year period for all water quality assessments. Generally, the most recent data from the 10-year assessment period is reviewed first when assessing toxic pollutants, eutrophication and fish contaminants. Also, the more recent data for all pollutant categories may be given more weight during the comprehensive watershed assessment or professional judgment group meetings. The goal is to use data from the 10 year period that best represents the current water quality conditions. Using data over a 10 year period provides a reasonable assurance that data will have been collected over a range of weather and flow conditions and that all seasons will be adequately represented; however, data for the entire period is not required to make an assessment.

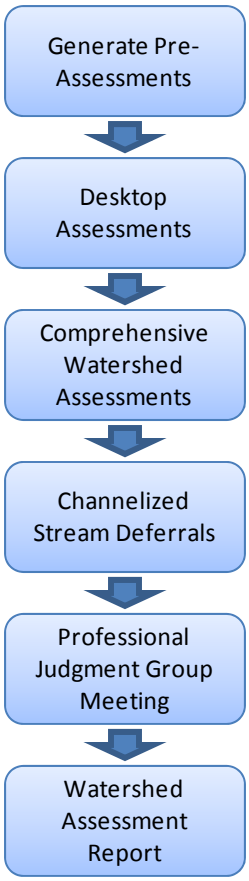

Figure 5. Flowchart of aquatic life use assessment process

IV. The LeSueur River Watershed Overview

Land use summary

The LeSueur River watershed covers a 287,176 hectare (710,832 acre) area in south central Minnesota within the Minnesota River Basin. A majority of the watershed lies within the Western Corn Belt Plains (WCBP) ecoregion with a small portion residing in the North Central Hardwoods Forest (NCHF) ecoregion (Figure 7). The watershed drains to the northwest into the Blue Earth River (and sub-sequentially into the Minnesota River) via the LeSueur River approximately two miles southwest of Mankato. Agriculture accounts for the majority of land use activities within the watershed (Figure 6). Watershed land use areas were estimated based on data from the University of Minnesota Remote and Geospatial Analysis Lab. Overall land cover percentages in the watershed are: forest (1.5 percent), rangeland (3.8 percent), wetland (3.5 percent), cropland (82.7 percent), developed (6.4 percent), and open water (2.0 percent) (Figure 6).

Land use within the LeSueur watershed is primarily agricultural, accounting for approximately 87 percent of the available acres. Two-year corn/soybean rotations comprise approximately 93 percent of cropped lands within the watershed (USDA-NRCS, 2009). Farm land within the LeSueur Watershed is highly drain tiled. There are currently 895 permitted feedlots and 52 permitted waste water dischargers.

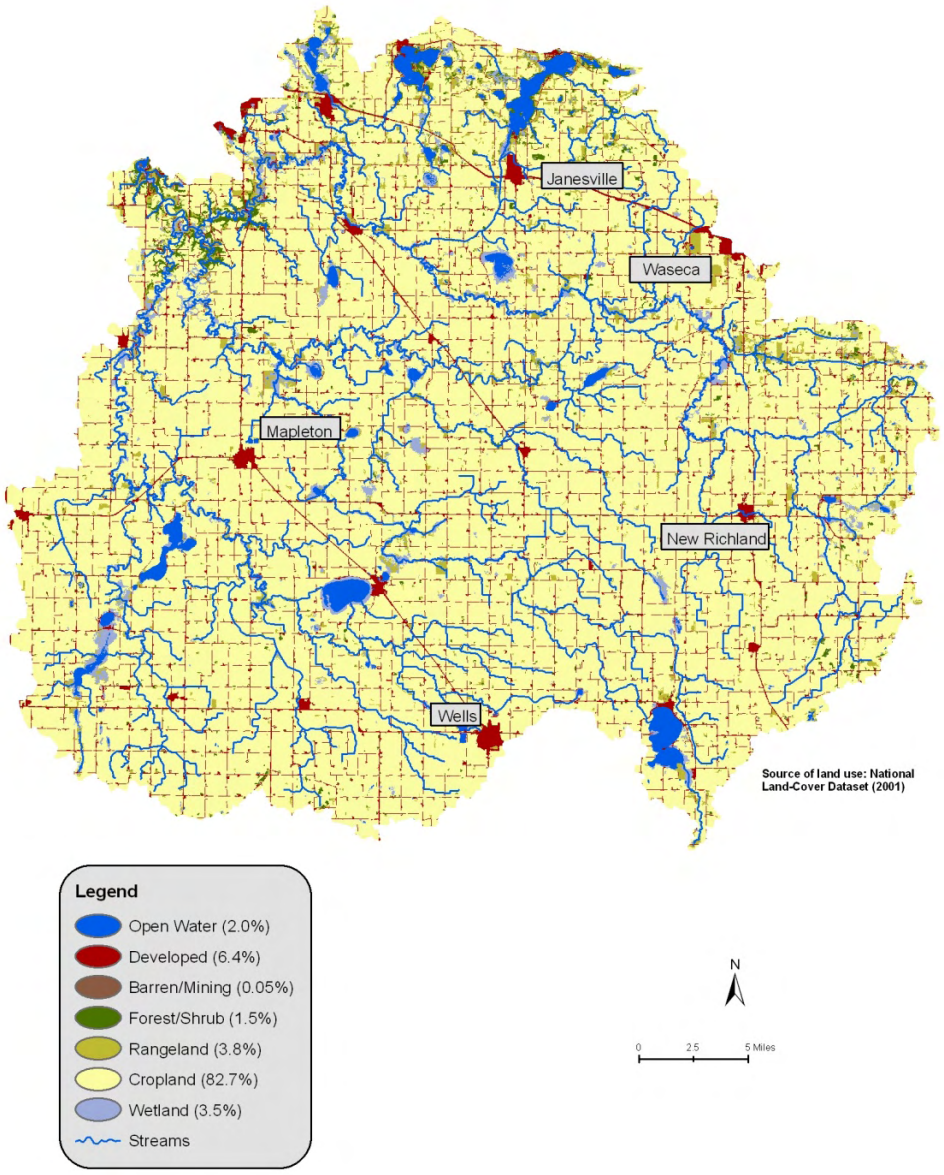

Figure 6. Land use map for the LeSueur River Watershed

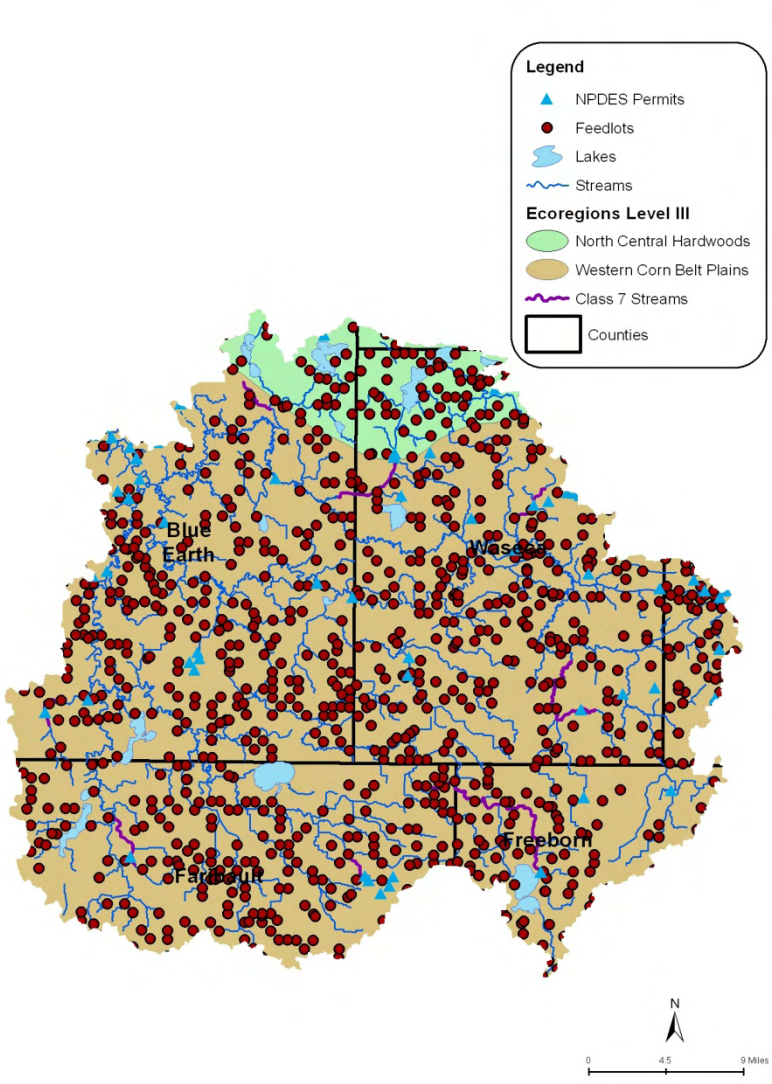

Figure 7. Map of ecoregions, feedlots and waste water permits for the LeSueur River Watershed

Surface water hydrology

The LeSueur Watershed lies completely within the South-Central Minnesota Groundwater Province of Minnesota's ecological classification system. This province is generally characterized by thick clayey glacial drift with limited extent sand aquifers. Surficial sediments in the watershed are glacially derived. The western half of the watershed is dominated by a relatively flat area composed of silt and clay deposits. This area is the remnant of glacial Lake Minnesota. (Figure 8).

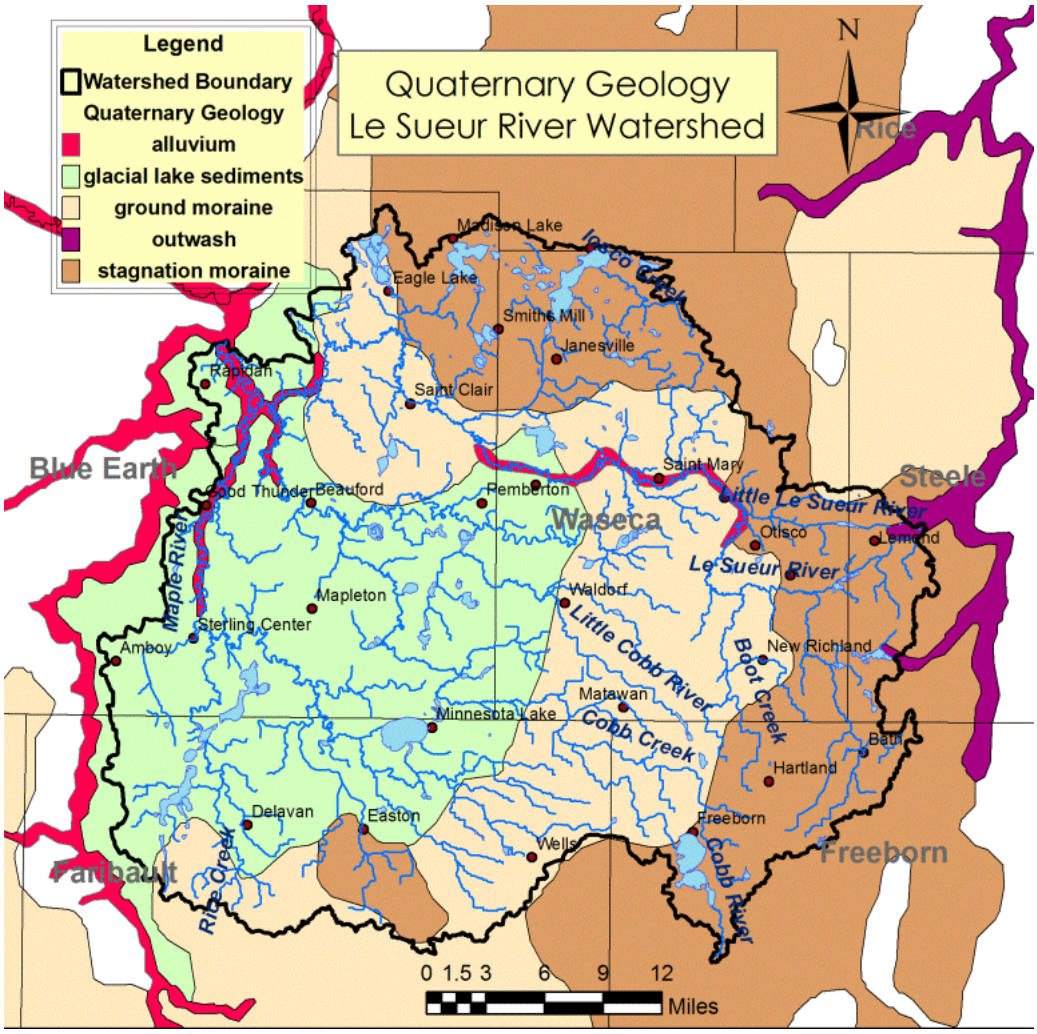

Figure 8. Geology of the LeSueur River Watershed

Wrapping around the glacial lake sediments to the east and north are ground moraine and stagnation moraine deposits, composed of rolling hills of unstratified till (sand, silt, and clay). Limited and discontinuous sand aquifers occur within the glacial deposits. Sand aquifers also occur along the outwash valleys of the Maple and Cobb Rivers. Glacial sediments in the watershed generally range from 100 to 200 feet in thickness.

Glacial sediments are underlain in the eastern two-thirds of the watershed by sandstone and limestone aquifers. Crystalline bedrock underlies the watershed in the western third.

Precipitation and climate in the LeSueur River Watershed

Precipitation in the LeSueur River watershed ranges from 29 to 33 inches annually (USDA-NRCS, 2009). Rain gauge records from the watershed's drainage point near Mankato, Wells, Waseca, and Amboy indicate dry conditions throughout the watershed in water year 2009 (October 2008 through September 2009). The average precipitation (based on rain gauge data collected from May through September) from the four locations was 11.2 inches. This was about six-ten inches below normal for 2009. Major rain events increase runoff throughout the watershed and may influence stream and lake levels and

water quality. While overall precipitation was below normal, there were several major rain events in 2008-2009. The bulk of monitoring for this watershed was completed between 2008 and 2009. The annual rainfall amounts for the years 2008 and 2009 in the LeSueur were slightly below the historical mean for the period 1915 to 2009.

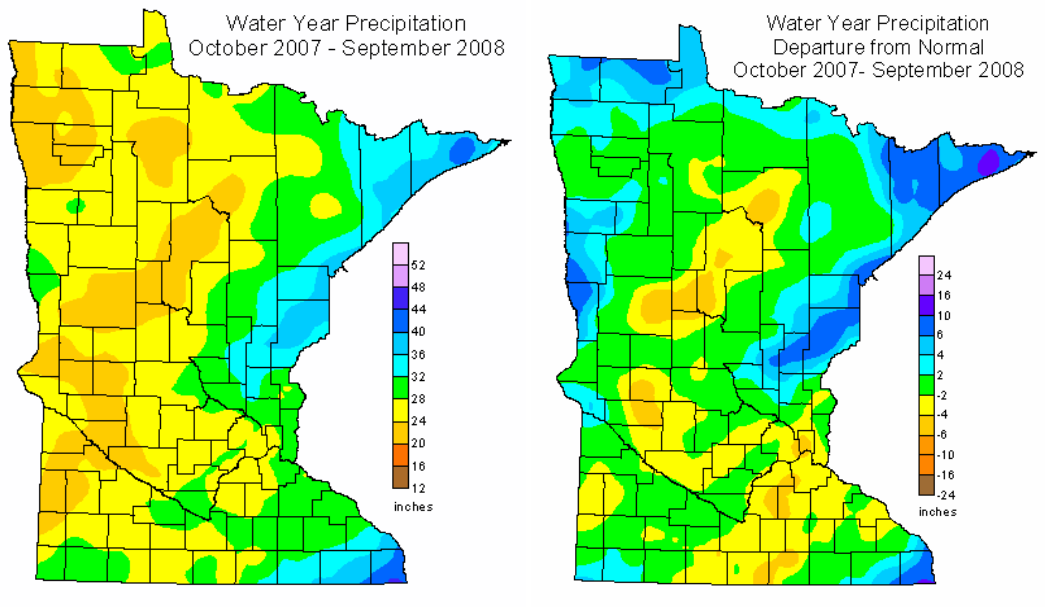

Figure 9. Precipitation and departure from normal precipitation maps for Minnesota during the 2007-2008 Water year

Surficial and groundwater withdrawals

Groundwater quantity

Groundwater quantity issues are not currently significantly impacted by irrigation in the LeSueur Watershed. Farm irrigation is not common because of the absence of readily accessible aquifers; in 2008 only nine irrigation wells had been permitted in the watershed.

Farm fields in the watershed are heavily tiled. Tiling removes standing water from fields. Groundwater hydrology is likely affected by farm field tiling in the watershed, but effects have not yet been adequately studied or evaluated.

Groundwater quality

Nitrates are the most common groundwater contaminant in the watershed. From baseline groundwater monitoring and ambient monitoring efforts in the LeSueur River watershed, the MPCA has nitrate data for 16 wells. The most recent nitrate concentrations for these wells range from 0.02 to 8 mg/L. The EPA drinking water standard for nitrate (maximum contaminant level [MCL]), is 10 mg/L. The total depth of these wells ranges from 80 ft. to 382 ft. and the depth-to-water ranges from 10 ft. to 160 ft. for the 12 wells that have depth data.

V. Watershed-Wide Data Collection Methodology

Load monitoring

The LeSueur River is monitored for pollutant loading at Hwy 66 near Rapidan approximately one mile before its confluence with the Blue Earth River. Water chemistry and discharge data are input into the "Flux32" load estimation program to estimate pollutant concentrations and loads on days when samples are not collected. Primary outputs include: annual pollutant loads, defined as the amount (mass) of a pollutant passing a stream location over a defined period of time; watershed yield, which describes amount of pollutant delivered per acre; and flow weighted mean concentrations, which are computed by dividing the pollutant load by the total seasonal flow volume. These are calculated for total suspended solids (TSS), total phosphorus (TP), orthophosphate (OP), Total Kjeldahl Nitrogen (TKN) and nitrate plus nitrite nitrogen (nitrate-N).

Stream water sampling

Eight water chemistry stations were sampled from May through September in 2008 and again in June through August of 2009 to provide sufficient water chemistry data to assess all components of the Aquatic Life and Recreation Use Standards in the 11 HUC subwatersheds (green circles and triangles in Figure 3). The first year of sampling was conducted by MPCA staff. A Surface Water Assessment Grant (SWAG) was then awarded to the Water Resources Center (WRC) at Minnesota State University Mankato to complete the monitoring in the second year. Following the IWM design, sampling locations were established near the outlets of the intermediate 11-HUC watersheds. The WRC and the Met Council have actively sampled the watershed for many years and has compiled an extensive data set. The additional data collected for this project filled in existing data gaps needed for a more complete watershed assessment. Due to the small drainage area of the Providence Creek, Easton and Madison Lake subwatersheds (11-HUC), intensive chemistry collection stations were not placed at their outlets. Instead, the MPCA will assess the condition of these small watersheds using existing data. See Appendix 2 for locations of stream water chemistry monitoring sites. See Appendix 1 for definitions of stream chemistry analytes monitored in this study.

Stream biological sampling

The biological monitoring component of the intensive watershed monitoring in the LeSueur Watershed was completed during the summer of 2008. A total of 99 sites were established across the watershed and sampled. These sites were located near the outlets of most minor HUC-14 watersheds, selected following the sampling design. Eighteen of these sites were previously sampled biological monitoring stations within the watershed were revisited in 2008. These monitoring stations were initially established as part of a random Minnesota River Basin wide survey in 2000 or as part of a 2007 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 2010 assessment was collected in 2008. A total of 76 AUIDs were sampled for biology and or water chemistry in the LeSueur River Watershed. Waterbody assessments to determine aquatic life use support were conducted for 23 AUIDs. Waterbody assessments were not conducted for 53 AUIDs because of lack of suffiecient data or assessment criteria for channelized and class 7 streams had not been developed prior

to the assessments. Nonetheless, the biological information that was not used in the assessment process will be helpful 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 the biological communities at each biological monitoring station an Index of Biological Integrity (IBI) was used, specifically the Fish Index of Biological Integrity (F-IBI) and the Macroinvertebrate Index of Biological Integrity (M-IBI). A fish and macroinvertebrate classification framework was developed to account for natural variation in community structure. For both the F-IBI and the M-IBI, Minnesota's streams and rivers were divided into seven distinct classes, with each class having its own unique IBI. The classification factors used to produce the seven classes were drainage area, gradient, water temperature and geographic region of the state. Fish and macroinvertebrate communities occurring at sites within each class are more similar to each other than those occurring in other classes. These classification factors are unaffected by human disturbance to ensure that the framework reflects natural variability and that the resulting IBIs reflect human-induced impacts to the waterbody. IBI development was stratified by class, with a unique suite of metrics, scoring functions, impairment thresholds, and confidence intervals identified for each. IBI scores higher than the impairment threshold indicate that the stream reach supports its aquatic life use; contrarily, scores below the impairment threshold indicate that the stream reach does not support its aquatic life use. Confidence limits around the impairment threshold help to ascertain where additional information may be considered to help inform the impairment decision. When IBI scores fall within the confidence interval, interpretation and assessment of waterbody condition involves consideration of potential stressors, and draws upon additional information regarding water chemistry, physical habitat, land use activities, etc. For individual biological monitoring station IBI scores, thresholds and confidence intervals for all biological monitoring sites within the watershed refer to Appendix 4.

Lake water sampling

The MPCA collects water quality data for lakes from May through September for each of the applicable years. Data collected from June through September is used to assess the lake's condition while May data is collected to observe lake conditions near the spring turn over and compare this with the remaining seasonal data. Lake surface samples were collected with an integrated sampler, a polyvinyl chloride (PVC) tube two meters (6.6 feet) in length with an inside diameter of 3.2 centimeters (1.24 inches). Depth total phosphorous (TP) samples were collected with a Kemmerer sampler. For lakes sampled by the MPCA, sampling procedures were employed as described in the MPCA Standard Operating Procedure for Lake Water Quality document, which can be found at: http://www.pca.state.mn.us/publications/wq-s1-16.pdf. Samples collected by the MPCA were sent to the Minnesota Department of Health using Environmental Protection Agency-approved methods for laboratory analysis. Samples were analyzed for nutrients, color, solids, pH, alkalinity, conductivity, and chlorophyll-*a* (chl-*a*). Temperature and dissolved oxygen (DO) profiles and Secchi disk transparency measurements were also taken. Historical DO and temperature profiles were used for water column analysis in the absence of more recent data.

Fish contaminants

Mercury and polychlorinated biphenyls (PCBs) were analyzed in fish tissue samples collected from the LeSueur River in 2008. Three lakes in the LeSueur watershed had contaminant data collected since 2000. The river fish were collected by the MPCA biomonitoring unit and the lake fish were collected by the DNR. After collection, the fish were wrapped in aluminum foil and frozen until they were thawed, scaled,

filleted, and ground. The homogenized fillets were placed in 125 mL glass jars with Teflon™ lids and frozen until thawed for mercury or PCBs analyses. The Minnesota Department of Agriculture Laboratory performed all mercury and PCBs analyses of fish tissue. In 2009, fish were collected from Madison Lake and analyzed for perfluorochemicals (PFCs). The fish were shipped to AXYS Analytical Ltd for processing and analysis of the fish for PFCs.

Prior to 2006, mercury fish tissue concentrations were assessed for water quality impairment based on the Minnesota Department of Health's fish consumption advisory. An advisory more restrictive than a meal per week was classified as impaired for mercury in fish tissue. Since 2006, a waterbody has been classified as impaired for mercury in fish tissue if 10 percent of the fish samples (measured as the 90th percentile) exceed 0.2 mg/kg of mercury, which is one of Minnesota's water quality standards for mercury. At least five fish samples are required per species to make this assessment and only the last 10 years of data are used for statistical analysis. MPCA's Impaired Waters Inventory includes waterways that were assessed as impaired prior to 2006 as well as more recently.

PCBs in fish have not been monitored as intensively as mercury in the last three decades due to monitoring completed in the 1970s and 1980s. That implied that it was not necessary to continue widespread frequent monitoring of smaller river systems as is done with mercury. Impairment assessment for PCBs in fish tissue is based on the fish consumption advisories prepared by the Minnesota Department of Health. If the consumption advice is to restrict consumption of a particular fish species to less than a meal per week because of PCBs, the MPCA considers the lake or river impaired. The threshold concentration for impairment is 0.22 mg/kg PCBs and more restrictive advice is recommended for consumption (one meal per month).

VI. Individual Watershed Results

HUC-11 watershed units

Assessment results are presented for each of the HUC-11 watershed units within the LeSueur River Watershed. This scale provides a robust assessment of water quality condition in the watershed unit and is a practical size for the development, management, and implementation of effective TMDLs and protection strategies. The primary objective is to portray all the impairments within a watershed resulting from the complex and multi-step assessment and listing process. The graphics presented for each of the HUC-11 watershed units contain the assessment results from the most recent 2010 Assessment Cycle as well as any impairment listings carried forward from previous assessment cycles. Discussion of assessment results will focus primarily on the 2008 intensive watershed monitoring effort but will consider all available data. The HUC-11 watershed graphics display impairment of aquatic consumption use support (mercury in fish tissue) on the LeSueur main-stem but are not discussed further as they were covered in the previous section (fish contaminants). Following the results by HUC-11 watershed 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 LeSueur major watershed (HUC-8). Given all of the potential sources of data and differing methodologies for assessing indicators and designated uses it is not feasible to provide results or summary tables for every monitoring station by parameter. However, in the proceeding pages an individual account of each 11 HUC subwatershed is provided. Within each account, readers are given a brief description of the subwatershed, a stream assessment table where an overall assessment result is provided for each AUID by each assessable parameter and designated use (i.e. aquatic life and aquatic recreation), a non assessed channelized AUID

table describing the quality of these AUIDs, a stream habitat results table, a outlet water chemistry results table, a table describing lake water chemistry, and a narrative summary relating the unique components of the assessment and highlighting interesting findings in the results.

Stream assessment

This table provides a summary of all assessable AUIDs by parameter within the watershed (where sufficient information was available to make an assessment). The tables denote the use support status of each individual water chemistry and biological parameter, as well as an overall use support assessment for aquatic life and aquatic recreation for each assessable AUID. The assessment for aquatic life is derived from analyzing biological data, DO, turbidity, chloride, pH and NH3 to determine use status, while the assessment for aquatic recreation in streams is solely based on E. coli concentrations. Immediately following the AUID specific use support results, the location of any assessed biological monitoring sites are listed. Water chemistry station locations are not provided because information collected at specific locations within each AUID are combined for the purposes of conducting waterbody assessments. Some AUIDs within the subwatershed do not have sufficient information for assessment and are not included in this table. Following the stream assessment table is a table describing a narrative biological condition of stations that could not be assessed due to their occurrence on channelized AUIDs and is not an assessment for aquatic life for these systems. For more information regarding chemistry parameters monitored in these studies refer to Appendix 1. A complete listing of all AUIDs within the watershed may be found in Appendix 3.

Stream habitat results

These tables convey the results of the Minnesota Stream Habitat Assessment (MSHA) surveys that are conducted during each fish sampling visit. The MSHA provides information on available fish habitat, land use and buffers along the immediate site reach, providing clues for impacts such as siltation or eutrophication which may lead to unhealthy fish and macroinvertebrate communities. The MSHA score is comprised of numerous scoring categories including land use, riparian zone, in-stream zone (substrate, embeddedness, cover types and amounts) and channel morphology (depth variability, sinuosity, stability, channel development, velocity), which are summed for a total possible score of 100 points. Total scores for each category and a summation of the total MSHA score are included with a narrative rating of good, fair or poor, indicating the overall condition of the 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 for each scoring category for that particular subwatershed. http://www.pca.state.mn.us/index.php/component/option,com_docman/task,doc_view/gid,6088

Outlet water chemistry results

These summary tables display the water chemistry results for the intensive watershed station representing the outlet of the HUC-11 watershed. This data along with other data collected within the 10 year assessment window can provide valuable insight on water quality characteristics and potential parameters of concern within the watershed and includes those parameters most closely related to the standards or expectations used for determining the assessments (i.e. supporting aquatic life and aquatic recreational use). While not all of the water chemistry parameters of interest have developed water quality standards, McCollor and Heiskary (1993) developed ecoregion expectations for a number of water quality parameters in streams that provide a good basis for evaluating water quality data and

estimating attainable water quality for an ecoregion. For comparative purposes, water chemistry results for the LeSueur River Watershed are compared to expectations developed by McCollor and Heiskary (1993) that were based on the 75th percentile of a long term dataset of least impacted streams.

Lake water chemistry

These summary tables display lake water chemistry results for all lakes where assessment quality data is present. Basic morphometry data, trophic status, trophic status indicators, trend data (based on volunteer monitoring statistics) and the assessment status is provided where available. A complete listing of all lakes within the watershed including those without sufficient data for assessments may be found in the MPCA LeSueur River Watershed Lakes Report: http://www.pca.state.mn.us/veizadfSe Sueur River Water Unit HUC07020011010

LeSueur River Watershed Unit - HUC

Watershed description

The LeSueur River HUC-11 watershed Unit lies in the northern half of the LeSueur River watershed. The watershed is 280 square miles and represents 25 percent of the entire LeSueur River watershed. . The LeSueur watershed encompasses the main stem of the LeSueur River (about 110 miles), Eagle Lake, and several short and medium length county and judicial ditch systems. Cropland is the major land use within this watershed (80.2 percent). The river starts in southwest Steele and the northern part of Freeborn counties and flows west into central Waseca County and into northeastern Blue Earth County where it drains into the Blue Earth River two miles southwest of Mankato. The LeSueur River HUC-11 watershed receives input from all of the other 11-digit HUC Watersheds. Tributaries located with the LeSueur River Watershed Unit include county ditches 12, 35, 38, 88, 19, 46, 15-2 and several unnamed tributaries. Biological station 08MN001 represents the outlet of the 11-digit and 8-digit HUC was also the fish contaminant station for the watershed.

Table 2. Water chemistry assessments on assessed AUIDs in the LeSueur River 11 HUC

AUID	USE Class	Acetochlor	Alachlor	Atrazine	Cl	E. coli	Metolachlor	NO2&NO3	pH	Phosphorus	T	NH3	DO
07020011-501, LeSueur River, Maple R to Blue Earth R	2B	NS	FS	FS	FS	FS	FS	NS	FS	IF	NS	FS	IF
07020011-507, LeSueur River, CD 6 to Cobb R	2B	--	--	--	--	NS	--	NS	FS	IF	NS	FS	IF
07020011-619, LeSueur River, Headwaters to Boot Cr	2B	--	--	--	--	--	--	--	--	--	NS	--	--
07020011-620, LeSueur River, Boot Cr to CD 6	2B	--	--	--	--	--	--	--	--	--	NS	--	--

Abbreviations:

T – Turbidity
Cl – Chloride
NO2&NO3 – Nitrate andNitrite
NH3 – Unionized Ammonia
pH – pH
DO – Dissolved Oxygen

NA = Not Assessed
FS = Fully Support
IF = Insufficient Information
-- = No Data
NS = Non-Support

Table 3. Use and biology assessments on assessed AUIDs in the LeSueur River 11 HUC

AUID	Biological Station ID	USE Class	F-IBI	M-IBI	Aquatic Life Use	Aq. Rec.	LR
07020011-501, LeSueur River, Maple R to Blue Earth R	08MN001	2B	NS	FS	NS	FS	--
07020011-506, LeSueur River, Cobb R to Maple R	08MN036	2B	FS	FS	IF	NA	--
07020011-507, LeSueur River, CD 6 to Cobb R	03MN071	2B	NS	FS	NS	NS	--
	08MN035						
	90MN105						
07020011-510, Unnamed creek, Unnamed cr to LeSueur R	08MN032	2B	FS	NS	FS	NA	--
07020011-511, County Ditch 35, Headwaters to LeSueur R	08MN030	2B	NS	NS	IF	NA	--
07020011-512, County Ditch 38, Headwaters to Unnamed cr	08MN050	2B	NA	NA	NA	NA	--
07020011-544, Unnamed creek, Unnamed cr to Unnamed cr	01MN040	2B	NA	NA	NA	NA	--
07020011-546, Unnamed creek, Unnamed cr to LeSueur R	08MN028	2B	NA	NA	NA	NA	--
07020011-558, County Ditch 12, T107 R23W S27, north line to Unnamed cr	08MN020	2B	NS	NS	NS	NA	--
07020011-601, Unnamed creek, CD 26 to LeSueur R	08MN059	2B	NA	NA	NA	NA	--
07020011-602, County Ditch 88, Unnamed cr to LeSueur R	08MN033	2B	NA	NA	NA	NA	--
07020011-603, Unnamed creek, Headwaters to Unnamed cr	08MN034	2B	NS	--	IF	NA	--
07020011-606,	08MN057	2B	NS	NS	IF	NA	--

AUID	Biological Station ID	USE Class	F-IBI	M-IBI	Aquatic Life Use	Aq. Rec.	LR
Unnamed creek, Eagle Lk to Unnamed cr							
07020011-608, County Ditch 19, Headwaters to LeSueur R	08MN049	2B	NS	NS	NS	NA	--
07020011-609, County Ditch 15-2, Headwaters to LeSueur R	08MN051	2B	NS	NS	NS	NA	--
07020011-618, County Ditch 46, Unnamed ditch to LeSueur R	08MN069	2B	NA	NA	NA	NA	--
07020011-619, LeSueur River, Headwaters to Boot Cr	07MN057	2B	NS	FS	NS	NA	--
	08MN029						
	08MN055						
07020011-620, LeSueur River, Boot Cr to CD 6	03MN070	2B	FS	NS	NS	NA	--
	08MN048						
	08MN052						
	08MN053						
	97MN008						
07020011-513, County Ditch 12, Unnamed ditch to T107 R23W S22, south line	08MN084	7	NA	--	--	--	NA

Abbreviations:

F-IBI – Biological, Fish
M-IBI – Biological, Macroinvertebrates
Aq. Rec. – Aquatic Recreation Assessment
NA = Not Assessed
FS = Fully Support

Aq. Life – Aquatic Life Use Assessment
LR– Limited Resource Use Assessment
IF = Insufficient Information **NS** = Non-Support
-- = No Data

Table 4. Non-Assessed biological stations on channelized AUIDs in the LeSueur River 11 HUC

AUID	Bio Station ID	Station location	Fish Quality	Macroinvertebrate Quality
07020011-512, County Ditch 38, Headwaters to Unnamed cr	08MN050	Downstream of CR 9, 1.5 mi. NE of St. Mary	Fair	Good
07020011-513, County Ditch 12, Unnamed ditch to T107 R23W S22, south line	08MN084	Upstream of CR 9, 3 mi. SW of Waseca	Fair	--
07020011-544, Unnamed creek, Unnamed cr to Unnamed cr	01MN040	W of Jct. Of CR7 and CR4	Fair	Poor
07020011-546, Unnamed creek, Unnamed cr to LeSueur R	08MN028	Downstream of CR 63, 5 mi. NE of New Richland	Fair	Fair
07020011-601, Unnamed creek, CD 26 to LeSueur R	08MN059	Downstream of 187th St, 1 mi. NE of St. Clair	Fair	Fair
07020011-602, County Ditch 88, Unnamed cr to LeSueur R	08MN033	Downstream of CR 15, 1 mi. W of St. Clair	Poor	Poor
07020011-618, County Ditch 46, Unnamed ditch to LeSueur R	08MN069	Downstream of CR 20, In Bath	Fair	Poor
07020011-619, LeSueur River, Headwaters to Boot Cr	07MN057	Downstream of 730th Ave, 1.5 mi. NW of Bath	Fair	Fair

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 4.3 for IBI results.

Table 5. Outlet stream water chemistry for the LeSueur River 11 HUC

Station Location	LeSueur River at CR 66, 2mi SE of Rapidan
Storet ID:	S000-340
Station #	08MN001

Parameter	Units	# Samples	Minimum	Maximum	Mean[1]	Median	WQ standard[2]	# WQ exceedances[3]	NGP 75th percentile[4]
NH_3	mg/l	12	<0.05	<0.05	<0.05	<0.05	0.04	0	
Calcium	mg/l	11	2	110	70.91	78	_	_	
Chloride	mg/l	12	1	40.4	19.32	18.25	230	0	
Chlorophyll a, corrected for pheophytin	ug/l	5	0.92	32.7	11.58	7.33	9	2	
Dissolved oxygen (DO)	mg/l	10	8.1	11.8	10.21	10.52	5	0	
Escherichia coli	MPN/100ml	10	1	200	69.5	53.5	126	2	
Hardness, Ca, Mg	mg/l CaCO3	11	10	415	280.82	310	_	_	
NO_2+NO_3	mg/l	12	0.05	13	5.25	4.45	6.5	5	
Kjeldahl nitrogen	mg/l	11	0.1	1.99	0.96	0.81	_	_	
Magnesium	mg/l	11	2	34	25.36	29	_	_	
pH	--	10	8.06	8.6	8.33	8.35	6.5-9.0	0	
Pheophytin a	ug/l	4	0.92	4.12	3.06	3.6	_	_	
Phosphorus	mg/l	12	0.003	0.335	0.114	0.101		0	0.35
Specific conductance	uS/cm	10	617	695	655.4	653.5		0	810
Sulfate	mg/l	12	1	66.4	36.79	35.9	_	_	
Temperature	deg C	10	13.1	25.1	19.82	20.05	30	0	0
TSS	mg/l	12	1	330	65.3	22		3	76
TSVS	mg/l	12	1	23	6.87	4.4	_	_	_
T-Tube	cm	10	8	86	26.6	20	_	_	
Turbidity	FNMU	25	0.55	125	28.27	17	25	12	

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the LeSueur River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 6. Minnesota Stream Habitat Assessment (MSHA) for LeSueur River 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
01MN040	Unnamed creek	1	0.0	7.5	11.0	9.0	10.0	37.5	Poor
03MN070	LeSueur River	1	0.0	7.0	19.5	12.0	25.0	63.5	Fair
03MN071	LeSueur River	2	0.0	8.0	15.9	7.0	22.0	52.9	Fair
07MN057	LeSueur River	2	0.5	10.0	18.2	7.5	19.0	55.2	Fair
08MN001	LeSueur River	1	0.0	9.0	18.1	6.0	24.0	57.1	Fair
08MN020	County Ditch 12	1	0.0	10.0	16.0	13.0	26.0	65.0	Fair
08MN028	Unnamed creek	2	0.0	7.3	11.5	4.0	6.5	29.3	Poor
08MN029	LeSueur River	1	0.0	10.5	13.3	7.0	20.0	50.8	Fair
08MN030	County Ditch 35	1	0.0	7.0	14.0	7.0	16.0	44.0	Poor
08MN032	Unnamed creek	1	0.0	10.5	20.7	13.0	24.0	68.2	Good
08MN033	County Ditch 88	1	0.0	7.5	15.7	11.0	11.0	45.2	Fair
08MN034	Unnamed creek	1	1.0	7.0	15.8	6.0	20.0	49.8	Fair
08MN035	LeSueur River	1	0.0	6.0	18.9	12.0	22.0	58.9	Fair
08MN036	LeSueur River	2	0.0	8.0	19.5	8.0	24.0	59.5	Fair
08MN048	LeSueur River	1	0.0	9.0	15.9	9.0	24.0	57.9	Fair
08MN049	County Ditch 19	1	0.0	12.5	20.1	11.0	33.0	76.6	Good
08MN050	County Ditch 38	1	0.0	12.0	20.7	10.0	26.0	68.7	Good
08MN051	County Ditch 15-2	2	0.0	13.3	18.7	14.5	29.0	75.4	Good
08MN052	LeSueur River	1	0.0	8.5	15.1	8.0	20.0	51.6	Fair
08MN053	LeSueur River	2	3.8	11.0	20.0	9.0	25.5	69.3	Good
08MN055	LeSueur River	2	0.0	12.3	20.4	11.5	21.0	65.1	Fair
08MN057	Unnamed creek	1	1.0	12.0	17.1	12.0	22.0	64.1	Fair
08MN059	Unnamed creek	2	1.3	12.0	16.4	8.5	21.0	59.2	Fair
08MN069	County Ditch 46	1	0.0	8.0	14.8	14.0	10.0	46.8	Fair
08MN084	County Ditch 12	1	0.0	7.0	13.9	8.0	7.0	35.9	Poor
Average Habitat Results: LeSueur River *11 HUC Watershed*			0.4	9.5	17.0	9.3	20.5	56.8	

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)

Table 7. Lake water aquatic recreation assessment for the LeSueur River 11 HUC

Lake Name	DOW#	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (M)	Avg. Depth (M)	CLMP Trend	Mean TP (ug/L)	Mean chl-a (ug/L)	Secchi Mean (m)	ARUS
Eagle (North)	07-0060-01	467	H	100	3	2.1	NT	170	76	0.3	NS
St. Olaf	81-0003	89	E	60	9.1	4.4	IF	37	20	1.5	FS

Abbreviations:

↘ -- Decreasing/Declining Trend
↗ -- Increasing/Improving Trends
NT – No Trend

H – Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic

FS – Full Support
NS – Non-Support
IF – Insufficient Information
ARUS – Aquatic Recreational Use Support

Watershed summary

Stream summary

Three stream AUIDs are supporting for fish IBI of 12 assessed. Four stream AUIDs are supporting out of 11 assessed for invertebrate IBIThe river itself is impaired the full length for turbidity and either fish or macroinvertebrates. When considering all assessment data including previous listings there are no fully supporting assessed stream AUIDs for aquatic life in this watershed unit. Assessments for aquatic recreation in this watershed unit indicate full support on one of two assessed AUIDs. The lowest reach, between the confluence with the Maple and the Blue Earth, is also impaired for mercury and acetochlor in the water column, and PCB (Polychlorinated biphenyl) in fish. Other agricultural chemicals (atrazine, alachlor and metolachlor) were detected in water samples in this reach, but not found at problematic levels. Monitoring for chloride and un-ionized ammonia do not indicate problems, but nitrite/nitrate, phosphorus and suspended solids often exceed ecoregion expectations. The lowest reach of the LeSueur River showed no problems with bacteria, and received a fair rating for habitat.

Intensive physical and chemical monitoring results are also available for the thirty-two mile reach of the LeSueur upstream of the Cobb and Maple Rivers. They show that bacteria presents problems for swimming, and that nitrite/nitrate, phosphorus, and suspended solids often do not meet ecoregion expectations, but un-ionized ammonia results are good. The habitat evaluation indicated fair conditions. Nine more sites along the full length of the LeSueur main stem reaches were evaluated for habitat, with two in the mid-section scoring good, and the rest fair. Small creek and ditch systems flowing into the LeSueur were evaluated for habitat at fourteen different sites throughout the watershed. Of these, six scored good and the remaining were fair.

Lake summary

Eagle Lake North is the northern basin of Eagle Lake located approximately two miles east of Mankato. Eagle Lake North is a shallow lake that is 189 hectares (467 acres) and represents 65 percent of the whole of Eagle Lake. A public landing is on the northern shore within Eagle Lake County Park. Unlike a majority of the other lakes within the LeSueur River HUC-8 watershed that are in the WCBP ecoregion, Eagle Lake is located within the NCHF ecoregion. Eagle Lake's watershed size is moderate relative to its surface area with a watershed to lake-ratio of 20:1.

Land use within the Eagle Lake watershed is relatively typical of the NCHF ecoregion with the exception of a high percentage of open rangeland. Given Eagle Lake's close proximity to the border of the NCHF and WCBP ecoregions, it is not uncommon for the watershed land use to be relatively similar to WCBP values.

Eagle Lake North was sampled for chemistry from May through September of 2006 and 2008. The average TP for Eagle Lake from both 2006 and 2008 data was 170 µg/L. This is well above the assessment criteria for lakes within the NCHF or WCBP ecoregion. TP in Eagle Lake climbed throughout the season and spiked in August of 2008 at 198 µg/L before declining in September.

The average chl-a for Eagle Lake North over the two-year period was 76 µg/L. This was also well above the assessment criteria for the NCHF. Chl-a levels spiked in August of 2008 at 84 µg/L and were at their lowest in the spring (Figure 16). As a result of the high levels of TP and chl-a, as well as high total suspended inorganic solids, the water clarity of Eagle Lake was well below the range of expected ecoregional values with an average of just 0.3 meters (one foot).

The lake was well-mixed throughout both monitoring seasons. This is typical for large, shallow lakes. Water temperature remained nearly constant from the surface to the bottom of the lake. DO levels remain above five mg/L throughout the entire year with the lowest levels appearing in July at just above five mg/L.

Based on the trophic status data, Eagle Lake was classified as hypereutrophic. Additionally, based on the TP and chl-a assessment standards, Eagle Lake North was determined to be non supporting of aquatic recreational use and was listed as impaired on the 2010 303(d) Impaired Waters List.

St. Olaf Lake is located approximately three miles east of New Richland. St. Olaf Lake is relatively small (36 hectares, 89 acres) with a maximum depth of 9.1 meters (30 feet). A public landing is on the northern shore within St. Olaf Lake County Park. St. Olaf Lake is located within the WCBP ecoregion. St. Olaf Lake's watershed is small relative to its surface area with a watershed to lake-ratio of 2:1. Land use within the St. Olaf Lake watershed is typical of the WCBP ecoregion with a majority of the land devoted to agricultural cropland use.

St. Olaf Lake was sampled for chemistry from May through September of 2008 and 2009. The average TP for St. Olaf Lake from both 2008 and 2009 data was 37 µg/L. This is below the assessment criteria for lakes within the WCBP ecoregion. TP in St. Olaf Lake peaked in May at 73 µg/L during spring turnover and steadily declined throughout the rest of the season.

The average chl-a for St. Olaf Lake over the two year period was 20 µg/L. This was above the assessment criteria expected for lakes within the WCBP ecoregion, but below the standard of 32 µg/L. Chl-a levels spiked in May at 60 µg/L and were at their lowest in September. Coinciding with low TP and chl-a, as well as low total suspended inorganic solids, the water clarity of St. Olaf Lake was above the range of WCBP ecoregional values with an average of 1.5 meters (4.9 feet).

The lake was well-mixed during the spring turnover event with a distinct thermocline forming at approximately four meters from July through September of 2008 and 2009. DO remained above five mg/L throughout the entire water column in the spring with levels dropping below five mg/L between four and five meters (~16.4 feet) from July through September. The highest level of oxygen consumption occurred in August with DO levels dropping below five mg/L between three and four meters (~13.1 feet).

Based on the chemical monitoring results and poor water clarity, St. Olaf Lake is classified as a eutrophic lake. Additionally, based on the TP, and, chl-a, and Secchi transparency assessment standards, St. Olaf Lake was determined to be fully supporting of aquatic recreational use and was not listed in the 2012 303(d) Impaired Waters List. This assessment may change since the chl-a average was just above the standard and additional monitoring is scheduled.

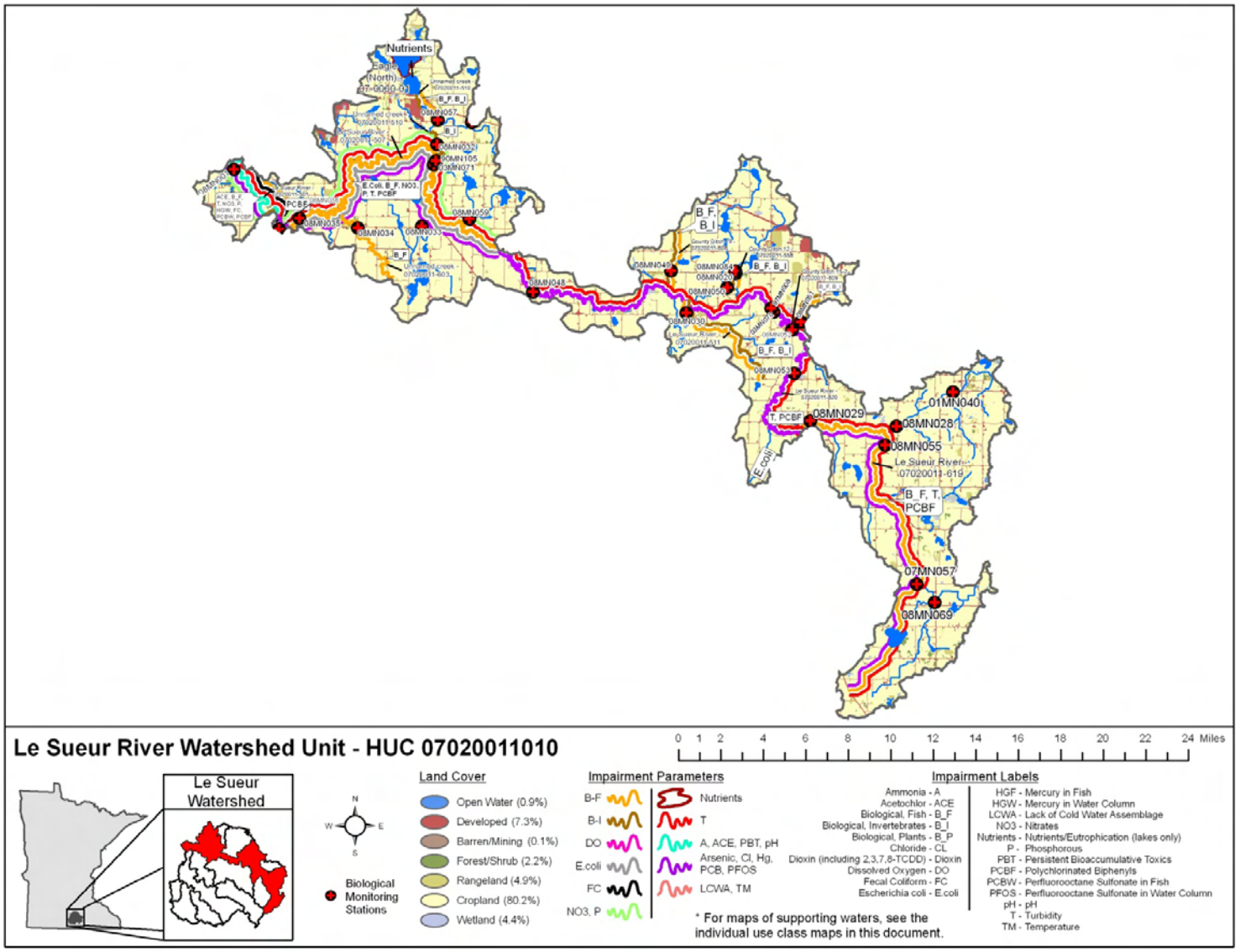

Figure 10. Currently listed impaired waters by parameter and land use characteristics in the LeSueur River Watershed Unit

Boot Creek Watershed Unit - HUC 07020011020

Watershed description

The Boot Creek watershed unit is a 50 square mile watershed located in north central Freeborn and southern Waseca counties and comprises five percent of the LeSueur River Watershed. The majority of the watershed is predominately agriculture (90.5 percent) and residential/urban development (7.2 percent). Boot Creek is the main stream of this 11-digit HUC watershed, which starts near the Waseca and Freeborn county line and flows north into the LeSueur River about two miles south of Otisco. Boot Creek is designated as a Class 7 limited resource water from county road 58, two miles southwest of New Richland to 260th avenue which is one mile from the confluence with the LeSueur River. Two tributaries to Boot Creek include Judicial Ditch 8 and Judicial Ditch 6 which start near Hartland and flows north to Boot Creek. Unnamed Ditch, which is a Class 7 limited resource water starts southeast of New Richland, flows west and is the other tributary to flow into Boot Creek.

Table 8. Water chemistry assessments on assessed AUIDs in the Boot Creek 11 HUC

AUID	USE Class	Cl	E. coli	NO2&NO3	pH	Phosphorus	T	NH3	DO
07020011-516, Boot Creek, Unnamed cr to T105 R22W S6, north line	7	FS	NS	FS	FS	FS	FS	FS	IF

Abbreviations:

T – Turbidity
Cl – Chloride
DO – Dissolved Oxygen
NO2+NO3– Nitrate and Nitrite Nitrogen
NH3 – Unionized Ammonia
Aq. Life – Aquatic Life Use Assessment
pH – pH

NA = Not Assessed
FS = Fully Support
IF = Insufficient Information
-- = No Data
NS = Non-Support

Table 9. Use and biology assessments on assessed AUIDs in the Boot Creek 11 HUC

AUID	Biological Station ID	USE Class	F-IBI	M-IBI	Aq. Life	Aq. Rec.	LR
07020011-561, Unnamed ditch, Headwaters to T105 R22W S16, west line	08MN078	2B	NA	NA	NA	NA	--
07020011-617, Judicial Ditch 8, Headwaters to Boot Cr	08MN060	2B	NA	NA	NA	NA	--
07020011-516, Boot Creek, Unnamed cr to T105 R22W S6, north line	07MN067 08MN007	7	NA	NA	--	--	NS
07020011-518, Unnamed ditch, T105 R22W S17, east line to Boot Cr	08MN016	7	NA	NA	--	--	NA

Abbreviations:
F-IBI – Biological, Fish
M-IBI – Biological, Macroinvertebrates
Aq. Rec. – Aquatic Recreation Assessment
Aq. Life – Aquatic Life Use Assessment
LR – Limited Resource Assessment
NA = Not Assessed
FS = Fully Support
IF = Insufficient Information **NS** = Non-Support
-- = No Data

Table 10. Non-assessed biological stations on channelized AUIDs in the Boot Creek 11 HUC

AUID	Biological Station ID	Station location	Fish Quality	Macroinvertebrate Quality
07020011-516, Boot Creek, Unnamed cr to T105 R22W S6, north line	07MN067	Upstream of Hwy 30, 1.5 mi. W of New Richland	Poor	--
07020011-518, Unnamed ditch, T105 R22W S17, east line to Boot Cr	08MN016	Downstream of Hwy 30, 0.5 mi. W of New Richland	Fair	Poor
07020011-561, Unnamed ditch, Headwaters to T105 R22W S16, west line	08MN078	Upstream of Hwy 30, 0.5 mi. E of New Richland	Poor	Poor
07020011-617, Judicial Ditch 8, Headwaters to Boot Cr	08MN060	Upstream of CR 1, 3 mi. SW of New Richland	Fair	Fair

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 4.3 for IBI results.

Table 11. Minnesota Stream Habitat Assessment (MSHA) for the Boot Creek 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
07MN067	Boot Creek	1	0.0	7.5	18.0	9.0	30.0	64.5	Fair
08MN007	Boot Creek	1	0.0	8.0	14.2	12.0	20.0	54.2	Fair
08MN016	Unnamed ditch	1	0.0	9.5	15.3	8.0	22.0	54.8	Fair
08MN021	Boot Creek	1	0.0	9.5	20.0	7.0	18.0	54.5	Fair
08MN060	Judicial Ditch 8	1	0.0	8.0	17.3	5.0	18.0	48.3	Fair
08MN078	Unnamed ditch	1	0.0	8.0	8.0	7.0	10.0	33.0	Poor
Average Habitat Results: Boot Creek *11 HUC Watershed*			0.0	8.4	15.5	8.0	19.7	51.6	

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)

Table 12. Outlet stream water chemistry for the Boot Creek 11 HUC

Station location:	Boot Creek, Downstream of 260th Ave. , 3 mi. NW of New Richland								
Storet ID:	S004-836								
Station #:	08MN007								
Parameter	Units	# Samples	Minimum	Maximum	Mean1	Median	WQ standard2	# WQ exceedances3	NGP 75th percentile4
NH_3	mg/l	10	0.05	0.3	0.10	0.05	0.04	3	
Calcium	mg/l	9	66	100	83	80	--	--	
Chloride	mg/l	9	2.34	37.8	18.33	19.5	230	0	
Chlorophyll a, corrected for pheophytin	ug/l	4	1.14	10	5.05	4.535	9	1	
Dissolved oxygen (DO)	mg/l	20	5.8	14.6	9.07	8.855	5	0	
Escherichia coli	MPN/100ml	17	123	2420	614.53	310	126	16	
Hardness, Ca, Mg	mg/l CaCO3	9	276	377	324.78	315	_	_	
Inorganic nitrogen (nitrate and nitrite)	mg/l	10	0.21	17	8.8	11.95	6.5	6	
Kjeldahl nitrogen	mg/l	10	0.32	0.86	0.51	0.48	--	--	
Magnesium	mg/l	9	27	31	28.56	28	--	--	
pH	none	20	7.66	9.35	8.15	8.06	6.5-9.0	0	
Pheophytin a	ug/l	4	2.52	4.11	3.19	3.06		--	
Phosphorus	mg/l	10	0.028	0.193	0.08	0.078		0	0.35
Specific conductance	uS/cm	20	473.8	755	636.28	643		0	810
Sulfate	mg/l	9	14.8	44.1	26.62	19.3		--	
Temperature, water	deg C	20	7.4	26.3	16.82	17.5	30		
TSS	mg/l	10	1	95	21.62	12.5			76
TSVS	mg/l	10	1	8.8	3.02	2.2		--	
T-Tube	cm	20	13	100	52.25	60		--	
Turbidity	NTRU	18	0	46	9.02	5.05	25	1	

[1]Geometric mean of all samples is provided for *E. coli*.

[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25

[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.

[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Boot Creek 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Lake Water Aquatic Recreation Assessment for the Boot Creek 11 HUC

There are no monitored lakes as there are no known DNR Classified lakes in the Boot Creek Watershed Unit.

Boot Creek Watershed Unit Summary

While many of the streams in the Boot Creek watershed have been altered for drainage in ways that impair habitat for aquatic life, portions of the Boot Creek main stem retain some natural meander. Stream reaches in this watershed unit have disturbed channel banks and beds that appear to be due to changes in flow conditions over time. There were no biological stations located on natural channels in this watershed. The outlet monitoring site for the Boot Creek Watershed is on a designated Limited Use Water, so it is not expected to meet currently available standards to support aquatic life and was not assessed for biology. Chloride, pH, and un-ionized ammonia met standards at this site, but monitoring at this reach identified a bacteria problem that is greater than the relaxed standards for this use classification.

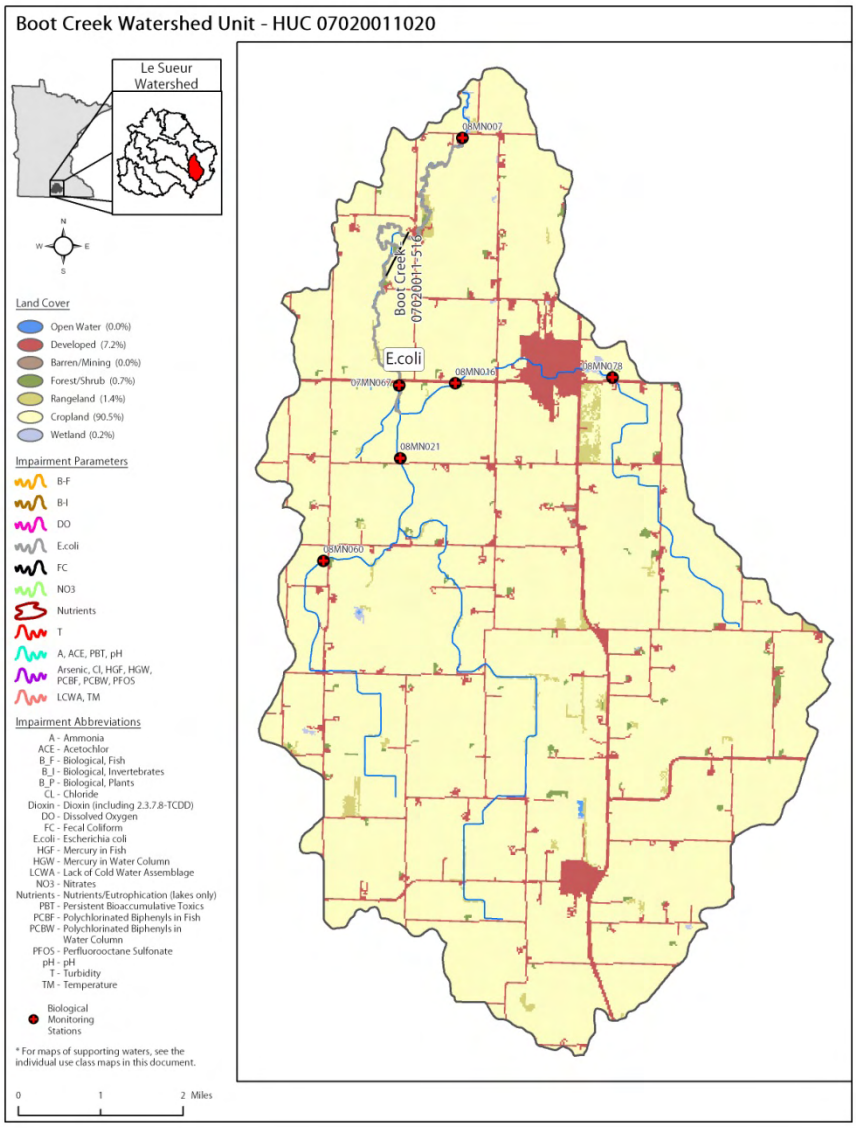

Figure 11. Currently listed impaired waters by parameter and land use characteristics in the Boot Creek Watershed Unit

Little LeSueur River Watershed Unit – HUC 07020011030

Watershed description

The Little LeSueur Watershed is located in the far eastern portion of the LeSueur River Watershed. The watershed has a drainage area of 24 square miles consisting of mainly cropland (76.7 percent) and rangeland (12.5 percent), and is 2 percent of the entire LeSueur River Watershed. The Little LeSueur River and its main tributary Judicial Ditch 10 start in western Steele County and flow east in to Waseca county where they combine to flow into the main-stem LeSueur River near the town of Otisco. Biological station 08MN027 represents the outlet for this watershed.

Water chemistry assessments on assessed AUIDs in the Little LeSueur 11 HUC

There were no AUIDs that had enough water chemistry information to assess water chemistry in this watershed.

Table 13. Use and biology assessments on assessed AUIDs in the Little LeSueur River 11 HUC

AUID	Bio Station ID	USE Class	F-IBI	M-IBI	Aquatic Life Use	Aquatic Recreation Use
07020011-573, Little LeSueur River, T106 R22W S12, east line to LeSueur R	08MN027	2C	NS	NS	NS	NA
07020011-610, Judicial Ditch 10, Headwaters to Little LeSueur R	08MN054	2B	NS	NS	IF[1]	NA

Abbreviations:
F-IBI – Biological, Fish
M-IBI – Biological, Macroinvertebrates
NA = Not Assessed
FS = Fully Support
Aq. Rec. – Aquatic Recreation Assessment
Aq. Life – Aquatic Life Use Assessment
IF = Insufficient Information **NS** = Non-Support
-- = No Data

Non-assessed biological stations on channelized AUIDs in the Little LeSueur River 11 HUC

There were no channelized biological stations in the Little LeSueur River watershed unit.

Outlet stream water chemistry for the Little LeSueur River 11 HUC

Outlet water chemistry was not collected because of the small size of the watershed unit. There is also no local data available. The one time water chemistry samples taken during biological sampling show phosphorus levels were below the ecoregion expectation for both sample sites. The one time nitrate-nitrite nitrogen level in the Little LeSueur site was above the ecoregion expectation, with a high value of 11 mg/L. One time water chemistry values for total phosphorus, total suspend solids and un-ionized ammonia were all within acceptable levels. Measurements for D.O., pH, water temperature and conductivity were also found to be within ecoregion expectations.

Table 14. Minnesota Stream Habitat Assessment (MSHA) for the Little LeSueur 11 HUC

Site ID	Stream Name	Visits	Land use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08MN027	Little LeSueur River	1	5.0	11.5	12.4	11.0	14.0	53.9	Fair
08MN054	Judicial Ditch 10	1	2.5	11.0	15.9	11.0	23.0	63.4	Fair
Average Habitat Results: *Little LeSueur River 11 HUC Watershed*			3.8	11.3	14.1	11.0	18.5	58.6	

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)

Lake water aquatic recreation assessment for the Little LeSueur 11 HUC

There are no monitored lakes in the Little LeSueur River 11-digit HUC Watershed Unit.

Little LeSueur watershed unit summary

Based on the data available, the Little LeSueur River shows signs of impairment of fish and macroinvertebrate communities. F-IBI and M-IBI scores in Judicial Ditch 10, although it is deferred due to channelization in the AUID, were poor. These measurements suggest that there may be impairment to biology in the stream. The high nitrate-nitrite nitrogen levels suggest that nitrogen levels could be a problem in the watershed. Further water chemistry and biology sampling should occur to determine the extent of the problem in the watershed. The habitat evaluation performed on the Little LeSueur and on Judicial Ditch 10 showed fair ratings. The land use in this watershed, while still a majority in cropland, also includes some perennial vegetation in pastureland and wooded land.

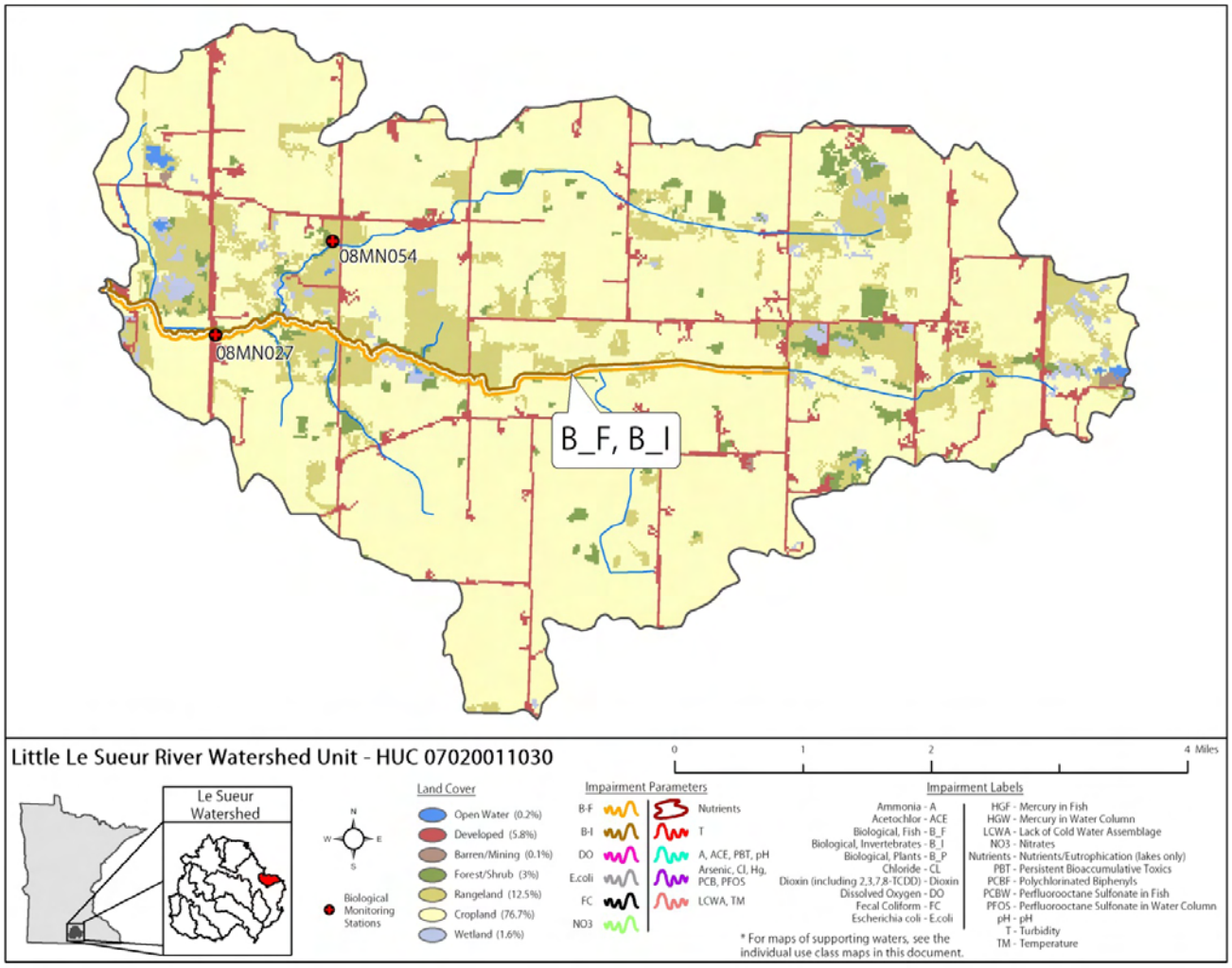

Figure 12. Currently listed impaired waters by parameter and land use characteristics in the Little LeSueur River Watershed Unit

Janesville Village Watershed Unit – HUC 07020011040

Watershed description

The Janesville Village Watershed Unit is located in the northern part of the LeSueur River Watershed. This watershed unit has a drainage area of 85 square miles and represents eight percent of the LeSueur River Watershed. Land use in the watershed unit is primarily cropland (72.6 percent) and rangeland (7.9 percent). County Ditch 6 is the main tributary in this watershed unit which starts at Lake Elysian in northern Waseca County and flows south of Janesville to the confluence with the LeSueur River approximately four miles southeast of St. Clair. County Ditch 6 is a Class 7 limited resource water for the majority of the reach from Janesville to approximately one mile upstream of the confluence with the LeSueur River. Other tributaries to County Ditch 6 include Silver Creek (County Ditch 3) and Iosco Creek. Biological station 08MN082 represents the outlet of County Ditch 6 not in a Class 7 use designation. Biological station 07MN068 represents the outlet of the Class 7 reach and was the 10X water chemistry site for the watershed unit.

Table 15. Water chemistry assessments on assessed AUIDs in the Janesville Village 11 HUC

AUID	USE Class	Cl	E. coli	pH	NH3	DO
07020011-521, County Ditch 6, T107 R24W S4, north line to T107 R25W S13, west line	7	FS	FS	FS	FS	IF

Abbreviations:
T – Turbidity
Cl – Chloride
pH – pH
NH3 – Unionized Ammonia
DO – Dissolved Oxygen
NA = Not Assessed
IF = Insufficient Information
NS = Non-Support
FS = Fully Support
-- = No Data

Table 16. Use and biology assessments on assessed AUIDs in the Janesville Village 11 HUC

AUID	Biological Station ID	USE Class	F-IBI	M- IBI	Aq. Life	Aq. Rec	LR
07020011-574, Silver Creek (County Ditch 3), Unnamed ditch to Iosco Cr	08MN042	2C	NS	NS	IF	NA	--
07020011-576, Iosco Creek, Silver Cr to T108 R23W S7, west line	08MN026	2C	NS	NS	NS	NA	--
07020011-520, County Ditch 6, Lake Elysian to T108 R24W S33, south line	08MN083	2B	NA	NA	NA	NA	--
07020011-522, County Ditch 6, T107 R25W S14, east line to LeSueur R	08MN082	2B	FS	NS	NS	NA	--
07020011-607, County Ditch 29, Unnamed ditch to CD 6	08MN046	2B	NA	NA	NA	NA	--
07020011-521, County Ditch 6, T107 R24W S4, north line to T107 R25W S13, west line	07MN068	7	NA	NA	--	--	IF

Abbreviations:
F-IBI – Biological, Fish
M-IBI – Biological, Macroinvertebrates
Aq. Rec. – Aquatic Recreation Assessment
NA = Not Assessed
FS = Fully Support
LR- Limited Resource Assessment
Aq. Life – Aquatic Life Use Assessment
IF = Insufficient Information **NS** = Non-Support
-- = No Data

Table 17. Non-assessed biological stations on channelized AUIDs in the Janesville Village 11 HUC

AUID	Bio Station ID	Station location	Fish Quality	Macroinvertebrate Quality
07020011-520, County Ditch 6, Lk Elysian to T108 R24W S33, south line	08MN083	Upstream of Hwy 14, 0.5 mi W of Janesville	Poor	Poor
07020011-521, County Ditch 6, T107 R24W S4, north line to T107 R25W S13, west line	07MN068	Downstream of CR 37, 3.5 mi. SW of Janesville	Poor	Poor
07020011-521, County Ditch 6, T107 R24W S4, north line to T107 R25W S13, west line	08MN047	Downstream of CR 54, 2mi. S of Janesville	Poor	Poor
07020011-607, County Ditch 29, Unnamed ditch to CD 6	08MN046	Upstream of CR 54, 1.5 mi. S of Janesville	Poor	Fair

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 4.3 for IBI results. Parentheses behind ratings indicate the quantity of site visits, which may or may not occur in the same year (10 percent of monitoring stations are repeated for quality control purposes).

Table 18. Minnesota Stream Habitat Assessment (MSHA) for the Janesville Village 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
07MN068	County Ditch 6	3	0.0	8.3	13.0	7.0	5.0	33.3	Poor
08MN026	Iosco Creek	1	0.0	12.5	15.2	5.0	26.0	58.7	Fair
08MN042	Silver Creek (County Ditch 3)	1	0.0	7.0	19.9	13.0	23.0	62.9	Fair
08MN046	County Ditch 29	1	0.0	7.0	19.8	5.0	15.0	46.8	Fair
08MN047	County Ditch 6	1	0.0	9.0	8.0	2.0	10.0	29.0	Poor
08MN082	County Ditch 6	1	5.0	11.0	21.8	14.0	24.0	75.8	Good
08MN083	County Ditch 6	1	2.5	9.5	9.0	10.0	10.0	41.0	Poor
Average Habitat Results: *Janesville Village 11 HUC Watershed*			0.8	9.0	14.7	7.8	13.7	46.0	

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)

Table 19. Outlet stream water chemistry for the Janesville Village 11 HUC

Station Location:	County Ditch 6, At CR 14, 4 mi. SW of Janesville								
Storet ID:	S000-654								
Station #:	07MN068								
Parameter	Units	# Samples	Minimum	Maximum	Mean1	Median	WQ standard2	# WQ exceedances3	NGP 75th percentile4
NH_3	mg/l	11	<0.05	<0.05	<0.05	<0.05	0.04	0	
Calcium	mg/l	10	56	69	61.1	60	--	--	
Chloride	mg/l	11	16.5	23.3	19.75	18.5	230	0	
Chlorophyll a, corrected for pheophytin	ug/l	5	2.99	23.3	13.60	12.3	9	3	
Dissolved oxygen (DO)	mg/l	20	4.12	15.52	9.84	9.25	5	1	
Escherichia coli	MPN/100ml	19	65	1203	253.47	135	126	11	
Hardness, Ca, Mg	mg/l CaCO3	10	243	283	262.8	264	_	_	
NO_2+NO_3	mg/l	11	0.05	7.4	3.57	4.2	6.5	1	
Kjeldahl nitrogen	mg/l	11	0.68	2.42	1.57	1.7	--	--	
Magnesium	mg/l	10	25	31	26.8	26	--	--	
pH	none	20	7.7	9.41	8.26	8.2	6.5-9.0	0	
Pheophytin a	ug/l	4	1.49	7.25	4.64	4.91		--	
Phosphorus	mg/l	11	0.086	0.226	0.15	0.136		0	0.35
Specific conductance	uS/cm	20	364	619	513.59	516.35		810	
Sulfate	mg/l	11	19.1	37.1	24.69	24.3	--	--	
Temperature, water	Deg C	20	15.2	27.3	21.41	21.95	30	0	
TSS	mg/l	11	6.2	22	13.75	14		0	76
TSVS	mg/l	11	1.2	10	6.07	7.2		--	
T-Tube	cm	20	20	72	45.1	60		--	
Turbidity	NTRU	22	4.3	30	11.42	9.45	25	2	

[1]Geometric mean of all samples is provided for *E. coli*.

[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25

[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.

[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Janesville Village 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 20. Lake water aquatic recreation assessment for the Janesville Village 11 HUC

Lake Name	DOW#	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (M)	Avg. Depth (M)	CLMP Trend	Mean TP (ug/L)	Mean chl-a (ug/L)	Secchi Mean (m)	ARUS
Reeds	81-0055	195	E	59	17.1	4.5	+	29	12	1.8	FS
Buffalo	81-0083	872	H	100	1.5	-	ND	222	111	0.6	IF
Elysian (Upper - u/s dam)	81-0095-01	2,228	H	100	4	1.8	-	162	73	0.5	NS

Abbreviations:
↘ -- Decreasing/Declining Trend
↗ -- Increasing/Improving Trends
NT – No Trend
H – Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic
FS – Full Support
NS – Non-Support
IF – Insufficient Information
ARUS – Aquatic Recreational Use Support

Watershed summary

Streams summary

One out of three assessed streams for fish IBI was found to be fully supporting. Macroinvertebrate IBI assessments indicate non-support for all three assessed AUIDs in the watershed unit. Assessment results indicate that none of the assessed AUIDs are fully supporting of aquatic life, with one stream reach being deferred due to channelization in the AUID. Not enough information was available to assess for aquatic recreation in this watershed unit. The streams in the northern part of this watershed flow from Lake Elysian, which is impaired for excess nutrients. County Ditch 6 (CD 6) flows out of the lake to the LeSueur River. The ditch was monitored in the middle portion, which is a designated Limited Use Water, so it is not expected to meet standards to support aquatic life. Bacteria, chloride, pH, and un-ionized ammonia met standards for limited at the monitoring site. Habitat evaluations at four sites along CD 6 show poor to fair conditions, with the site rated good closest to the LeSueur confluence where the channel retains some natural characteristics. Iosco Creek, Silver Creek and County Ditch 29 all rated fair for habitat, and flow into the lake.

Lakes summary

Two lakes (Upper Elysian & Reeds) have been fully assessed. Buffalo Lake has insufficient data to complete an assessment.

Upper Elysian Lake is a large, shallow well mixed lake located approximately one mile north of Janesville. Upper Elysian Lake's watershed size is moderate relative to its surface water area with an area of 11,696 hectares (28,951 acres) and a watershed to lakeratio of 13:1. Land use is dominated by cropland with the percentage being closer to use found in the WCBP but exceeding the expected range for the NCHF.

Upper Elysian Lake was sampled for chemistry from May through September of 2006, 2007, and 2009. The average TP for Upper Elysian Lake from all the sampling years was 169 µg/L (Table 12). This is well above the assessment criteria for shallow lakes within the NCHF ecoregion. Over the course of the three sampling years, TP spiked in July of 2006 at 289 µg/L and was at its lowest in September of 2009 at 60 µg/L.

The average chl-*a* value for Upper Elysian Lake was 73 µg/L (Table 12). This was also well above the assessment criteria for the NCHF ecoregion. Chl-*a* levels spiked in May of 2007 at 187 µg/L and were at their lowest in June of 2007 at 8 µg/L (Figure 24). As a result of the high levels of TP and chl-*a,* as well as high total suspended inorganic solids (13 mg/L), the water clarity of Upper Elysian Lake is below the range of the assessment standard with an average of just 0.5 meters (1.6 feet).

The pattern of Upper Elysian Lakes water chemistry and transparency from the summer of 2009, fluctuated seasonally. TP concentrations were high during the spring, dropped in June, and increased over the summer peaking in August. The pattern of increasing TP from June through August in Upper Elysian Lake is consistent with other shallow lakes in Minnesota. When compared to historic profile data the absence of a thermocline suggests that Upper Elysian Lake is subject to continuous mixing throughout the season resulting in nutrients being stirred up from the sediment and released into the lake water.

Minimal profile data exists, however, when historic temperature and DO profiles collected in 1998 are used as a reference, the lake likely remains well-mixed throughout the season. Water temperature remained nearly constant from the surface to the bottom of the lake. DO remains above five mg/L through most of the year with hypoxic conditions developing at approximately two meters in July and August.

Based on the chemical monitoring results and poor water clarity, Upper Elysian Lake was classified as a hypereutrophic lake. Additionally, based on the TP and chl-*a* standards for the support of aquatic recreation, Upper Elysian Lake was determined to be non supporting of aquatic recreational use and was listed as an impaired water on the 2008 303(d) Impaired Waters List.

Reeds Lake is a small, deep unmixed lake located approximately four miles northeast of Janesville. Reeds Lake's watershed is small relative to its surface water area with an area of 216 hectares (534 acres) and a watershed to lake ratio of nearly 3:1. Reeds Lake was sampled for chemistry from May through September of 2001 and 2008. The average total TP for Reeds Lake was 29 µg/L. This is well below the assessment criteria for shallow lakes within the NCHF ecoregion and is in full support of aquatic recreation use standards. The average chl-*a* value for Reeds Lake was 12 µg/L. This was also below the assessment criteria for the NCHF ecoregion. As a result of the low levels of TP and chl-*a,* as well as low total suspended inorganic solids (3 mg/L), the water clarity of Reeds Lake is greater than the assessment standard with an average of 1.8 meters (5.9 feet).

Figure 26 illustrates the pattern of water chemistry and transparency from the summer of 2008 for Reeds Lake. TP concentrations remained low during a majority of the year until September when they climbed to 47 µg/L during the fall turn over. When compared to historic profile data, the presence of a thermocline at four meters indicates that Reeds Lake is subject to the development of two limnetic layers. The upper, warmer layer is well mixed with higher DO while the lower layer remains cooler with lower DO concentrations. During the spring and fall turnovers, nutrients are subject to release within the water column mixing throughout the season, resulting in nutrients being stirred up from the sediment and released into the lake water as is evident in the September TP spike.

Minimal profile data exists, however, when historic temperature and DO profiles collected in 2001 are used as a reference, the lake likely mixes in the spring and fall and forms a distinct thermocline during the summer months. The thermocline developed around nine meters (29.5 feet) during the spring and was present between three and four meters (~13 feet) during the summer months. DO remained above five mg/L to a depth of nine meters (29.5 feet) in the spring but dropped below 5 mg/L around four meters (13 feet) through the summer with anoxic conditions below six meters (19.7 feet).

Based on the chemical monitoring results and high water clarity, Reeds Lake was classified as a eutrophic lake. Additionally, based on the TP and chl-*a* standards for the support of aquatic recreation, Reeds Lake was determined to be fully supporting of aquatic recreational use and was not listed as an impaired water under the 2010 303(d) Impaired Waters List.

Buffalo Lake is a large (352 hectares (872 acres)), shallow mixed lake located approximately three miles south of Janesville. Buffalo Lake's watershed is 1,617 hectares (4,003 acres) and is small relative to its surface water area with a watershed to lake ratio of nearly 6:1. Watershed land use is dominated by cropland. Water quality monitoring for Buffalo Lake began in the spring of 2008 but was canceled following the drawdown of the lake for waterfowl management. The average for the three TP, chl-*a*, and Secchi samples collected were 222 µg/L, 111 µg/L, and 0.6 meters (two feet) respectively. Based on these limited results, Buffalo Lake would likely have been listed as impaired. However, more data is required to conclude this assessment.

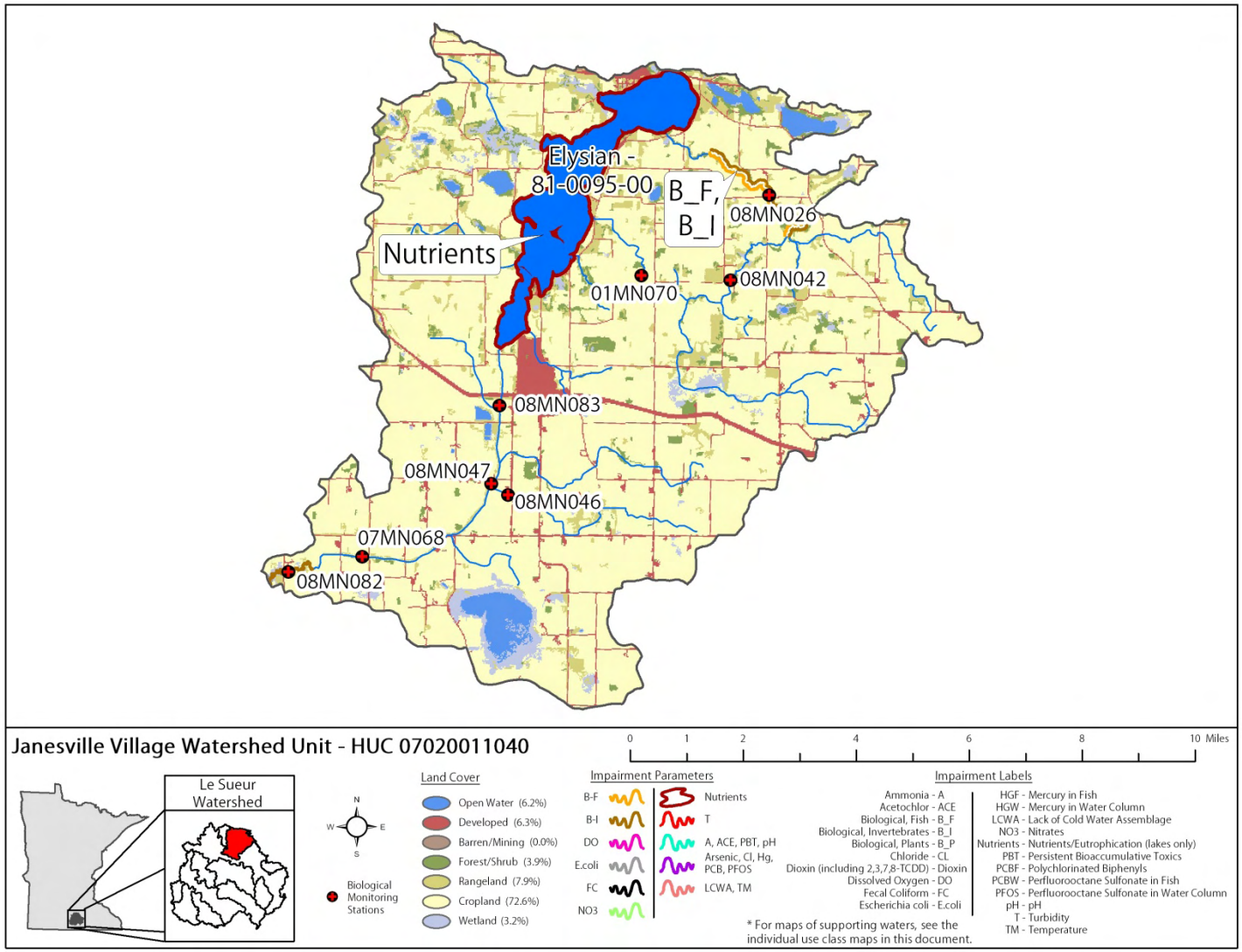

Figure 13. Currently listed impaired waters by parameter and land use characteristics in the Janesville Village Watershed Unit

Madison Lake Watershed Unit HUC 07020011050

Watershed description

The Madison Lake Watershed Unit lies along the northern boundary of the LeSueur River watershed in eastern Blue Earth and small parts of western Waseca and LeSueur counties. This watershed is 19 square miles in area and represents two percent of the LeSueur River watershed. Cropland (57.8 percent) is the major land use within this area and there are eight lakes which comprise approximately 15 percent of the watershed unit area. The Madison Lake watershed drains into an unnamed tributary that eventually flows in to the LeSueur River near the town of Eagle Lake through an outlet (07020011-605) south of Mud Lake. Biological station 08MN025 represents the outlet of the watershed unit.

Water chemistry assessments on assessed AUIDs in the Madison Lake 11 HUC

Not enough water chemistry data was available to assess any AUID in this watershed unit.

Table 21. Use and biology assessments on assessed AUIDs in the Madison Lake 11 HUC

AUID	Bio Station ID	USE Class	F-IBI	Aq. Life	Aq. Rec.
07020011-605, Unnamed creek, Mud Lk (07-0034-00) to Unnamed cr	08MN025	2B	IF	IF	NA

Abbreviations: **F-IBI** – Biological, Fish **Aq. Rec.** – Aquatic Recreation Assessment **Aq. Life** – Aquatic Life Use Assessment

NA = Not Assessed **IF** = Insufficient Information

NS = Non-Support **FS** = Fully Support **--** = No Data

Non-assessed biological stations on channelized AUIDs in the Madison Lake 11 HUC

There were no channelized biological stations in the Madison Lake watershed unit.

Table 22. Minnesota Stream Habitat Assessment (MSHA) for the Madison Lake 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08MN025	Unnamed creek	2	0.0	9.0	20.5	11.0	16.5	57.0	Fair
Average Habitat Results: *Madison Lake 11 HUC Watershed*			0.0	9.0	20.5	11.0	16.5	57.0	

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)

Outlet stream water chemistry for the Madison Lake 11 HUC

Outlet water chemistry was not collected because of the small size of the watershed unit. There is also no local data available. One time water chemistry values for total phosphorus, potal suspend solids, nitrate-nitrite nitrogen and un-ionized ammonia were all within acceptable levels. Measurements for water temperature and conductivity were also found to be within ecoregion expectations. DO data for the two visits indicate a potential DO flux issue (2.8 and 12.2 mg/l). One of the two pH readings was above the standard of 9 (9.3) and the other reading was within the standard. The biological station on this AUID is roughly two miles downstream of nutrient impaired Madison Lake.

Table 23. Lake water aquatic recreation assessment for the Madison Lake 11 HUC

Lake Name	DOW#	Area (acres)	Trophic Status	percent Littoral	Max. Depth (M)	Avg. Depth (M)	CLMP Trend	Mean TP (ug/L)	Mean chl-a (ug/L)	Secchi Mean (m)	ARUS
Madison	07-0044	1,389	E	65	18	3.4	NT	78	44	1	NS

Abbreviations:

↘ -- Decreasing/Declining Trend
↗ -- Increasing/Improving Trends
NT – No Trend

H – Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic

FS – Full Support
NS – Non-Support
IF – Insufficient Information
ARUS – Aquatic Recreational Use Support

Madison Lake watershed unit summary

The outlet of Mud Lake and Madison Lake was the only reach sampled for fish IBI in the watershed unit. The stream reach wasn't sampled for macroinvertebrates due to low flow conditions during the sampling time frame. The final assessment for aquatic life has been deferred due to channelization on the AUID. Habitat assessment indicated a rating of fair. Invertebrate sampling did not occur due to low flow conditions at time of sampling. Not enough data was collected from any stream reach in the watershed to assess for aquatic recreation. This small watershed is primarily cropland draining to Madison Lake, which is impaired for excess nutrients and mercury, and other smaller shallow lakes and wetlands that have not been assessed.

Lake summary

There are eight lakes in the watershed unit. One, Madison Lake (07-0044), has been assessed.

Madison Lake is a large, deep intermittently stratifying lake located approximately six miles east of Mankato. Madison Lake's watershed is moderate in size relative to its surface water area, with an area of 4,509 hectares (11,161 acres) and a watershed to lake ratio of 8:1. Land use is dominated by cropland with the percentage being closer to what is found in the WCBP and exceeding the expected range for the NCHF.

Madison Lake was sampled for chemistry from May through October of 2008 and 2009. The average TP for Madison Lake was 78 µg/L. This was above the assessment criteria for lakes within the NCHF ecoregion. Samples were collected at two locations on Madison Lake with higher values occurring at site 101. Additionally, depth TP samples were collected with high values being recorded in late summer as nutrients are released into the lake water as decomposition occurs within the lake sediment. This coincides with the sharp drop in DO within the hypolimnium as oxygen is consumed during the decomposition.

The average chl-a value for Madison Lake was 44 µg/L. This was also well above the assessment criteria for the NCHF ecoregion. Chl-a levels spiked in September at 52 µg/L at site 101 and were at their lowest in June at 7 µg/L at site 201. As a result of the high levels of TP and chl-a, the water clarity of Madison Lake is below the range of the assessment standard with an average of just one meter (3.3 feet).

Profile data from 2008 for both sites indicates that a weak thermocline forms at a depth of eight-nine meters (~29.5 feet) in July and August but remains well mixed during the rest of the season. This indicates that Madison Lake is subject to continuous mixing during the spring and fall but a thermocline will develop during periods of low winds and water movement. As a result, nutrients are likely being stirred up from the sediment and released into the lake water during much of the year. DO remained above five mg/L through most of the year with hypoxic conditions developing at approximately four-six meters (~19.7) in July and August and anoxic conditions below six meters (19.7 feet) in July.

Based on the chemical monitoring results and poor water clarity, Madison Lake was classified as a eutrophic lake. Additionally, based on the TP and chl-a standards for the support of aquatic recreation, Madison Lake was determined to be non-supporting of aquatic recreational use and was listed as an impaired water under the 2010 303(d) Impaired Waters List.

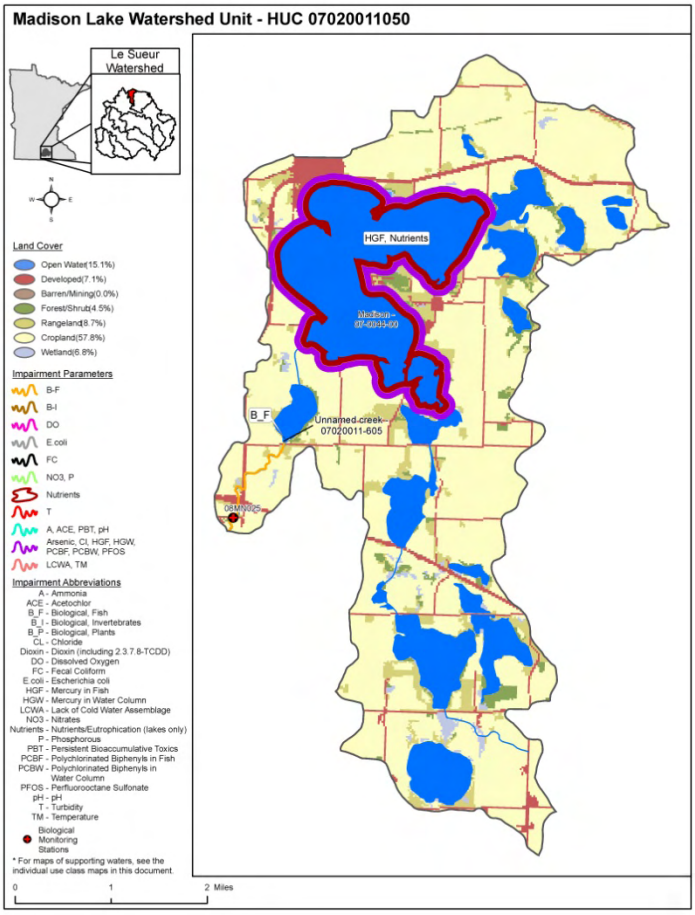

Figure 14. Currently listed impaired waters by parameter and landuse characteristics in the Madison Lake Watershed Unit

Little Cobb River Watershed Unit HUC 07020011060

Watershed description

The Little Cobb Watershed Unit is located in the center of the LeSueur River Watershed, and encompasses the southwestern part of Waseca County and the southeastern part of Blue Earth County. The drainage area of the watershed unit is 132 square miles and represents 12 percent of the LeSueur River Watershed. Land use in this Watershed Unit is primarily cropland (86.6 percent) and development (5.8 percent). The Tributaries to the Little Cobb River (County Ditch 8, Bull Run Creek, County Ditch 20, and several smaller tributaries) start east of the town of Waldorf and flow west to form the Little Cobb River, which flows on to the confluence with Cobb River just east of Beauford. Biological station 08MN006 represents the outlet and 10X water chemistry site for the watershed unit.

Table 24. Water chemistry assessments on assessed AUIDs in the Little Cobb River 11 HUC

AUID	USE Class	Acetochlor	Alachlor	Atrazine	Chloride	E. coli	Metolachlor	NO2&NO3	pH	Phosphorus	Turbidity	NH3	DO
07020011-504, Little Cobb River, Bull Run Cr to Cobb R	2C	FS	FS	FS	FS	NS	FS	NS	FS	IF	NS	FS	NS

Abbreviations:

T – Turbidity
Cl – Chloride
pH – pH
NH3 – Unionized Ammonia
DO – Dissolved Oxygen

NA = Not Assessed
FS = Fully Support
IF = Insufficient Information
NS = Non-Support
-- = No Data

Table 25. Use and biology assessments on assessed AUIDs in the Little Cobb River 11 HUC

AUID	Bio Station ID	USE Class	F-IBI	M-IBI	Aquatic Life Use	Aquatic Recreation Use
07020011-504, Little Cobb River, Bull Run Cr to Cobb R	08MN006	2C	NS	--	NS	NS
	08MN070			--		
	96MN007					
07020011-524, Little Cobb River (County Ditch 8), Unnamed ditch to Severson Lk	07MN066	2C	NA	NA	NA	NA
	08MN038					
	08MN039					
07020011-525, Bull Run Creek, Silver Lk outlet to Little Cobb R	08MN040	2C	NA	--	NA	NA
07020011-566, County Ditch 20, Headwaters to Silver Lk outlet	08MN062	2B	NA	--	NA	NA
07020011-599, Unnamed creek, Unnamed lk (Hobza Marsh 07-0019-00) to Unnamed cr	08MN064	2B	NA	--	NA	NA
07020011-611, Unnamed creek, Headwaters to Unnamed cr	08MN061	2B	NA	NA	NA	NA
07020011-613, Unnamed creek, Headwaters to Unnamed cr	08MN037	2B	NS	--	IF	NA

Abbreviations:

F-IBI – Biological, Fish
M-IBI – Biological, Macroinvertebrates
DO – Dissolved Oxygen
pH – pH
Aq. Life – Aquatic Life Use Assessment
Aq. Rec. – Aquatic Recreation Assessment
NA = Not Assessed
IF = Insufficient Information
NS = Non-Support
FS = Fully Support
-- = No Data

Table 26. Non-assessed biological stations on channelized AUIDs in the Little Cobb River 11 HUC

AUID	Bio Station ID	Station location	Fish Quality	Macroinvertebrate Quality
07020011-504, Little Cobb River, Bull Run Cr to Cobb R	08MN006	Downstream of CR 174, 3 mi E of Beauford	Fair	--
07020011-504, Little Cobb River, Bull Run Cr to Cobb R	08MN070	Downstream of CR 169, 3 mi. W of Pemberton	Good	--
07020011-524, Little Cobb River (County Ditch 8), Unnamed ditch to Severson Lk	07MN066	Upstream of 240th Ave, 2 mi. SE of Waldorf	Fair	--
07020011-524, Little Cobb River (County Ditch 8), Unnamed ditch to Severson Lk	08MN038	Downstream of CR 4, 0.5 mi. W of Waldorf	Fair	Poor
07020011-524, Little Cobb River (County Ditch 8), Unnamed ditch to Severson Lk	08MN039	Downstream of CR 53, 4 mi. S of Pemberton	Fair	--
07020011-525, Bull Run Creek, Silver Lk outlet to Little Cobb R	08MN040	Upstream of W County Line Road / 631st Ave., 2 mi. SE of Pemberton	Poor	--
07020011-566, County Ditch 20, Headwaters to Silver Lk outlet	08MN062	Upstream of CR 71, 5 mi. SE of Waldorf	Poor	Good
07020011-599, Unnamed creek, Unnamed lk (Hobza Marsh 07-0019-00) to Unnamed cr	08MN064	Upstream of CR 168, 5 mi. W of Pemberton	Poor	--
07020011-611, Unnamed creek, Headwaters to Unnamed cr	08MN061	Upstream of CR 4, 2 mi. SE of Waldorf	Good	Fair

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 4.3 for IBI results.

Table 27. Minnesota Stream Habitat Assessment (MSHA) for the Little Cobb River 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
07MN066	Little Cobb River (County Ditch 8)	1	0.0	10.0	20.0	7.0	22.0	59.0	Fair
08MN006	Little Cobb River	1	3.0	11.5	12.7	9.0	20.0	56.2	Fair
08MN037	Unnamed creek	1	0.0	13.0	14.7	12.0	18.0	57.7	Fair
08MN038	Little Cobb River (County Ditch 8)	1	0.0	12.0	14.0	14.0	15.0	55.0	Fair
08MN039	Little Cobb River (County Ditch 8)	1	0.0	8.0	9.0	3.0	12.0	32.0	Poor
08MN040	Bull Run Creek	1	0.0	6.5	11.9	2.0	10.0	30.4	Poor
08MN061	Unnamed creek	2	0.0	8.0	10.6	9.0	15.5	43.1	Poor
08MN062	County Ditch 20	1	0.0	13.0	16.8	1.0	17.0	47.8	Fair
08MN064	Unnamed creek	1	0.0	1.0	3.0	0.0	4.0	8.0	Poor
08MN070	Little Cobb River	1	2.5	9.0	13.1	10.0	13.0	47.6	Fair
Average Habitat Results: *Little Cobb River 11 HUC Watershed*			0.5	9.1	12.4	6.9	14.7	43.6	

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)

Table 28. Outlet stream water chemistry for the Little Cobb River 11 HUC

Station location:	Little Cobb River at CR 174, 3 mi E of Beauford
Storet ID:	S003-574
Station #:	08MN006

Parameter	Units	# Samples	Minimum	Maximum	Mean1	Median	WQ standard2	# WQ exceedances3	NGP 75th percentile4
NH_3	mg/l	10	<0.05	<0.05	<0.05	<0.05	0.04	0	
Calcium	mg/l	9	71	92	79.44	80	--	--	
Chloride	mg/l	10	13.1	20.9	16.44	16.1	230	0	
Chlorophyll a, corrected for pheophytin	ug/l	4	2.46	97.9	37.72	25.25	9	3	
Dissolved oxygen (DO)	mg/l	21	2.84	14	7.14	6.95	5	1	
Escherichia coli	MPN/100ml	17	50	1203	374	300	126	12	
Hardness, Ca, Mg	mg/l CaCO3	9	288	366	320.67	327	_	_	
NO_2+NO_3	mg/l	10	0.05	410	45.08	3.85	6.5	4	
Kjeldahl nitrogen	mg/l	10	0.74	1.84	1.21	1.24		--	
Magnesium	mg/l	9	27	33	29.67	29		--	
pH	none	21	7.8	8.74	8.20	8.22	6.5-9.0	0	
Pheophytin a	ug/l	4	2.52	16.2	7.79	6.23		--	
Phosphorus	mg/l	10	0.107	0.256	0.18	0.19		0	0.35
Specific conductance	uS/cm	21	365.8	665	530.7	510		0	810
Sulfate	mg/l	10	18.1	26.2	21.28	21.45		--	
Temperature, water	Deg C	21	14.6	25.2	20.35	21	30	0	
TSS	mg/l	10	10	180	48.4	35.5		1	76
TSVS	mg/l	10	2	23	7.94	7.4		--	
T-Tube	cm	20	5	30	16.7	16		--	
Turbidity	NTRU	20	7.8	195	38.76	22.5	25	9	

[1]Geometric mean of all samples is provided for *E. coli*.

[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25

[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.

[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Little Cobb River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Lake water Aquatic Recreation Assessment for the Little Cobb River 11 HUC

There are no monitored lakes in the Little Cobb River 11-digit HUC watershed unit.

Watershed summary

No streams were assessed for aquatic life due to the prevalence of channelized stream reaches in this watershed unit. The biological monitoring of channelized reaches varied from good to poor, and did not show clear pattern. The Little Cobb River from Bull Run Creek to the Cobb River is non-supporting of aquatic recreation, and is most likely influenced by agricultural land use practices which is predominantly cropland. The downstream-most reach of the main stem of the Little Cobb River is currently recognized as having impaired aquatic life based on data for fish, dissolved oxygen, turbidity and mercury in the water column, and for aquatic recreation based on bacteria. The most recent monitoring shows that the bacteria, dissolved oxygen and suspended solids problems continue, and that ecoregion expectations for nitrite/nitrate, as well as phosphorus are often exceeded. However, results of monitoring for agricultural pesticides (acetochlor, alachlor, atrazine and metolachlor) and un-ionized ammonia are meeting water quality standards. Habitat evaluations on this reach show fair conditions.

Habitat evaluations at sites on next upstream reaches of the main stem and two tributaries, including Bull Run Creek, show poor conditions, while those higher in the watershed on the main stem and other tributaries produced ratings of fair.

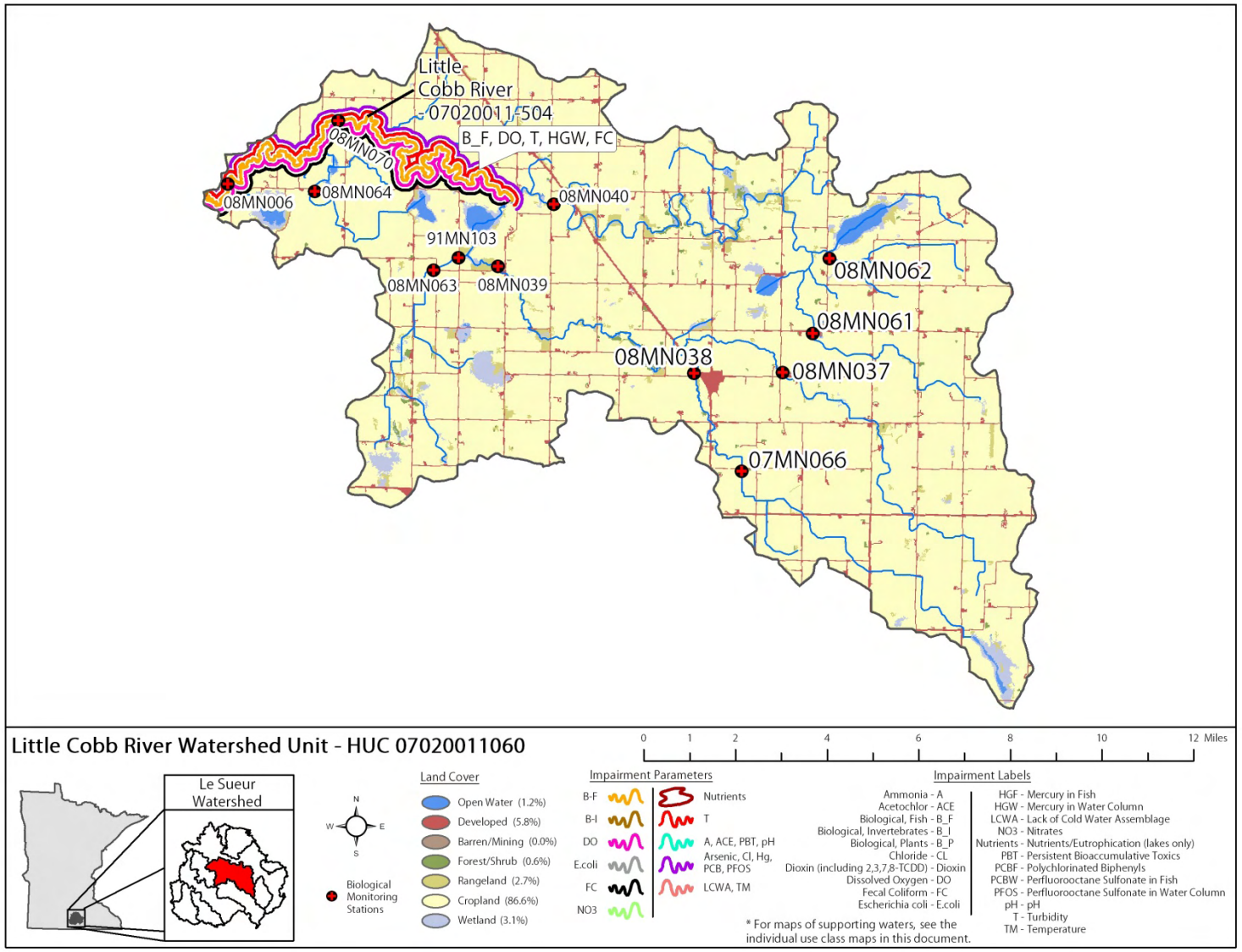

Figure 15. Currently listed impaired waters by parameter and land use characteristics in the Little Cobb River Watershed Unit

Cobb River Watershed Unit HUC 07020011070

Watershed description

The Cobb River watershed unit lies roughly within the center of the LeSueur River watershed. This 178 square mile watershed unit represents 16 percent of the LeSueur River watershed. The watershed unit starts in northwestern Freeborn County near the town of Freeborn and flows west. The watershed then covers parts of Faribault and Waseca counties, and enters the southeastern corner of Blue Earth County. Tributaries include Cobb Creek Ditch, the Little Cobb River, and several small headwater streams. Cropland (83.7 percent) and developed land (6.1 percent) are predominant land uses within this watershed unit. Only one lake (Freeborn) was assessed. The Cobb River drains to the LeSueur River 3.5 miles south of Mankato. Biological station 08MN005 represents the outlet of the watershed unit.

Table 29. Water chemistry assessments on assessed AUIDs in the Cobb River 11 HUC

AUID	USE Class	Acetochlor	Alachlor	Atrazine	Cl	E. coli	Metolachlor	NO2 + NO3	pH	Phosphorus	T	NH3	DO
07020011-556, Cobb River, T107 R26W S30, west line to LeSueur R	2C	--	--	--	FS	NS	--	NS	FS	IF	NS	FS	IF
07020011-568, Cobb River, T104 R23W S34, south line to Little Cobb R	2C	--	--	--	--	--	--	--	--	--	NS	--	--
07020011-503, Unnamed creek (Little Beauford Ditch), Headwaters to Cobb R	2B	NS	FS	FS	--	NS	FS	NS	FS	IF	NS	FS	IF

Abbreviations:

T – Turbidity
NO2+NO3– Nitrate Nitrite Nitrogen
DO – Dissolved Oxygen
NA = Not Assessed
NS = Non-Support
-- = No Data
NH3 – Unionized Ammonia
Cl – Chloride
pH – pH
IF = Insufficient Information
FS = Fully Support

Table 30. Use and biology assessments on assessed AUIDs in the Cobb River 11 HUC

AUID	Biological Station ID	USE Class	F-IBI	M-IBI	Aq. Life	Aq. Rec.	LR
07020011-505, Cobb River, Little Cobb R to T107 R27W S36, west line	01MN039	2C	FS	FS	FS	NA	--
	08MN065						--
07020011-556, Cobb River, T107 R26W S30, west line to LeSueur R	08MN005	2C	NS	NS	NS	NS	--
07020011-568, Cobb River, T104 R23W S34, south line to Little Cobb R	08MN017	2C	NS	NS	NS	NA	--
	08MN067						--
	08MN071						--
	08MN081						--
	97MN002						--
07020011-503, Unnamed creek (Little Beauford Ditch), Headwaters to Cobb R	91MN104	2B	NA	NA	NS	NS	--
07020011-530, County Ditch 57, Unnamed ditch to Cobb R	08MN066	2B	NA	NA	NA	NA	--
07020011-541, Judicial Ditch 51, Unnamed ditch to Kremers Marsh	01MN030	2B	NA	NA	NA	NA	--
07020011-562, Cobb Creek Ditch, Headwaters to T103 R23W S1, west line	08MN080	2B	NA	NA	NA	NA	--
07020011-615, Unnamed creek, Headwaters to Unnamed cr	08MN068	2B	NA	NA	NA	NA	--
07020011-529, Cobb Creek, T104 R23W S17, east line to Cobb R	08MN018	7	NA	NA	--	--	NA
07020011-583, Cobb Creek Ditch, T103 R23W S2, east line to Unnamed ditch	01MN036	7	NA	NA	--	--	NA

Abbreviations:

F-IBI – Biological, Fish
M-IBI – Biological, Macroinvertebrates
LR – Limited Resource Assessment
Aq. Life – Aquatic Life Use Assessment
Aq. Rec. – Aquatic Recreation Assessment

NA = Not Assessed
FS = Fully Support
IF = Insufficient Information
-- = No Data
NS = Non-Support

Table 31. Non-assessed biological stations on channelized AUIDs in the Cobb River 11 HUC

AUID	Bio Station ID	Station location	Fish Quality	Macroinvertebrate Quality
07020011-503, Unnamed creek (Little Beauford Ditch), Headwaters to Cobb R	91MN104	Upstream of Hwy 22, 5.5 mi E of Good Thunder	Poor	Poor
07020011-530, County Ditch 57, Unnamed ditch to Cobb R	08MN066	Downstream of 586th Ave, 2 mi. NE of Mapleton	Poor	Poor
07020011-541, Judicial Ditch 51, Unnamed ditch to Kremers Marsh	01MN030	downstream of CR 30, 6 mi NE of Minnesota Lake	Fair	Poor
07020011-562, Cobb Creek Ditch, Headwaters to T103 R23W S1, west line	08MN080	Upstream of CR 29, 1 mi. SE of Freeborn	Poor	Poor
07020011-568, Cobb River, T104 R23W S34, south line to Little Cobb R	08MN067	Upstream of CR 4, 3 mi. NE of Mapleton	Fair	Fair
07020011-583, Cobb Creek Ditch, T103 R23W S2, east line to Unnamed ditch	01MN036	0.3 mi upstream of CR 10, about 1 mi. N of Freeborn	Fair	Fair
07020011-615, Unnamed creek, Headwaters to Unnamed cr	08MN068	Downstream of 55th St, 1mi. W of Matawan	Fair	Poor

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 4.3 for IBI results. Parentheses behind ratings indicate the quantity of site visits, which may or may not occur in the same year (10 percent of monitoring stations are repeated for quality control purposes).

Table 32. Minnesota Stream Habitat Assessment (MSHA) for the Cobb River 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA Rating
01MN030	Judicial Ditch 51	2	0.6	7.3	14.9	7.0	16.0	45.8	Fair
01MN036	Cobb Creek Ditch	2	0.0	5.0	13.2	10.0	16.5	44.7	Poor
01MN039	Cobb River	1	1.3	5.0	20.0	7.0	20.0	53.3	Fair
08MN005	Cobb River	2	2.5	9.5	19.3	12.5	24.5	68.3	Good
08MN017	Cobb River	1	0.0	11.0	17.1	16.0	25.0	69.1	Good
08MN018	Cobb Creek	1	0.0	9.5	18.5	9.0	21.0	58.0	Fair
08MN065	Cobb River	1	0.0	9.5	21.1	9.0	27.0	66.6	Good
08MN066	County Ditch 57	1	0.0	6.0	14.0	1.0	14.0	35.0	Poor
08MN067	Cobb River	1	0.0	8.5	12.1	13.0	11.0	44.6	Poor
08MN068	Unnamed creek	1	0.0	7.0	13.5	5.0	16.0	41.5	Poor
08MN071	Cobb River	1	0.0	11.5	10.0	11.0	15.0	47.5	Fair
08MN080	Cobb Creek Ditch	1	0.0	7.0	15.0	10.0	4.0	36.0	Poor
08MN081	Cobb River	2	0.0	8.5	16.2	6.0	22.0	52.7	Fair
91MN104	Unnamed creek (Little Beauford Ditch)	1	3.5	10.5	12.0	7.0	7.0	40.0	Poor
Average Habitat Results: *Cobb River 11 HUC Watershed*			0.6	8.1	15.6	8.8	17.7	50.8	

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)

Table 33. Outlet stream water chemistry for the Cobb River 11 HUC

Station location:	Cobb River at CR 16, 3.5 mi. NW of Beauford								
Storet ID:	S003-446								
Station #:	08MN005								
Parameter	Units	# Samples	Minimum	Maximum	Mean1	Median	WQ standard2	# WQ exceedances3	NGP 75th percentile4
NH_3	mg/l	10	<0.05	<0.05	<0.05	<0.05	0.04	0	
Calcium	mg/l	9	71	97	82.78	88	--	--	
Chloride	mg/l	11	13.5	18.1	16.11	16.2	230	0	
Chlorophyll a, corrected for pheophytin	ug/l	5	5.47	46.6	15.49	8.32	9	1	
Dissolved oxygen (DO)	mg/l	20	5.13	12.43	9.27	9.415	5	0	
Escherichia coli	MPN/100ml	18	10	228	79.06	49	126	4	
Hardness, Ca, Mg	mg/l CaCO3	9	293	382	332	343	_	_	
NO_2+NO_3	mg/l	10	0.08	12	5.69	5.35	6.5	5	
Kjeldahl nitrogen	mg/l	10	0.62	1.73	1.02	0.91	--	--	
Magnesium	mg/l	9	27	34	30.44	30	--	--	
pH	none	20	8.08	9.19	8.36	8.31	6.5-9.0	0	
Pheophytin a	ug/l	5	3.04	4.59	3.58	3.1	--	--	
Phosphorus	mg/l	10	0.056	0.245	0.14	0.15	0	0	0.35
Specific conductance	uS/cm	20	392.5	674	560.07	570	--	0	810
Sulfate	mg/l	11	21	52.8	34.62	29.3	--	--	
Temperature, water	Deg C	20	13.3	27.3	22.04	22.85	30	0	
TSS	mg/l	11	8.4	130	47.84	36		3	76
TSVS	mg/l	11	2	19	7.11	4.4	--	--	
T-tube	cm	20	6	38	20.85	18.5	--	--	
Turbidity	NTRU	23	6.9	152	36.41	26	25	12	

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Cobb River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 34. Lake water aquatic recreation assessment for the Cobb River 11 HUC

Lake Name	DOW#	Area (acres)	Trophic Status	percent Littoral	Max. Depth (M)	Avg. Depth (M)	CLMP Trend	Mean TP (ug/L)	Mean chl-a (ug/L)	Secchi Mean (m)	ARUS
Freeborn	24-0044	2,001	H	100	2.1	0.9	ND	325	120	0.2	NS

Abbreviations:
↘ -- Decreasing/Declining Trend
↗ -- Increasing/Improving Trends
NT – No Trend
H – Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic
FS – Full Support
NS – Non-Support
IF – Insufficient Information
ARUS – Aquatic Recreational Use Support

Watershed summary

One out of three AUIDs assessed for fish IBI was found to be fully supporting in the watershed unit. Likewise for macroinvertebrate IBI, one AUID out of three assessed were found to be fully supporting. Overall, one AUID stream reach out of four assessed in this watershed was found to be fully supporting of aquatic life. The two AUIDs that had enough data for assessment of aquatic recreation were found to be non-supporting. This watershed includes the full twenty-six miles of the main stem of the Cobb River, along with short tributaries throughout the length. Most of the main stem is listed as impaired based on turbidity, and biological impairments based on fish and macroinvertebrates have been recognized more recently. In addition, the reach closest to the confluence with the LeSueur River is impaired for aquatic recreation based on high bacteria. Chloride and un-ionized ammonia monitoring results indicated no problems, but nitrite/nitrate, suspended solids and phosphorus often were above of ecoregion expectations.

Little Beauford Ditch (07020011-503) was chosen for special monitoring related to the Minnesota River Basin for more than a decade, due to the stressors that it shares with many streams in the basin. As a result, it is recognized as impaired not only for turbidity and bacteria, but also for acetochlor, mercury in the water column and poly chlorinated biphenyls (PCB) in fish, for which monitoring is less common. Monitoring results for metolachlor, alachlor, atrazine and un-ionized ammonia show no problems, but ecoregion expectations for nitrite/nitrate, as well as phosphorus are often exceeded. Only sites on the most downstream reaches of the Cobb River received habitat ratings of good, while sites on the remaining length of the river are showing fair conditions. Sites on five of the short tributaries indicated fair conditions, and those on two other tributaries are rated poor.

Lake summary

Only one lake (Freeborn) has been assessed within the Cobb River watershed.

Freeborn Lake is a large, shallow polymictic well-mixed lake located approximately seven miles northwest of Albert Lea. The town of Freeborn lies on the northern shore. The lake currently sees limited recreational use and has low water clarity and minimal aquatic vegetation. Freeborn Lake's watershed is small relative to its surface area with a watershed to lake ratio of 4:1. Land use is dominated by cultivated agricultural use that is typical for the WCBP ecoregion.

Freeborn Lake was sampled for chemistry from May through September of 2008 and 2009. The average TP for Freeborn Lake from both 2008 and 2009 data was 325 micrograms per liter (µg/L) (Table 6). This is well above the assessment criteria for shallow lakes within the WCBP ecoregion. TP in Freeborn Lake spiked in June at 489 µg/L and steadily declined throughout the summer to its lowest level of 228 µg/L in September (Figure 10).

The average chl-a for Freeborn Lake over the two-year period was 120 µg/L (Table 6). This was also well above the assessment criteria for the WCBP ecoregion. Chl-a levels spiked in August at 179 µg/L and were at their lowest in the spring (Figure 10). As a result of the high levels of TP and chl-a, as well as exceedingly high total suspended inorganic solids, the water clarity of Freeborn Lake is below the range expected for its ecoregion, with an average of just 0.2 meters (0.7 feet).

The lake was well-mixed throughout the 2009 monitoring season, which is to be expected for large, shallow lakes. Water temperature remained nearly constant from the surface to the bottom of the lake. DO remained above five milligrams per liter (mg/L) throughout the entire year with the lowest levels appearing in September at approximately seven mg/L (Figure 9).

Based on the trophic status data, Freeborn Lake was classified as hypereutrophic. Additionally, based on the TP and chl-a assessment standards, Freeborn Lake was determined to be non-supporting of aquatic recreational use and will be listed as impaired on the 2012 303(d) Impaired Waters List.

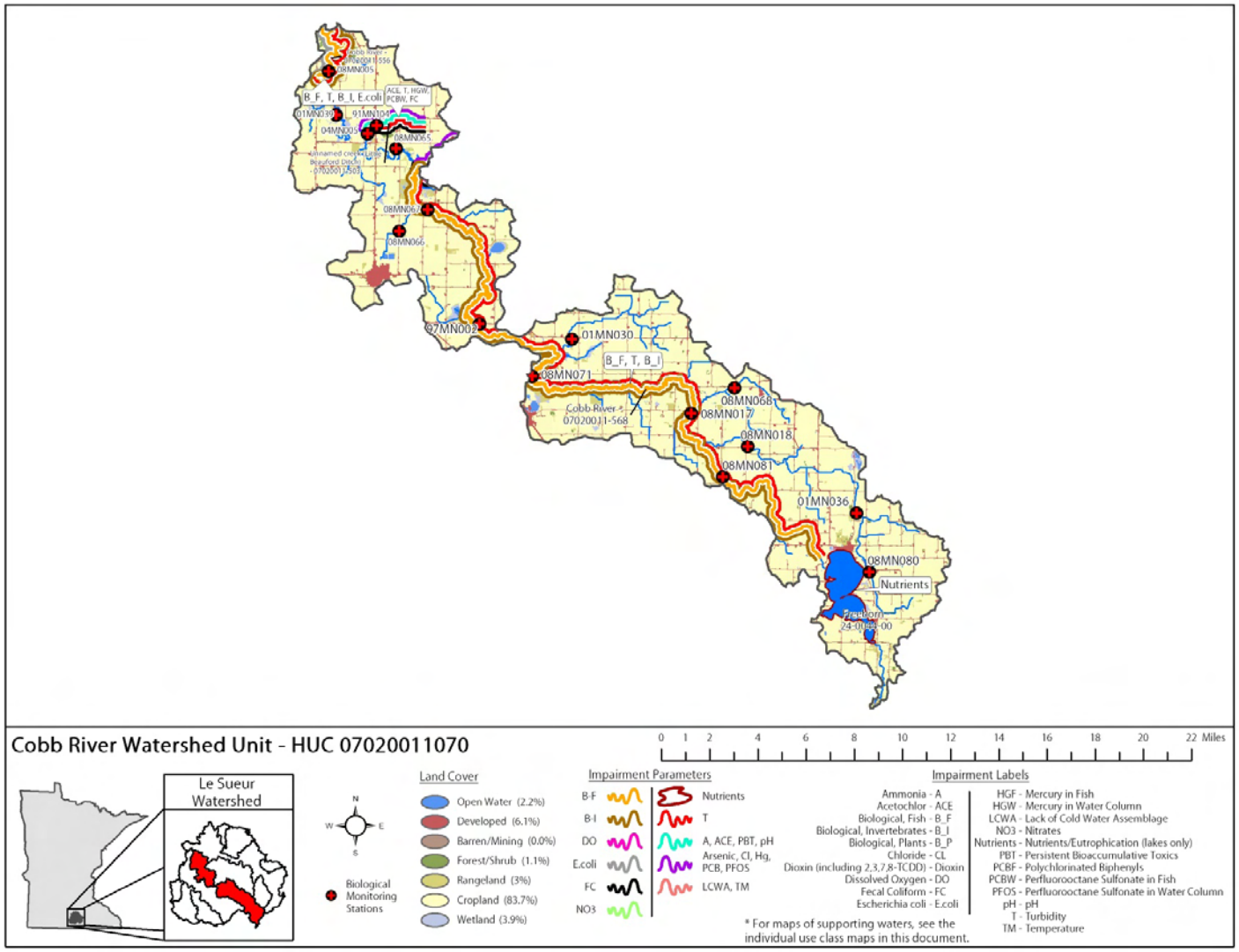

Figure 16. Currently listed impaired waters by parameter and land use characteristics in the Cobb River Watershed Unit

Easton Watershed Unit HUC 07020011080

Watershed description

The Easton Watershed unit is located in the southwestern part of the LeSueur River Watershed. The drainage area of this watershed is 68 square miles and represents six percent of the LeSueur River Watershed. Land use in this watershed unit is predominately cropland (91.6 percent) and development (5.8 percent). This watershed unit is located in north-central Faribault County. The main stream in this watershed unit is County Ditch 3 and tributaries include County Ditch 7, County Ditch 70, County Ditch 20, and Judicial Ditch 9. County Ditch 3 flows north to the confluence with the Maple River six miles south of Mapleton. Biological station 08MN002 represents the outlet of the Easton Watershed Unit.

Table 35. Water chemistry assessments on assessed AUIDs in the Easton 11 HUC

AUID	USE Class	Cl	E. coli	NO2&NO3	pH	Phosphorus	T	NH3	DO
07020011-552, County Ditch 3 (Judicial Ditch 9), JD 9 to Maple R	2B	FS	NS	NS	FS	IF	NS	FS	IF

Abbreviations:

T – Turbidity
NO2&NO3-Nitrate and Nitrite
Aq. Life – Aquatic Life Use Assessment
pH – pH
NA = Not Assessed
FS = Fully Support
NH3 – Unionized Ammonia
Cl – Chloride
DO – Dissolved Oxygen
Aq. Rec. – Aquatic Recreation Assessment
IF = Insufficient Information **NS** = Non-Support
-- = No Data

Table 36. Use and biology assessments on assessed AUIDs in the Easton 11 HUC

AUID	Bio Station ID	USE Class	F- IBI	M-IBI	Aq. Life	Aq. Rec.
07020011-547, County Ditch 70, Headwaters to Unnamed cr	01MN004	2B	NA	NA	NA	NA
07020011-548, County Ditch 70, Unnamed cr to CD 3	08MN044	2B	NA	NA	NA	NA
07020011-550, County Ditch 3, Unnamed cr to CD 7	07MN062	2B	NA	NA	NA	NA
07020011-552, County Ditch 3 (Judicial Ditch 9), JD 9 to Maple R	08MN002	2B	NA	NA	NS	NS
07020011-590, County Ditch 20, Headwaters to CD 3	08MN045	2B	NA	NA	NA	NA
07020011-591, County Ditch 7, Headwaters to CD 3	08MN012	2B	NA	NA	NA	NA
07020011-594, Judicial Ditch 9, Unnamed cr to CD 3	08MN013	2B	NA	NA	NA	NA

Abbreviations:

F-IBI – Biological, Fish
M-IBI – Biological, Macroinvertebrates
Aq. Rec. – Aquatic Recreation Assessment

NA = Not Assessed
Aq. Life – Aquatic Life Use Assessment

NA = Not Assessed
FS = Fully Support

IF = Insufficient Information **NS** = Non-Support
-- = No Data

Table 37. Non-assessed biological stations on channelized AUIDs in the Easton 11 HUC

AUID	Bio Station ID	Station location	Fish Quality	Macroinvertebrate Quality
07020011-547, County Ditch 70, Headwaters to Unnamed cr	01MN004	E of CR 19, approx. 4 mi S of Easton	Poor	Poor
07020011-548, County Ditch 70, Unnamed cr to CD 3	08MN044	Upstream of CR 19, 2 mi. S of Easton	Fair	Poor
07020011-550,County Ditch 3, Unnamed cr to CD 7	07MN062	Downstream of Hwy 19, 2 mi. NW of Easton	Poor	Good
07020011-552, County Ditch 3 (Judicial Ditch 9), JD 9 to Maple R	08MN002	Upstream of CR 46, 6 mi. S of Mapleton	Poor	Poor
07020011-590, County Ditch 20, Headwaters to CD 3	08MN045	Upstream of CR 113, 1.5 SE of Easton	Fair	Fair
07020011-591,County Ditch 7, Headwaters to CD 3	08MN012	Upstream of 200th St, 2 mi. NW of Easton	Fair	Fair
07020011-594, Judicial Ditch 9, Unnamed cr to CD 3	08MN013	Downstream of 445th Ave., 7 mi. NE of Delavan	Poor	Poor

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 4.3 for IBI results. Parentheses behind ratings indicate the quantity of site visits, which may or may not occur in the same year (10 percent of monitoring stations are repeated for quality control purposes).

Table 38. Minnesota Stream Habitat Assessment (MSHA) for the Easton 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
01MN004	County Ditch 70	1	0.0	8.0	6.0	11.0	14.0	39.0	Poor
07MN062	County Ditch 3	2	0.0	8.0	14.6	7.0	17.5	47.1	Fair
08MN002	County Ditch 3 (Judicial Ditch 9)	1	0.0	7.5	14.4	6.0	10.0	37.9	Poor
08MN012	County Ditch 7	1	0.0	7.0	18.4	10.0	7.0	42.4	Poor
08MN013	Judicial Ditch 9	1	0.0	7.5	14.0	5.0	10.0	36.5	Poor
08MN044	County Ditch 70	1	0.0	7.0	15.7	5.0	18.0	45.7	Fair
08MN045	County Ditch 20	2	0.0	9.3	9.5	8.5	13.0	40.3	Poor
Average Habitat Results: *Easton 11 HUC Watershed*			0.0	7.9	13.0	7.6	13.3	41.8	

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)

Table 39. Outlet stream water chemistry for the Easton 11 HUC

Station Location:	County Ditch 3, At CR 46, mi. S of Mapleton
Storet ID:	S002-473
Station #:	08MN002

Parameter	Units	# Samples	Minimum	Maximum	Mean1	Median	WQ standard2	# WQ exceedances3	NGP 75th percentile4
NH_3	mg/l	10	<0.05	0.08	<0.05	<0.05	0.04	2	
Calcium	mg/l	10	62	120	92.3	96	--	--	
Chloride	mg/l	10	13.1	16.3	15.11	15.05	230	0	
Chlorophyll a, corrected for pheophytin	ug/l	4	3.57	21.3	10.52	8.61	9	2	
Dissolved oxygen (DO)	mg/l	20	6.52	13.9	9.75	9.23	5	0	
Escherichia coli	MPN/100ml	17	24	7701	974.71	202	126	12	
Hardness, Ca, Mg	mg/l CaCO3	10	282	440	359.3	361	_	_	
NO_2+NO_3	mg/l	10	0.05	16	9.18	12	6.5	7	
Kjeldahl nitrogen	mg/l	10	0.38	1.27	0.78	0.76	--	--	
Magnesium	mg/l	10	28	34	31.3	31.5	--	--	
pH	none	20	7.57	8.76	8.15	8.18	6.5-9.0	0	
Pheophytin a	ug/l	4	2.5	9.64	4.91	3.74		--	
Total Phosphorus	mg/l	10	0.049	0.214	0.099	0.0775		0	0.35
Specific conductance	uS/cm	20	497.2	784	636.72	642		0	810
Sulfate	mg/l	10	31.7	71.1	44.37	35.4	--	--	
Temperature, water	Deg C	20	11	30.5	19.41	18.9	30		
TSS	mg/l	10	4	73	27.5	19.5		0	76
TSVS	mg/l	10	1.2	8	4.23	4	--	--	
Transparency, tube with disk	cm	20	8	60	38.45	44.5	--	--	
Turbidity	NTRU	21	3.3	78	18.37	12	25	6	

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Upper Sauk 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Lake water aquatic recreation assessment for the Easton 11 HUC

There are no monitored lakes in the Easton watershed 11-digit HUC Unit.

Watershed summary

This watershed has the lowest average habitat score of all the HUC-11 watersheds in the LeSueur. No stream reaches were assessed for fish or macroinvertebrate IBIs in this watershed unit due to channelization in the sampling reach. Overall, County Ditch 3 was the only AUID to be assessed for aquatic life and was found to be non supporting based on existing turbidity impairment and multiple lines of evidence. Aquatic recreation is also non-support for the one assessed AUID on this reach. The watershed land use is overwhelmingly agricultural cropland and the stream flow has been extensively altered. The reach of County Ditch 3 closest to the confluence with the Maple River was monitored intensively for physical and chemical measures in 2008 and 2009. Considering citizen transparency monitoring, as well, the reach was listed as impaired for turbidity. High bacteria results also showed that aquatic recreation is not supported here. The ecoregion criteria for nitrite/nitrate was often exceeded at this site, although chloride, ammonia and phosphorus did meet standards and criteria.

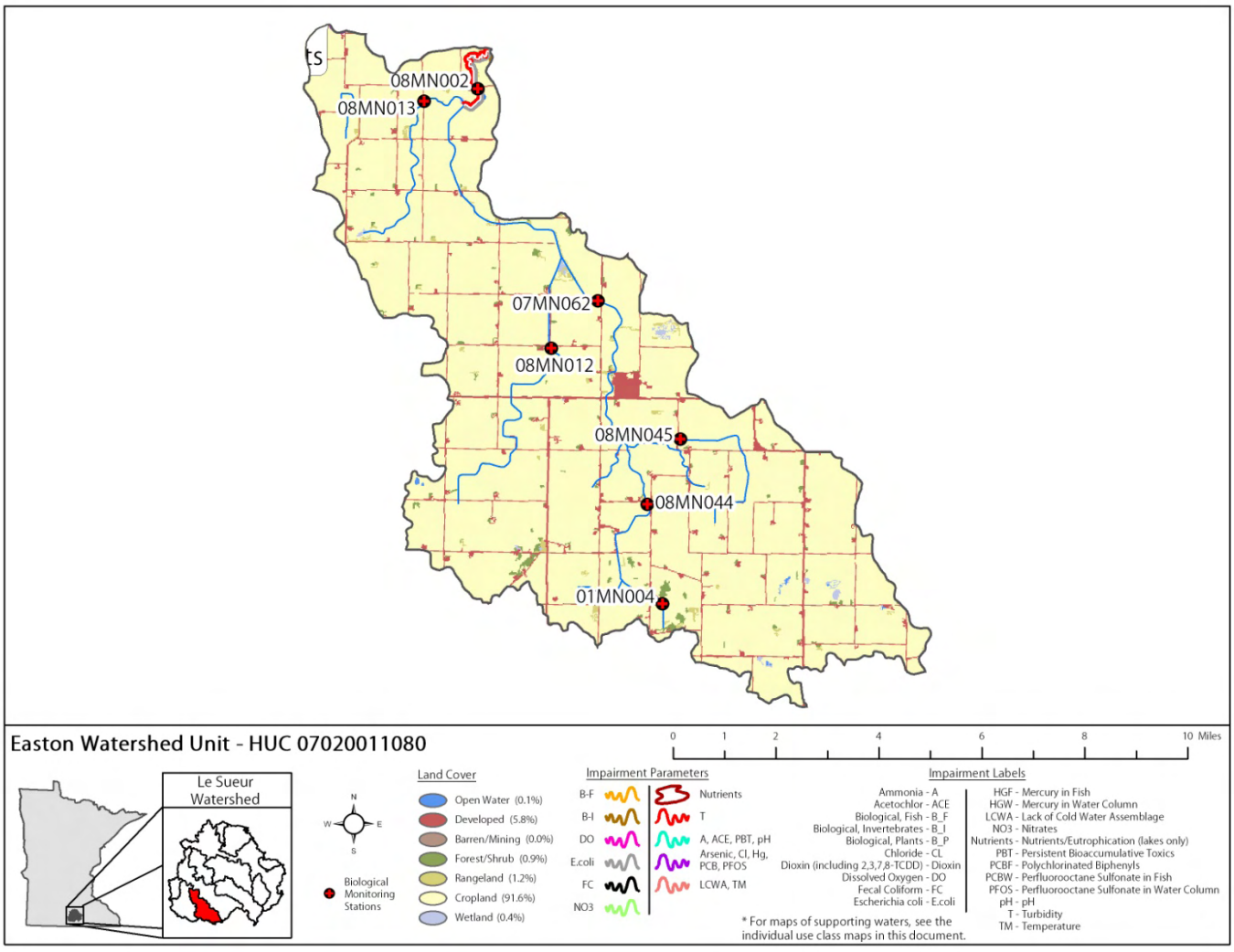

Figure 17. Currently listed impaired waters by parameter and land use characteristics in the Easton Watershed Unit

Rice Creek Watershed Unit HUC 07020011090

Watershed description

The Rice Creek watershed unit lies within the southwestern portion of the LeSueur River watershed and is located in north central Faribault County. This watershed includes the full twenty-eight miles of Rice Creek and two tributaries to it, and is located in the lower (northern) portion of the LeSueur River HUC-8 watershed. This 81 square mile watershed represents 18 percent of the LeSueur River watershed. Cropland (82.4 percent) and development (5.5 percent) are the major land uses within this watershed. There are three assessed lakes in the watershed unit. There are several small tributaries that flow to Rice Creek and Judicial Ditch 1 is the main tributary. The Rice Creek watershed drains north into the Maple River through Rice Creek near Mapleton. Biological station 08MN004 represents the outlet of the Rice Creek Watershed.

Table 40. Water chemistry assessments on assessed AUIDs in the Rice Creek 11 HUC

AUID	USE Class	Chloride	E. coli	NO2&NO3	pH	Phos	T	NH3	DO
07020011-531, Rice Creek, Headwaters to Maple R	2B	FS	NS	NS	FS	IF	NS	FS	IF
07020011-532, Judicial Ditch 1, Headwaters to T103 R27W S1, north line	2B	--	--	--	--	--	IF	--	--

Abbreviations:

T – Turbidity
Cl – Chloride
DO – Dissolved Oxygen
Aq. Rec. – Aquatic Recreation Assessment
NH3 – Unionized Ammonia
Aq. Life – Aquatic Life Use Assessment
pH – pH

NA = Not Assessed
FS = Fully Support
IF = Insufficient Information
NS = Non-Support
-- = No Data

Table 41. Use and biology assessments on assessed AUIDs in the Rice Creek 11 HUC

AUID	Bio Station ID	USE Class	Fish IBI	Macroinvertebrate IBI	Aq. Life Use	Aq. Rec. Use	LR
07020011-531, Rice Creek, Headwaters to Maple R	01MN014	2B	NS	NS	NS	NS	--
	03MN067						
	08MN004						
	08MN010						
	08MN076						
	08MN086						
07020011-532, Judicial Ditch 1, Headwaters to T103 R27W S1, north line	08MN077	2B	NA	NA	IF	NA	--
07020011-589, Unnamed creek, Rice Lk to Rice Cr	08MN009	2B	NA	NA	NA	NA	--
07020011-533, Judicial Ditch 1, T104 R27W S36, south line to Rice Cr	08MN011	7	NA	NA	--	--	NA

Abbreviations:
F-IBI – Biological, Fish
M-IBI – Biological, Macroinvertebrates
Aq. Life – Aquatic Life Use Assessment
Aq. Rec. – Aquatic Recreation Assessment
NA = Not Assessed
IF = Insufficient Information
NS = Non-Support
FS = Fully Support
-- = No Data

Table 42. Non-assessed biological stations on channelized AUIDs in the Rice Creek 11 HUC

AUID	Bio Station ID	Station location	Fish Quality	Macroinvertebrate Quality
07020011-531, Rice Creek, Headwaters to Maple R	01MN014	downstream of road, 1 mi W of CR 13, 2 mi S of Delavan	Poor	Poor
07020011-532, Judicial Ditch 1, Headwaters to T103 R27W S1, north line	08MN077	Upstream of Hwy 109, 1 mi. S of Delavan	Fair	Poor
07020011-533, Judicial Ditch 1, T104 R27W S36, south line to Rice Cr	08MN011	Downstream of 210th St, 2 mi. NW of Delavan	Poor	Poor
07020011-589, Unnamed creek, Rice Lk to Rice Cr	08MN009	Downstream of 400th Ave, 3 mi. NW of Delavan	Poor	Good

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 4.3 for IBI results. Parentheses behind ratings indicate the quantity of site visits, which may or may not occur in the same year (10 percent of monitoring stations are repeated for quality control purposes).

Table 43. Minnesota Stream Habitat Assessment (MSHA) for the Rice Creek 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
01MN014	Rice Creek	1	0.0	5.5	8.0	6.0	8.0	27.5	**Poor**
03MN067	Rice Creek	1	0.0	10.0	16.0	13.0	23.0	62.0	Fair
08MN004	Rice Creek	1	0.0	8.5	8.0	7.0	17.0	40.5	Poor
08MN009	Unnamed creek	1	0.0	8.0	16.9	6.0	7.0	37.9	Poor
08MN010	Rice Creek	1	0.0	6.0	18.0	5.0	13.0	42.0	Poor
08MN011	Judicial Ditch 1	1	0.0	7.5	19.7	3.0	18.0	48.2	Fair
08MN076	Rice Creek	1	0.0	8.0	14.0	6.0	14.0	42.0	Poor
08MN077	Judicial Ditch 1	1	0.0	8.0	11.0	9.0	10.0	38.0	Poor
08MN086	Rice Creek	1	0.0	8.0	17.5	9.0	23.0	57.5	Fair
Average Habitat Results: *Rice Creek 11 HUC Watershed*			0.0	7.7	14.3	7.1	14.8	44.0	

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)

Table 44. Outlet stream water chemistry for the Rice Creek 11 HUC

Station location:	Rice Creek At CR151, 0.5 mi S of Sterling Center
Storet ID:	S002-431
Station #:	08MN004

Parameter	Units	# Samples	Minimum	Maximum	Mean1	Median	WQ standard2	# WQ exceedances3	NGP 75th percentile4
Ammonia-nitrogen	mg/l	11	<0.05	<0.05	<0.05	<0.05	0.04	0	
Calcium	mg/l	11	58	94	75.82	78	--	--	
Chloride	mg/l	11	13.7	18.2	15.23	15.4	230	0	
Chlorophyll a, corrected for pheophytin	ug/l	4	2.93	6.73	4.21	3.595	9	0	
Dissolved oxygen (DO)	mg/l	20	6.12	14.6	8.61	8.755	5	0	
Escherichia coli	MPN/100ml	17	70	2909	469.53	344	126	14	
Hardness, Ca, Mg	mg/l CaCO3	11	244	366	310.27	310	--	--	
NO_2+NO_3	mg/l	11	0.05	8.3	3.93	3.9	6.5	4	
Kjeldahl nitrogen	mg/l	11	0.43	1.35	0.92	0.93	--	--	
Magnesium	mg/l	11	24	35	29.36	28	--	--	

pH	none	20	7.77	9.12	8.33	8.27	6.5-9.0		
Pheophytin a	mg/l	15	0.066	9.09	1.2026	0.15		--	
Phosphorus	ug/l	11	0.066	0.206	0.14	0.136		0	0.35
Specific conductance	uS/cm	20	360.9	653	562.6	572		0	810
Sulfate	mg/l	11	22.1	68	38.35	30.1	--	--	
Temperature, water	Deg C	20	12.1	30.8	20.68	21.9	30	1	
Total suspended solids	mg/l	11	9.6	57	30.24	26		0	76
Total volatile solids	mg/l	11	2.4	7.8	4.8	4.4	--	--	
T-tube	cm	21	7	64	23.38	23	--	--	
Turbidity	NTRU	23	7.6	72	21.62	15	25	5	

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Upper Sauk 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 45. Lake water aquatic recreation assessment for the Rice Creek 11 HUC

Lake Name	DOW#	Area (acres)	Trophic Status	percent Littoral	Max. Depth (M)	Avg. Depth (M)	CLMP Trend	Mean TP (ug/L)	Mean chl-a (ug/L)	Secchi Mean (m)	ARUS
Lura	07-0079	1,295	E	100	2.7	1.5	NT	193	44	1.1	NS
Bass	22-0074	199	E	84	6.1	3	+	57	32	1	IF
Rice	22-0075	978	H	100	1.5	0.7	ND	218	46	0.5	IF

Abbreviations:
↘ -- Decreasing/Declining Trend
↗ -- Increasing/Improving Trends
NT – No Trend
H – Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic
FS – Full Support
NS – Non-Support
IF – Insufficient Information
ARUS – Aquatic Recreational Use Support

Watershed summary

Only one AUID was assessed in this watershed unit and was found to be non-supporting for both fish and macroinvertebrate IBI. Likewise, the only assessed AUID was found to be non-supporting of aquatic recreation. A large tributary system flows through a complex of lakes and wetlands, including Bass Lake, which is impaired for mercury in fish tissue, in the western mid-section of the watershed. An evaluation near the confluence with Rice Creek rates this tributary poor or habitat. Judicial Ditch 1, the other tributary, is rated fair closer to the confluence, but poor for habitat in the upstream end of the reach. Rice Creek itself shows fair conditions throughout its length, except for a poor rating at the most downstream sampling point where the intensive physical and chemical monitoring was done in 2008 and 2009. The intensive monitoring shows continuing problems with suspended solids on this reach, which is already listed for turbidity. Bacteria levels were also high enough to indicate impairment, with nitrite/nitrate often exceeding ecoregion expectations. Phosphorus, chloride and ammonia do meet criteria and standards here.

Lake summary

There are three lakes with assessment data for this watershed.

Lura Lake is a large, shallow well mixed lake located approximately three miles southwest of Mapleton. Lura Lake's watershed is small relative to its surface water area with an area of 1,073 hectares (2,657 acres) and a watershed to lake ratio of 2:1. Land use is dominated by the lake and surrounding wetlands with the percentage being well above the range of values expected for the WCBP. Additionally, land use devoted to crop and is lower than the typical watershed in the WCBP.

Lura Lake was sampled for chemistry in 2004 and 2009. The average TP for Lura Lake was 193 µg/L. This was well above the assessment criteria for lakes within the WCBP ecoregion. Over the course of the two sampling years TP spiked in August of 2009 at 276 µg/L while the lowest value was 53 µg/L in September of 2009.

The average chl-*a* value for Lura Lake was 44 µg/L. This was also above the assessment criteria for the WCBP ecoregion. Chl-*a* levels spiked in August of 2009 at 101 µg/L and were at their lowest in June of 2009 at 1.2 µg/L. Despite the high levels of TP and chl-*a*, the water clarity for Lura Lake is above the assessment standard with an average of just 1.1 meters (3.6 feet).

Profile data was collected sporadically throughout Lura Lake for DO and temperature measurements. DO briefly dropped just below five mg/L in early July of 2009 but remained above five mg/L throughout the remainder of the year. The surface water temperature spiked at 25.6C in August and a thermocline did not develop. This indicates that Lura Lake is continuously mixing throughout the season. As a result, nutrients are continuously being stirred up from the sediment and released into the lake water. It is likely that a majority of the nutrient loading for Lura Lake occurs internally due to constant mixing and a relatively small watershed.

Based on the chemical monitoring results and water clarity, Lura Lake was classified as a eutrophic lake. Additionally, based on the TP and chl-*a* standards for the support of aquatic recreation, Lura Lake was determined to be non supporting of aquatic recreational use and was listed as an impaired water under the 2008 303(d) Impaired Waters List. Lura Lake is impaired for excess nutrients and also mercury in fish tissue. Lura Lake outflows to Rice Creek.

Bass Lake is a small, deep intermittently mixing lake located approximately three miles northeast of Winnebago. Bass Lake's watershed is small relative to its surface water area with an area of 197 hectares (487 acres) and a watershed to lake ratio of 2:1. Land use is dominated by the lake and surrounding wetlands with the percentage being well above the range of values expected for the WCBP. Additionally, land use devoted to cropland is lower than the typical watershed in the WCBP.

Bass Lake was last sampled for chemistry in 2004 by local volunteers. The average TP for Bass Lake was 57 µg/L. This was below the assessment criteria for lakes within the WCBP ecoregion. In 2004, TP was at its highest in June at 65 µg/L while the lowest value of 47 µg/L occurred in June. The average chl-*a* value for Bass Lake was 32 µg/L. This was above the assessment criteria for the WCBP ecoregion. In 2004, chl-*a* levels spiked in August at 42 µg/L and were at their lowest in May at 24 µg/L. Coinciding with the relatively low levels of TP and chl-*a*, the water clarity for Bass Lake was below (better than) the assessment standard with an average of 1 meter (3.3 feet).

Historic data from 2004 was used to evaluate Bass Lake's DO and temperature profiles. DO dropped below 5 mg/L in June and July at approximately 3.5 meters (11.5 feet) but remained above 5 mg/L throughout the entire water column in August and September. Temperature profiles indicate weak thermoclines developing from the surface to the bottom of Bass Lake. This is further indication that Bass Lake is continuously mixing throughout the season. It is likely that a majority of the nutrient loading for Bass Lake occurs internally due to constant mixing and the limited external loading due to the small watershed.

Based on the limited chemical monitoring results and water clarity, Bass Lake has not been fully assessed and further monitoring is recommended. However, with the existing data, Bass Lake has been determined to be eutrophic. Additionally, the Citizen Lake Monitoring Program (CLMP) has monitored the lake for several years. Data collected through this program has shown a trend of improving water clarity. Bass Lake has insufficient data to determine whether it will be listed as impaired water or not.

Rice Lake is a large, shallow polymictic lake located approximately two miles east of Winnebago. Rice Lake's watershed is moderate relative to its surface water area with an area of 5,973 hectares (14,787 acres) and a watershed to lake ratio of 15:1. Land use is dominated by cropland with the percentage being above the range of values expected for the WCBP.

Rice Lake was last sampled for chemistry in 2008. The average TP for Rice Lake was 218 µg/L. This was well above the assessment criteria for lakes within the WCBP ecoregion. In 2008, TP was at its highest in July at 376 µg/L while the lowest value of 72 µg/L occurred in May.

The average chl-*a* value for Rice Lake was 46 µg/L. This was above the assessment criteria for the WCBP ecoregion. In 2008, chl-*a* levels coincided with a nutrient spike in July at 123 µg/L and were at their lowest in August at 2 µg/L. Coinciding with the high levels of TP and chl-*a*, the water clarity for Rice Lake was below the assessment standard with an average of 0.5 meters (1.6 feet).

Due to accessibility issues, consistent profile data was not collected on Rice Lake in 2008. Given the lake's large fetch, shallow depth, and high TSS and TSIS (20 mg/L & 9 mg/L) it is assumed that Rice Lake is continuously mixing. Additionally, only one year of data exists for this basin. The lake is highly managed for waterfowl production and was in drawdown for much of 2008/2009. During these periods Rice Lake was extremely difficult to navigate with little open water and high emergent vegetation.

Based on the limited chemical monitoring results and water clarity, Rice Lake has not been fully assessed. However, with the existing data, Rice Lake has been determined to be hypereutrophic. Due to the high level of waterfowl management and issues with accessing open water further monitoring was not recommended. Rice Lake has insufficient data to determine whether it will be listed as impaired water or not.

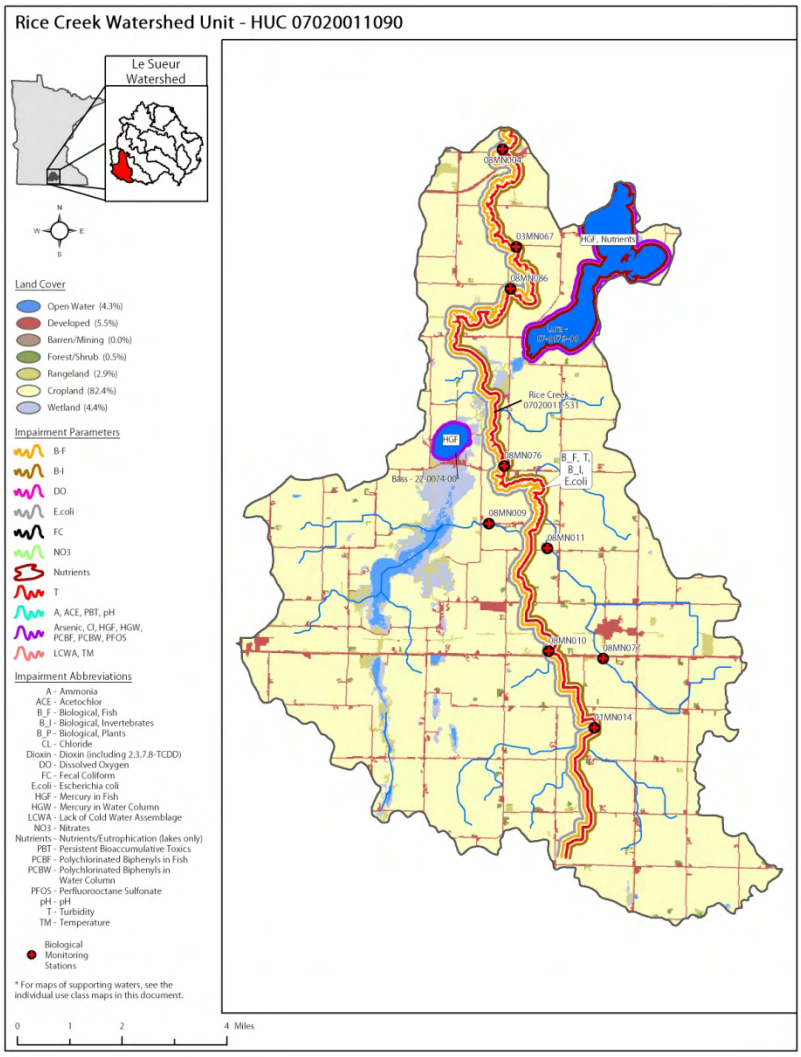

Figure 18. Currently listed impaired waters by parameter and land use characteristics in the Rice Creek Watershed Unit

Providence Creek Watershed Unit HUC 07020011100

Watershed description

The Providence Creek Watershed unit is located in the far western part of the LeSueur River Watershed. The watershed unit is 27 square miles which represents two percent of the LeSueur River Watershed, and is located in south-central Blue Earth and north-central Faribault counties. Land use in this watershed unit is predominately cropland (90 percent) and developed land (6.8 percent). Providence Creek (Judicial Ditch 49) is the mainstream in the watershed unit and starts southeast of Amboy and flows north to the confluence with the Maple River near the village of Sterling Center. A large portion of the Providence Creek is designated as Class 7 limited resource value waters. Biological station 08MN008 represents the outlet of the watershed, but 10X water chemistry sampling did not occur at this station due to the small size of this watershed Unit.

Table 46. Water chemistry assessments on assessed AUIDs in the Providence Creek 11 HUC

AUID	USE Class	T
07020011-539, Providence Creek (Judicial Ditch 49), Headwaters to T105 R27W S30, north line	2B	--
07020011-540, Providence Creek (Judicial Ditch 49), T105 R27W S17, west line to Maple R	2B	IF
07020011-502, Providence Creek (Judicial Ditch 49), T105 R27W S19, south line to T105 R27W S18, east line	7	--

Abbreviations: **T** – Turbidity

NA = Not Assessed **IF** = Insufficient Information **NS** = Non-Support
FS = Fully Support **--** = No Data

Table 47. Use and biology assessments on assessed AUIDs in the Providence Creek 11 HUC

AUID	Biological Station ID	USE Class	F-IBI	M- IBI	Aq. Life	Aq. Rec.	LR
07020011-539, Providence Creek (Judicial Ditch 49), Headwaters to T105 R27W S30, north line	08MN075	2B	NA	NA	NA	NA	--
07020011-540, Providence Creek (Judicial Ditch 49), T105 R27W S17, west line to Maple R	08MN008	2B	NA	NA	IF	NA	--
07020011-502, Providence Creek (Judicial Ditch 49), T105 R27W S19, south line to T105 R27W S18, east line	08MN074	7	NA	NA	--	--	NA

Abbreviations:
F-IBI – Biological, Fish
M-IBI – Biological, Macroinvertebrates
Aq. Rec. – Aquatic Recreation Assessment
Aq. Life – Aquatic Life Use Assessment
NA = Not Assessed
FS = Fully Support
IF = Insufficient Information
NS = Non-Support
-- = No Data

Table 48. Non-assessed biological stations on channelized AUIDs in the Providence Creek 11 HUC

AUID	Bio Station ID	Station location	Fish Quality	Macroinvertebrate Quality
07020011-502, Providence Creek (Judicial Ditch 49), T105 R27W S19, south line to T105 R27W S18, east line	08MN074	Downstream of Hwy 30, 1.5 mi. E of Amboy	Poor	Fair
07020011-539, Providence Creek (Judicial Ditch 49), Headwaters to T105 R27W S30, north line	08MN075	Upstream of CR 148, 2 mi. SE of Amboy	Poor	Poor
07020011-540, Providence Creek (Judicial Ditch 49), T105 R27W S17, west line to Maple R	08MN008	Downstream of 542nd Ave. 3 mi. SE of Amboy	Poor	Poor

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 4.3 for IBI results. Parentheses behind ratings indicate the quantity of site visits, which may or may not occur in the same year (10 percent of monitoring stations are repeated for quality control purposes).

Table 49. Minnesota Stream Habitat Assessment (MSHA) for the Providence Creek 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08MN008	Providence Creek (Judicial Ditch 49)	1	0.0	4.0	18.0	11.0	12.0	45.0	Fair
08MN074	Providence Creek (Judicial Ditch 49)	1	0.0	9.0	12.0	11.0	16.0	48.0	Fair
08MN075	Providence Creek (Judicial Ditch 49)	1	0.0	8.0	9.0	10.0	10.0	37.0	Poor
Average Habitat Results: *Providence Creek 11 HUC Watershed*			0.0	7.0	13.0	10.7	12.7	43.3	

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)

Outlet Stream Water Chemistry for the Providence Creek 11 HUC

Outlet water chemistry was not collected because of the small size of the watershed unit. There is limited local data available.

Lake Water Aquatic Recreation Assessment for the Providence Creek 11 HUC

There are no monitored lakes in the Providence Creek Watershed Unit 11-digit HUC.

Watershed summary

No AUIDs in this watershed unit were assessed for fish IBI, macroinvertebrate IBI, aquatic life, or aquatic recreation. This small watershed between Amboy and Sterling Center, is drained by Providence Creek to the Maple River. Nearly the full length of Providence Creek has been channelized, and the habitat ratings along the length are poor at the upstream location and fair and two middle section sites. This watershed will be assessed once tier aquatic life use standards have been developed for channelized stream reaches. Preliminary IBI ratings from channelized stream reaches indicate mainly poor biotic conditions.

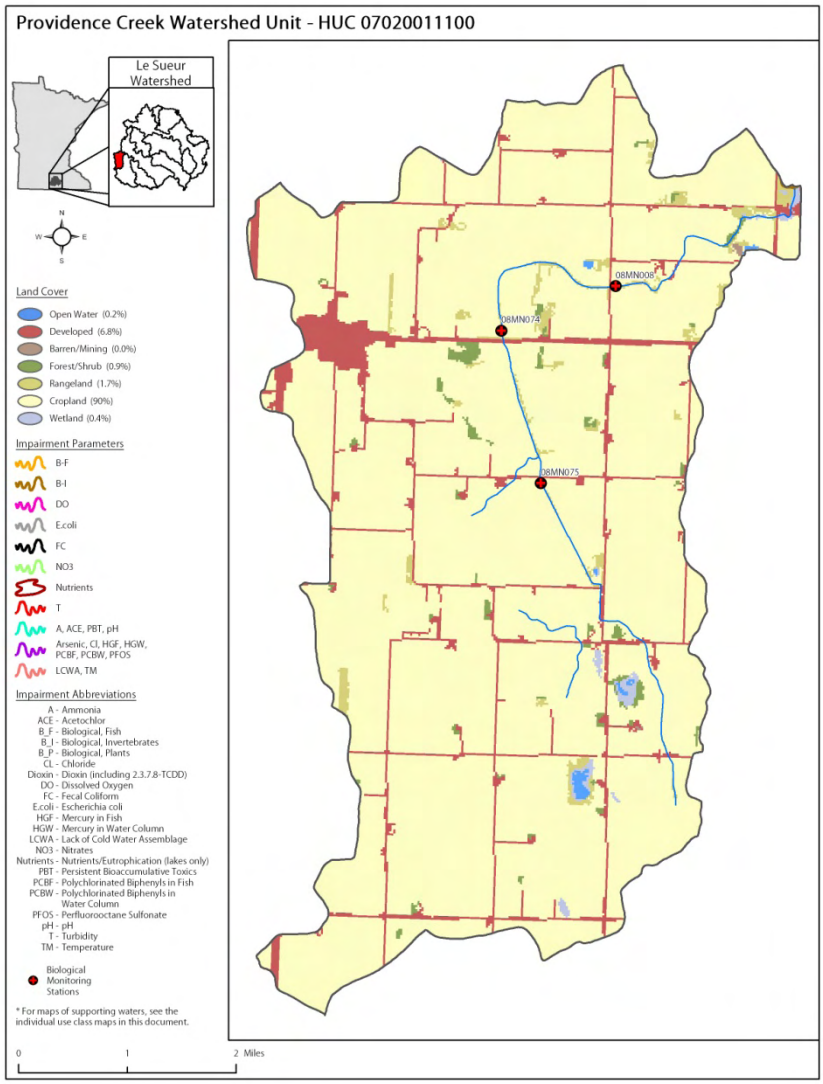

Figure 19. Currently listed impaired waters by parameter and land use characteristics in the Providence Creek Watershed Unit

Maple River Watershed Unit HUC 07020011110Watershed description

The Maple River watershed unit lies within the southern half of the LeSueur River watershed and covers the north part of Faribault and south-central part of Blue Earth County. The Maple River watershed includes the more than eighty miles of Maple River main stem, along with Minnesota Lake and headwater tributaries and small lakes. This 165 square mile watershed represents 15 percent of the LeSueur River watershed. Cropland (84.4 percent) and developed land (6.4 percent) are the predominant land uses within this watershed unit. Minnesota Lake is the only lake that has been assessed in this watershed. Tributaries in this watershed unit include County Ditch 7, County Ditch 85, Big Slough and several smaller unnamed headwater streams. The Maple River watershed drains from southeast to northwest into the LeSueur River approximately three miles south of Mankato. Biological station 08MN003 represents the outlet of this watershed unit.

Table 50. Water chemistry assessments on assessed AUIDs in the Maple River 11 HUC

AUID	USE Class	Chloride	E. coli	NO2&NO3	pH	Phosphorus	T	NH_3	D.O
07020011-534, Maple River, Rice Cr to LeSueur R	2B	FS	NS	NS	FS	NS	NS	FS	IF
07020011-535, Maple River, Minnesota Lk outlet to Rice Cr	2B	--	--	--	--	--	NS	--	--
		--	--	--	--	--		--	--
07020011-565, Unnamed ditch (Minnesota Lake Inlet), Headwaters to Minnesota Lk	2B	--	--	--	--	--	FS	--	--

Abbreviations:

F-IBI – Biological, Fish
M-IBI – Biological, Macroinvertebrates
DO – Dissolved Oxygen

T – Turbidity
Cl – Chloride
pH – pH

NH3 – Unionized Ammonia
Aq. Life – Aquatic Life Use Assessment
Aq. Rec. – Aquatic Recreation Assessment

NA = Not Assessed
FS = Fully Support

IF = Insufficient Information **NS** = Non-Support
-- = No Data

Table 51. Use and biology assessments on assessed AUIDs in the Maple River 11 HUC

AUID	Biological Station ID	USE Class	Fish IBI	Invert IBI	Aq. Life	Aq. Rec.
07020011-534, Maple River, Rice Cr to LeSueur R	08MN003	2B	FS	NS	NS	NS
	08MN019					
07020011-535, Maple River, Minnesota Lk outlet to Rice Cr	08MN024	2B	NS	NS	NS	NA
	08MN023					
07020011-537, Maple River, Headwaters (Penny Lk 24-0048-00) to Unnamed cr	08MN022	2B	NA	NA	NA	NA
	08MN079					
	91MN102					
07020011-565, Unnamed ditch (Minnesota Lake Inlet), Headwaters to Minnesota Lk	--	2B	--	--	IF	NA
07020011-580, Maple River, Unnamed cr to Minnesota Lk outlet	08MN072	2B	NA	NA	NA	NA
07020011-592, County Ditch 7, Unnamed cr to Maple R	08MN014	2B	NA	NA	NA	NA
07020011-593, County Ditch 85, Unnamed cr to Maple R	08MN015	2B	NS	NS	IF	NA
07020011-596, Big Slough, Unnamed cr to CD 35	08MN041	2B	NA	NA	NA	NA
07020011-597, Unnamed creek, Unnamed cr to Maple R	08MN073	2B	NA	--	NA	NA
07020011-598, Unnamed creek, Unnamed lk to Maple R	08MN043	2B	NA	NA	NA	NA

Abbreviations:

F-IBI – Biological, Fish
M-IBI – Biological, Macroinvertebrates
DO – Dissolved Oxygen
T – Turbidity
Cl – Chloride
pH – pH
NH3 – Unionized Ammonia
Aq. Life – Aquatic Life Use Assessment
Aq. Rec. – Aquatic Recreation Assessment

NA = Not Assessed
FS = Fully Support
IF = Insufficient Information
-- = No Data
NS = Non-Support

Table 52. Non-assessed biological stations on channelized AUIDs in the Maple River 11 HUC

AUID	Biological Station ID	Station location	Fish Quality	Macroinvertebrate Quality
07020011-537, Maple River, Headwaters (Penny Lk 24-0048-00) to Unnamed cr	08MN022	Downstream of CR 27, 3 mi. NW of Wells	Fair	Fair
07020011-537, Maple River, Headwaters (Penny Lk 24-0048-00) to Unnamed cr	08MN079	Upstream of 200th St, 3 mi. NW of Wells	Poor	Fair
07020011-537, Maple River, Headwaters (Penny Lk 24-0048-00) to Unnamed cr	91MN102	Downstream of Hwy 22, 2.5 mi NW of Wells	Fair	Fair
07020011-580, Maple River, Unnamed cr to Minnesota Lk outlet	08MN072	Downstream 235th St, 1.5 mi. W of Minnesota Lake	Fair	Poor
07020011-592, County Ditch 7, Unnamed cr to Maple R	08MN014	Upstream of 210th St, 2 mi. N of Easton	Poor	Fair
07020011-596, Big Slough, Unnamed cr to CD 35	08MN041	Upstream of TR 15 (588th Ave), 4 mi. S of Mapleton	Poor	Fair
07020011-597, Unnamed creek, Unnamed cr to Maple R	08MN073	Downstream of CR 150, 2.5 mi. W of Mapleton	Poor	--
07020011-598, Unnamed creek, Unnamed lk to Maple R	08MN043	Upstream of 557th Ave, 2.5 mi. SE of Good Thunder	Poor	Poor

See Appendix 5.1 for clarification on the good/fair/poor thresholds and Appendix 4.3 for IBI results. Parentheses behind ratings indicate the quantity of site visits, which may or may not occur in the same year (10 percent of monitoring stations are repeated for quality control purposes).

Table 53. Minnesota Stream Habitat Assessment (MSHA) for the Maple River 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08MN003	Maple River	1	0.0	12.0	22.3	10.0	33.0	77.3	Good
08MN014	County Ditch 7	1	2.0	10.0	17.1	10.0	15.0	54.1	Fair
08MN015	County Ditch 85	1	0.0	10.0	17.1	5.0	17.0	49.1	Fair
08MN019	Maple River	2	0.0	10.3	17.8	9.5	15.5	53.1	Fair
08MN022	Maple River	1	0.0	7.5	20.0	4.0	19.0	50.5	Fair
08MN023	Maple River	1	0.0	8.0	12.8	7.0	18.0	45.8	Fair
08MN024	Maple River	1	0.0	10.0	17.5	8.0	21.0	56.5	Fair
08MN041	Big Slough	1	0.0	6.5	12.5	5.0	4.0	28.0	Poor
08MN043	Unnamed creek	1	0.0	10.5	4.0	2.0	7.0	23.5	Poor
08MN072	Maple River	1	0.0	7.5	8.0	9.0	18.0	42.5	Poor
08MN073	Unnamed creek	1	0.0	9.0	10.4	10.0	14.0	43.4	Poor
08MN079	Maple River	1	0.0	6.0	17.6	6.0	15.0	44.6	Poor
91MN102	Maple River	1	0.0	7.0	21.0	5.0	22.0	55.0	Fair
Average Habitat Results: Maple River *11 HUC Watershed*			0.1	8.9	15.4	7.1	16.7	48.3	

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)

Table 54. Outlet stream water chemistry for the Maple River 11 HUC

Station location:	Maple River at CR 35, 6 mi. N of Good Thunder
Storet ID:	S002-427
Station #:	08MN003

Parameter	Units	# Samples	Minimum	Maximum	Mean1	Median	WQ standard2	# WQ exceedances3	NGP 75th percentile4
NH_3	mg/l	14	<0.05	<0.05	<0.05	<0.05	0.04	0	
Calcium	mg/l	13	63	120	87.23	84	--	--	
Chloride	mg/l	14	14.4	18.9	16.48	16.95	230	0	
Chlorophyll a, corrected for pheophytin	ug/l	5	1.76	11.2	5.12	3.62	9	1	
Dissolved oxygen (DO)	mg/l	20	6.54	12.63	9.46	9.275	5	0	
Escherichia coli	MPN/100ml	18	4	1782	178.83	75	126	4	
Hardness, Ca, Mg	mg/l CaCO3	13	285	448	347	329	--	--	
NO_2+NO_3	mg/l	14	0.1	12	5.87	5.4	6.5	7	
Kjeldahl nitrogen	mg/l	14	0.43	1.33	0.77	0.65	--	--	
Magnesium	mg/l	13	29	36	31.38	31	--	--	
pH	none	20	8.01	8.84	8.37	8.36	6.5-9.0	0	
Pheophytin a	mg/l	4	1.93	9.87	4.64	3.385	--	--	
Phosphorus	ug/l	14	0.028	0.318	0.12	0.1045		0	0.35
Specific conductance	uS/cm	20	409.7	752	595.03	596		0	810
Sulfate	mg/l	14	44.2	98	61.65	50.4	--	--	
Temperature, water	Deg C	20	13.1	29.4	21.64	22.55	30	0	
TSS	mg/l	14	2.4	250	47.34	18.5		2	76
TSVS	mg/l	14	1	17	4.84	2.6		--	
T-Tube	cm	20	2	100	32.8	27.5		--	
Turbidity	NTRU	27	2.8	108	25.05	16	25	11	

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
[4]Based on 1970-1992 summer data; see *Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions* (McCollor and Heiskary 1993).

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Upper Sauk 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 55. Lake water aquatic recreation assessment for the Maple River 11 HUC

Lake Name	DOW#	Area (acres)	Trophic Status	percent Littoral	Max. Depth (M)	Avg. Depth (M)	CLMP Trend	Mean TP (ug/L)	Mean chl-a (ug/L)	Secchi Mean (m)	ARUS
Minnesota	22-0033	1,914	H	100	1.5	0.5	ND	145	40	0.3	IF

Abbreviations:
↘ -- Decreasing/Declining Trend
↗ -- Increasing/Improving Trends
NT – No Trend
H – Hypereutrophic
E – Eutrophic
M – Mesotrophic
O – Oligotrophic
FS – Full Support
NS – Non-Support
IF – Insufficient Information
ARUS – Aquatic Recreational Use Support

Watershed summary

Only one out of three assessed AUIDs were found to be supporting for fish IBI and none of the three assessed reaches were supporting for macroinvertebrate IBI. None of the AUIDs in this watershed were found to be fully supporting of aquatic life or aquatic recreation in the watershed unit. The land use is primarily agricultural cropland across the watershed, and much of the headwater channels are channelized. Approximately half of the non- assessed channelized stream reaches had a poor rating and the other half had a fair rating. Most of the main stem is impaired due to high levels of turbidity and poor communities of aquatic macroinvertebrates. The thirty-one mile reach closest to the LeSueur River confluence is also impaired by bacteria, and the twenty-six miles between Minnesota Lake and the Rice Creek confluence is also listed as impaired due to unhealthy fish communities. Habitat evaluations at two of the three short tributaries in the northern half of the watershed found poor habitat, and the other is rated fair. Except for one site on the Maple River near the mouth, which has good habitat, seven additional main stem sites and two headwater tributary sites are rated as fair. Intensive physical and chemical monitoring at the most downstream reach of the Maple River show that chloride and un-ionized ammonia meet water quality standards, but nitrite/nitrate, phosphorus and suspended solids do not meet ecoregion criteria.

Lake summary

Minnesota Lake is a large, shallow polymictic lake located within the town of Minnesota Lake. Minnesota Lake's watershed is small relative to its surface water area with an area of 2,332 hectares (5,772 acres) and a watershed to lake ratio of 3:1. Land use is dominated by cropland use with the percentage falling into the range of values expected for the WCBP. Additionally, water and wetland land use is higher than the typical watershed in the WCBP due to the size of the lake.

Minnesota Lake was sampled for chemistry in 2008 and 2009. The average TP for Minnesota Lake was 145 µg/L. This was well above the assessment criteria for lakes within the WCBP ecoregion. Over the course of the two sampling years TP spiked in July of 2009 at 222 µg/L while the lowest value was 115 µg/L in September of 2009.

The average chl-a value for Minnesota Lake was 40 µg/L. This was also well above the assessment criteria for the WCBP ecoregion. Chl-a levels spiked in August of 2009 at 96 µg/L and were at their lowest in July of 2008 at 4 µg/L. As a result of the high levels of TP and chl-a, as well as exceedingly high Total Inorganic Solids levels (48 mg/L), the water clarity of Minnesota Lake is below the range of the assessment standard with an average of just 0.3 meters (one foot).

Due to Minnesota Lake's shallow depth, profile data is limited to surface measurements of DO and temperature. DO remained above five mg/L throughout the year while the water temperature spiked at 23.9 C in August. The lake's shallow depth, large fetch, and high levels of suspended solids all indicate that Minnesota Lake is subject to continuous mixing throughout the season. As a result, nutrients are continuously being stirred up from the sediment and released into the lake water. Additionally, it is likely that a majority of the nutrient loading for Minnesota Lake occurs internally due to constant mixing and a relatively small watershed.

Based on the chemical monitoring results and poor water clarity, Minnesota Lake was classified as a hypereutrophic lake. Additionally, based on the limited chemical monitoring results and water clarity, Minnesota Lake has not been fully assessed. However, based on the TP and chl-a standards (criteria) for the support of aquatic recreation, Minnesota Lake would likely be determined to be non-supporting of aquatic recreational use.

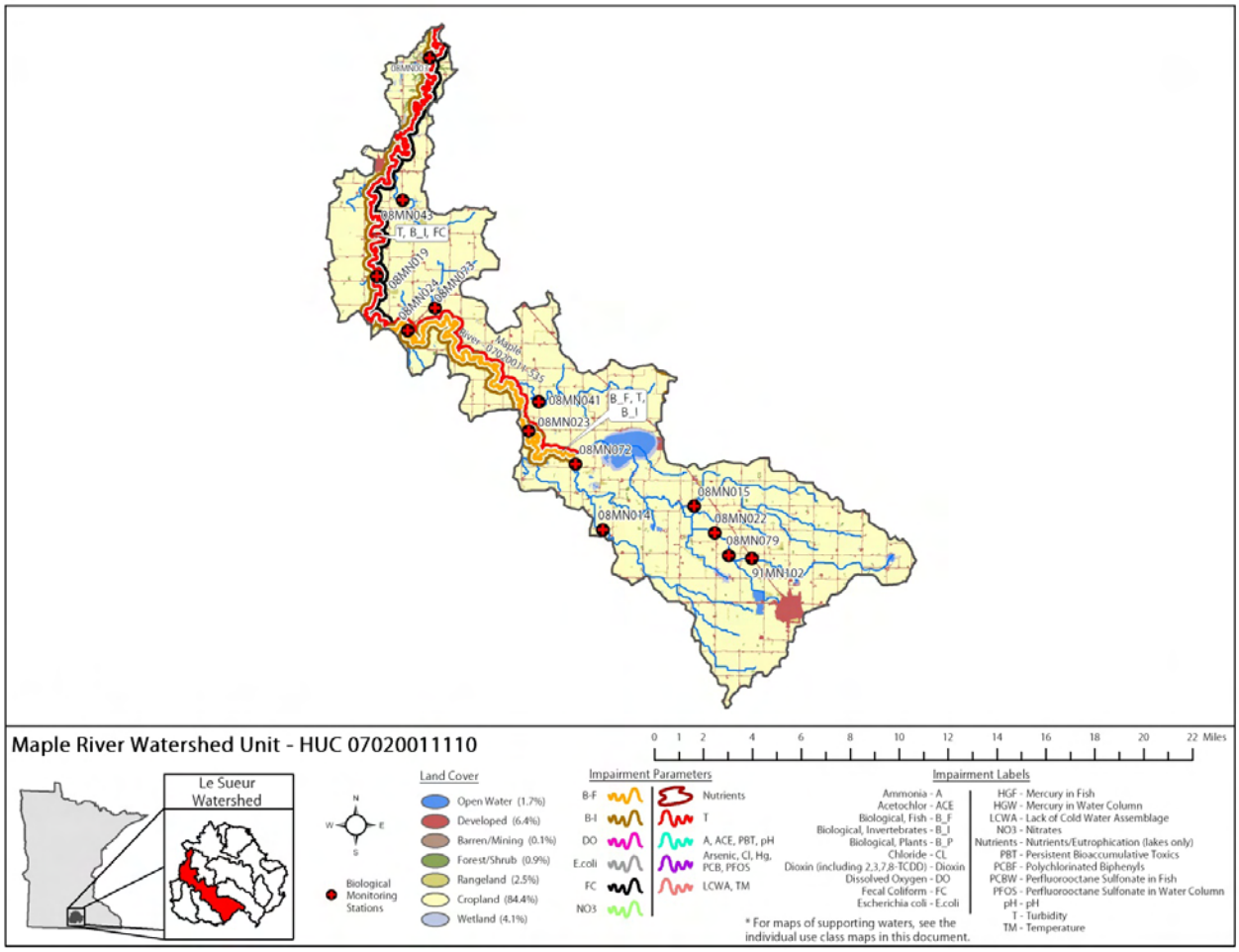

Figure 20. Map of impaired waters for the Maple River 11-Digit HUC watershed

VII. Watershed Wide Results and Discussion

Assessment results and data summaries are included below for the entire HUC-8 watershed unit of the LeSueur River and are grouped by sample type. Summaries are provided for aquatic consumption results on select river reaches and lakes in the watershed, load monitoring results near the mouth of the river, and aquatic life and aquatic recreation uses in lakes and streams throughout the watershed.

Load monitoring

Annual FWMCs were calculated and compared for years 2007-2009 (Figures 22-25) and compared to the River Nutrient Region (RNR) standards (only TP and TSS draft standards are available for the South RNR). It should be noted that while a FWMC exceeding given water quality standard is generally a good indicator that the water body may be out of compliance with the RNR standard, this does not always hold true. Waters of the state are listed as impaired based on the percentage of individual samples exceeding a given standard, generally 10 percent and greater (MPCA 2010a), over the most recent ten year period and not based on comparisons with FWMCs. A river with a FWMC above a water quality standard, for example, would not be listed as impaired if less than 10 percent of the individual samples collected over the assessment period were above the standard.

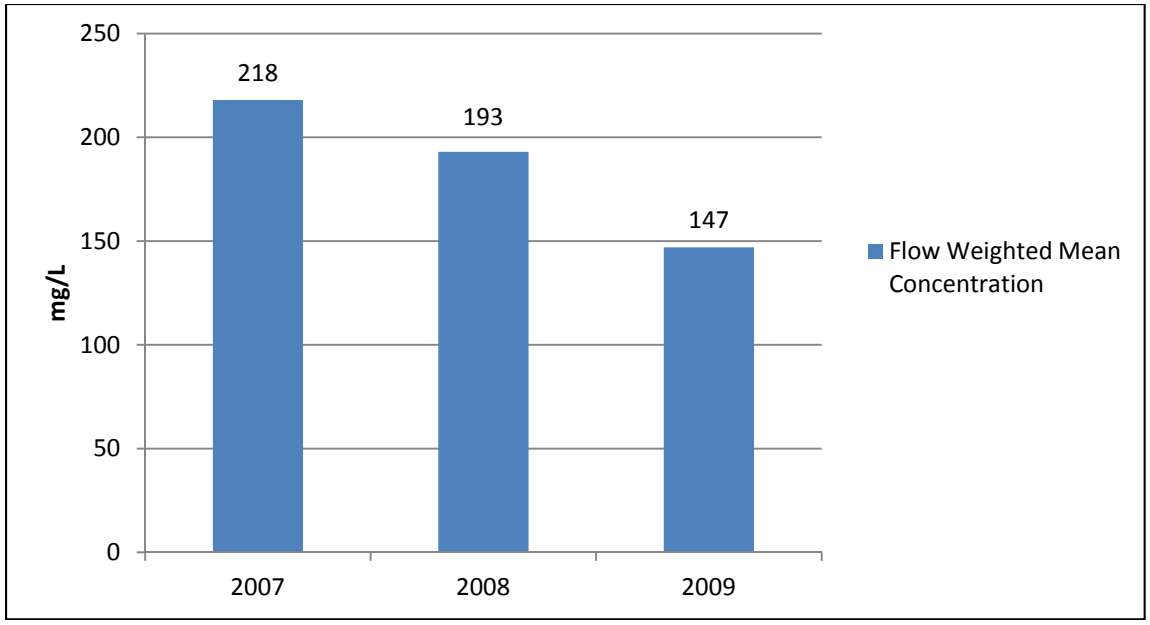

Figure 21. Total Suspended Solids (TSS) Flow Weighted Mean Concentrations for the LeSueur River.

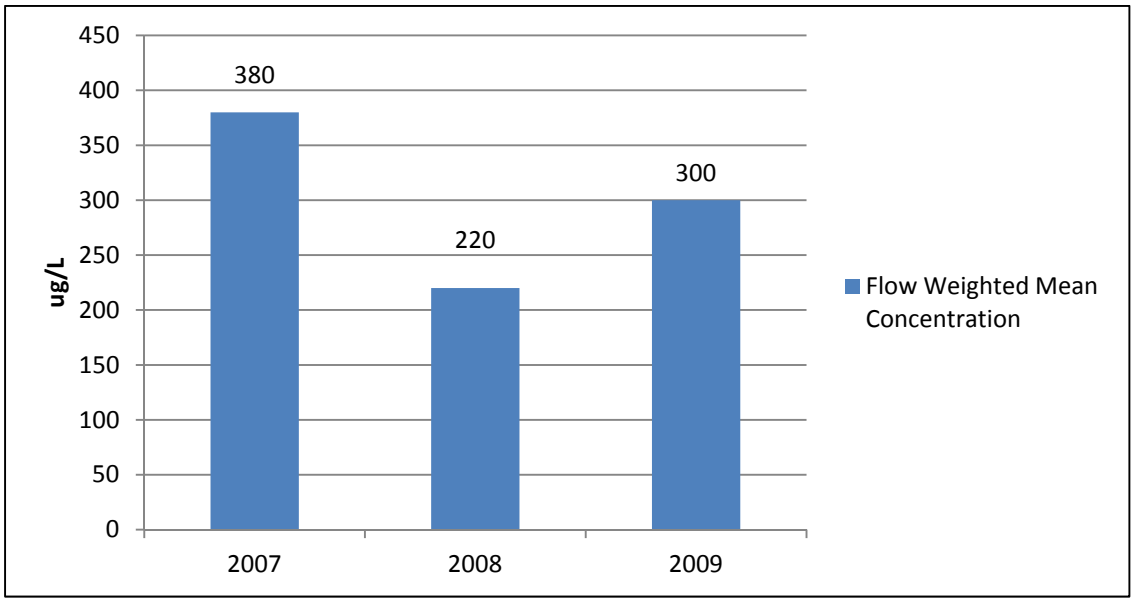

Figure 22. Total Phosphorus (TP) Flow Weighted Mean Concentrations for the LeSueur River.

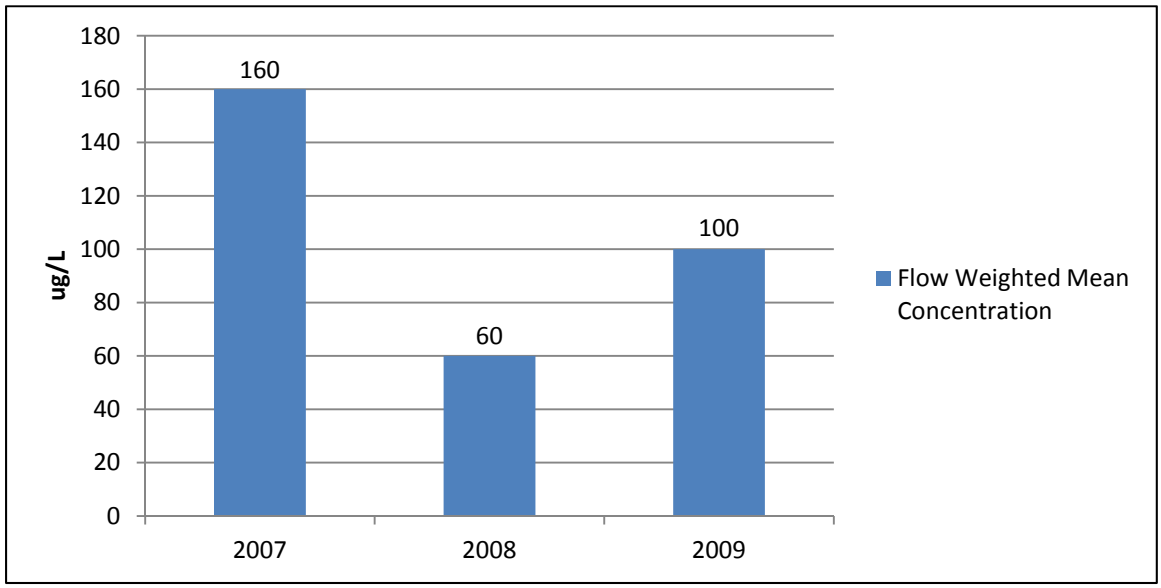

Figure 23. Dissolved Orthophosphate (DOP) Flow Weighted Mean Concentrations for the LeSueur River.

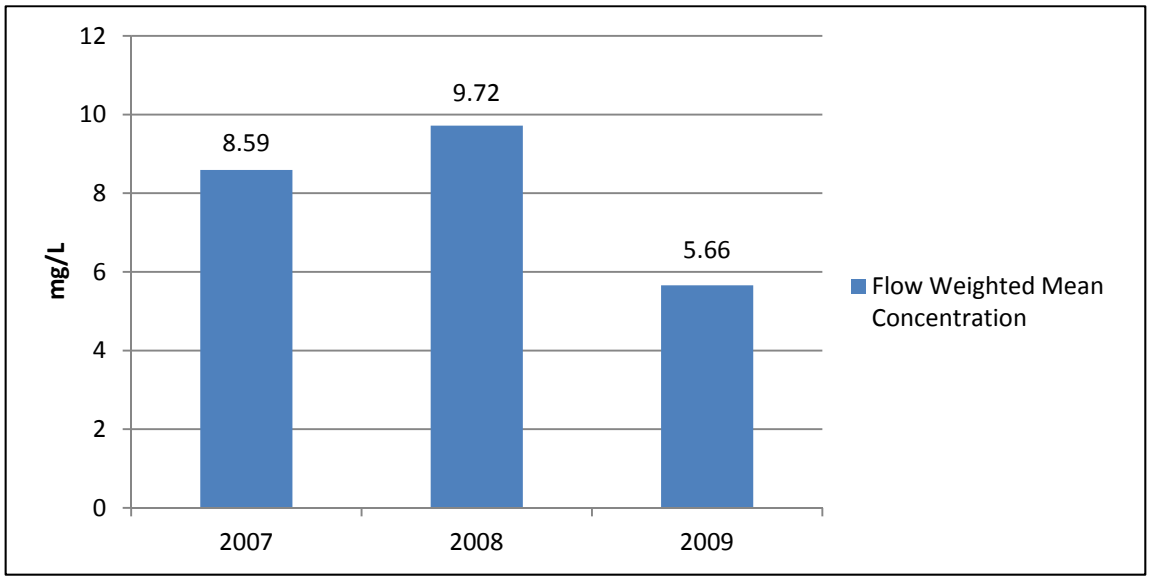

Figure 24. Nitrate + Nitrite Nitrogen (Nitrate-N) Flow Weighted Mean Concentrations for the LeSueur River.

Pollutant sources affecting rivers are often diverse and can be quite variable from one watershed to the next depending on land use, climate, soils, slopes, and other watershed factors. However, as a general rule, elevated levels of total suspended solids (TSS) and nitrate plus nitrite-nitrogen (nitrate-N) are generally regarded as “non-point” source derived pollutants originating from many small diffuse sources such as urban or agricultural runoff. Excess total phosphorus (TP) and dissolved orthophosphate (DOP) can be attributed to both “non-point” as well as “point”, or end of pipe, sources such as industrial or municipal waste water treatment plants. Major “non-point” sources of phosphorus include dissolved phosphorus from fertilizers and phosphorus adsorbed to and transported with sediment during runoff.

Within a given watershed, pollutant sources and source contributions can also be quite variable from one runoff event to the next depending on factors such as: canopy development, soil saturation level, and precipitation type and intensity. Surface erosion and in-stream sediment concentrations, for example, will typically be much higher following high intensity rain events prior to canopy development rather than after low intensity post-canopy events where less surface runoff and more infiltration occur (figure 26). Precipitation type and intensity influence the major course of storm runoff, routing water through several potential pathways including overland, shallow and deep groundwater, and/or tile flow. Runoff pathways along with other factors determine the type and levels of pollutants transported in runoff to receiving waters and help explain between-storm and temporal differences in FWMCs and loads, barring differences in total runoff volume. During years when high intensity rain events provide the greatest proportion of total annual runoff, concentrations of TSS and TP tend to be higher with DOP and nitrate-N concentrations tending to be lower. In contrast, during years with high snow melt runoff and less intense rainfall events, TSS levels tend to be lower while TP, DOP, and nitrate-N levels tend to be elevated.

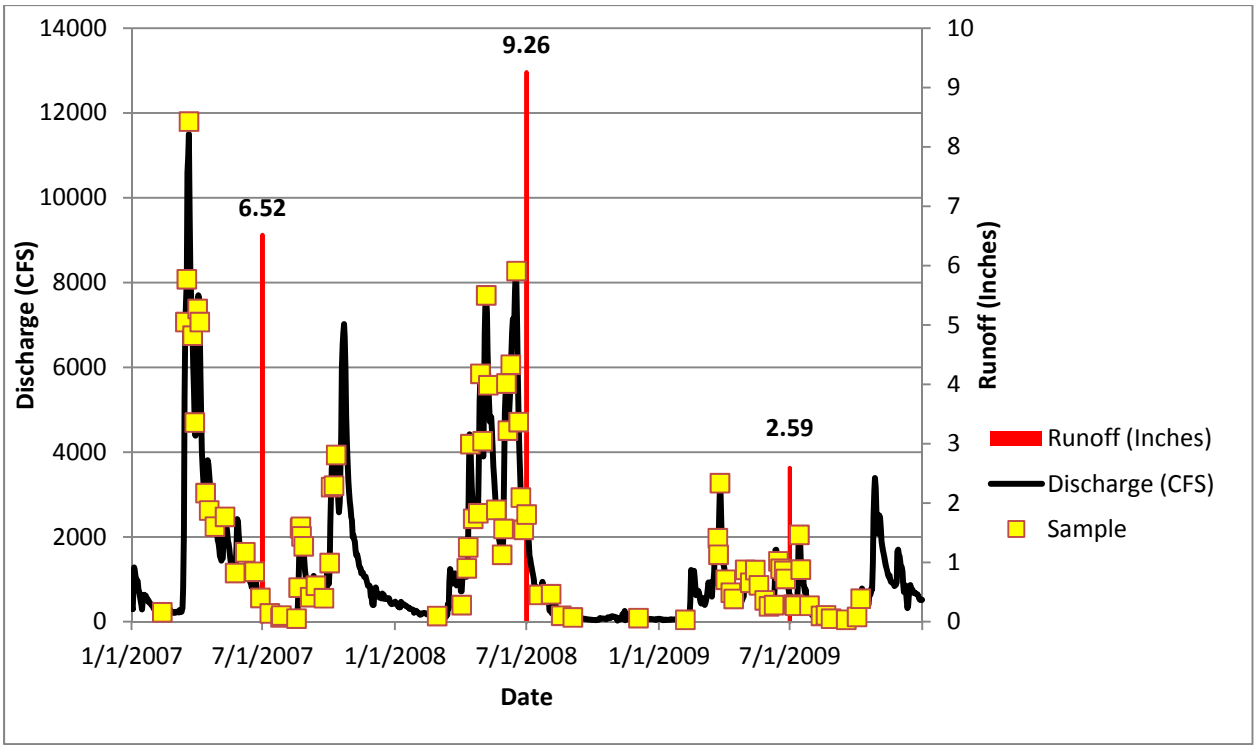

Figure 25. Hydrograph and Annual Runoff for the LeSueur River near Rapidan 2007-2009.

Total suspended solids

Water clarity refers to the transparency of water. 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. By definition, turbidity is caused primarily by suspension of particles that are smaller than one micron in diameter in the water column.

Analysis has shown a strong correlation to exist between the measures of TSS and turbidity. The greater the level of TSS, the murkier the water appears and the higher the measured turbidity. High turbidity results in reduced light penetration that harms beneficial aquatic species and favors undesirable algae species (MPCA and MSUM 2009). An overabundance of algae can lead to increases in turbidity, further compounding the problem. Periods of high turbidity often occur during spring snowmelt and when heavy rains fall on unprotected soils. Upon impact, raindrops dislodge soil particles and overland flow transports fine particles of silt and clay into rivers and streams (MPCA and MSUM 2009). High turbidity can also be caused by the erosion of stream banks, bluffs, and ravines caused by high flows (MNACP Final Report 2011).

Currently, the State of Minnesota's TSS standards are moving from the "development phase" into the "approval phase" and must be considered to be draft standards until complete approval. Within the South RNR, the TSS draft standard is 65 mg/L (MPCA 2010c), when greater than 10 percent of the individual samples exceed the draft standard, the river is out of compliance. Calculations from 2007 through 2009 show 68, 53, and 37 percent of the individual TSS samples exceeded the 65 mg/L draft standard, respectively. In addition, the computed FWMCs for the three sample years all drastically exceeded the 65 mg/L draft standard (218, 193, and 147 mg/L, respectively) (Figure 22). In 2007, the samples with the highest measured TSS concentrations (883 mg/L and 812 mg/L respectively) were collected during a high intensity rainfall event in August and during the rising limb of the spring runoff hydrograph. In 2008 and 2009, the highest individual concentrations coincided with spring snowmelt runoff when concentrations reached 1580 and 1490 mg/L, respectively. Although the data may not reflect long-term trends, both TSS FWMCs and annual loads showed a consistent decline from 2007 through 2009 (Figure 22 and Table 1. Because of the strong correlation that often exists between pollutant loads and annual runoff volume, annual load reductions may be due strictly to differences in annual runoff volume (Figure 2).

Total phosphorus

Nitrogen (N), phosphorus (P), and potassium (K) are essential macronutrients and are required for growth by all animals and plants. Lack of sufficient nutrient levels in surface water often restricts the growth of aquatic plant species (University of Missouri Extension 1999). In freshwaters such as lakes and streams, phosphorus is typically the nutrient limiting growth; increasing the amount of phosphorus entering a stream or lake will increase the growth of aquatic plants and other organisms. Although phosphorus is a necessary nutrient, excessive levels overstimulate aquatic growth in lakes and streams resulting in reduced water quality. The progressive deterioration of water quality from overstimulation of nutrients is called eutrophication where, as nutrient concentrations increase, the surface water quality is degraded (University of Missouri Extension 1999). Elevated levels of phosphorus in rivers and streams 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 (University of Missouri Extension 1999). In "non-point" source dominated watersheds, TP concentrations are strongly correlated with stream flow. During years of above average precipitation, TP loads are generally highest.

TP standards for Minnesota's rivers are also in the final approval phase and must be considered draft standards until final approval. Within the South RNR, the TP draft standard is 150 ug/L as a summer average. Summer average violations of one or more "response" variables (pH, biological oxygen demand (BOD), dissolved oxygen flux, chlorophyll-a) must also occur along with the numeric TP violation for the water to be listed. Concentrations from 2007 through 2009 show that 65, 51, and 36 percent of the individual TP samples exceeded the 150 ug/L draft standard, respectively. Observation of Figure 13 shows that all of the FWMCs from 2007 to 2009 are considerably higher than the draft standard at 380, 220, and 300 ug/L, respectively. Like TSS, Table 4 shows a consistent decline in annual TP loads from 2007 through 2009.

Dissolved orthophosphate

Dissolved Orthophosphate (DOP) is a water soluble form of phosphorus that is readily available to algae (bioavailable) (MPCA and MSUM 2009). While orthophosphates occur naturally in the environment, river and stream concentrations may become elevated with additional inputs from waste water treatment plants, noncompliant septic systems, and fertilizers in urban and agricultural runoff. The 2007 through 2009 FWMC ratio of DOP to TP shows that 27 to 42 percent of TP is in the orthophosphate form. Table 4 indicates a decline in DOP loads, similar to TSS and TP over the three year monitoring period.

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, they too, like phosphorus, can stimulate excessive levels of some algae species in streams (MPCA 2010b). Because nitrate and nitrite-nitrogen are water soluble, transport to surface waters is enhanced through agricultural drainage. The ability of nitrite-N to be readily converted to nitrate-nitrogen is the basis for the combined laboratory analysis of nitrate plus nitrite-nitrogen, 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. Environmentally, studies have shown that the elevated nitrate-nitrogen levels in the Minnesota River

basin contribute to hypoxia (low levels of dissolved oxygen) in the Gulf of Mexico. This occurs by nitrate-nitrogen stimulating the growth of algae which, through death and biological decomposition, consume large amounts of dissolved oxygen and thereby threaten aquatic life (MPCA and MSUM 2009).

Nitrate- N can also be a common toxicant to aquatic organisms in Minnesota's surface waters with invertebrates appearing to be the most sensitive to nitrate toxicity. Draft nitrate-N standards have been proposed (2012) for the protection of aquatic life in lakes and streams. The draft acute value (maximum standard) for all Class 2 surface waters is 41 mg/L nitrate-N for a 1-day duration, and the draft chronic value for Class 2B (warm water) surface waters is 4.9 mg/L nitrate-N for a four-day duration.

Long-term monitoring of major watersheds on a statewide level show elevated levels of nitrate-N in Minnesota's western and southern basins (Figure 16). More specifically, the watersheds of the Minnesota River Basin have some of the highest measured nitrate-N FWMC's in the state (Figure 16). In addition, concentrations found in the middle and lower portions of the Minnesota River Basin (near the LeSueur River) are substantially higher than those found in the western (upper) portion of the basin (Figure 16). Nitrate-N FWMCs from 2007 through 2009 for the LeSueur River Watershed were 8.6, 9.7, and 5.7 mg/L, respectively (Figure 15). Calculations of the LeSueur River's annual nitrate-N loads show a consistent decline over the three year sampling period (Table 55), similar to TSS and TP.

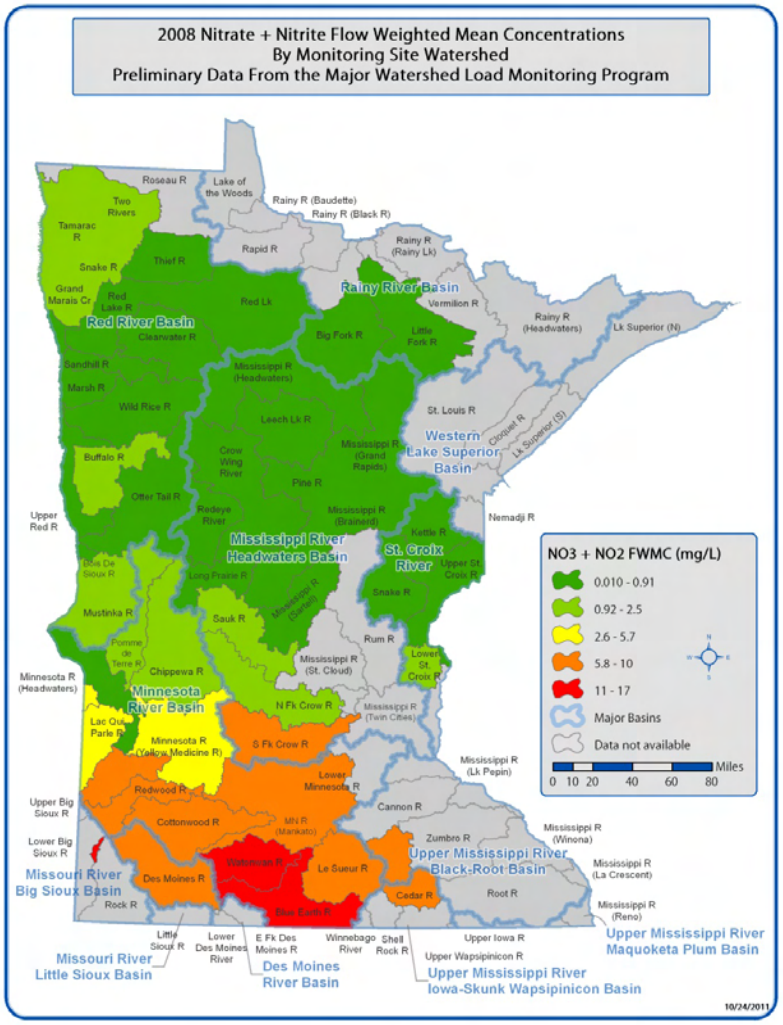

Figure 26. Nitrate-Nitrogen Flow Weighted Mean Concentrations for watersheds throughout Minnesota, 2008.

Stream quality

A total of 72 stream AUIDs were sampled for fish and 63 AUIDs were sampled for macroinvertebrates in the LeSueur River watershed during the assessment window. Only 23 AUIDs were assessable for fish and 20 AUIDs were assessable for macroinvertebrates due to channelization of stream reaches and low flow conditions during the sampling period. A total of six AUIDs were found to be fully supporting for fish IBI and four AUIDs were found to be supporting for macroinvertebrate IBI. Only one AUID was in support for both fish and macroinvertebrates. A total of 21 AUIDs were assessable for aquatic life use based on biology. Only two AUIDs were found to be fully supporting of aquatic life use standards. Eight AUIDs were able to be assessed for aquatic recreation and only one was found to fully support aquatic recreation. Twenty-five new impairments have been added to the LeSueur River watershed during the 2010 assessment cycle.

Table 57. Stream AUID assessment results for the LeSueur River Watershed

				Supporting			Non-support			
	Area (acres)	**# AUIDs Sampled**	**# Assessed AUIDs**	**# Aquatic Life**	**# Aquatic Recreation**	**#L UW**	**# Aquatic Life**	**# Aquatic Recreation**	**# LUW**	**Insufficient Data**
LeSueur **River HUC 8 Totals**	710,832	**75**	**21**	**1**	**1**	**0**	**19**	**7**	**2**	**110**
LeSueur River HUC 11	179,164	19	8	0	1	0	8	1	0	25
Boot Creek	32,015	6	1	0	0	0	0	0	1	8
Little LeSueur River	15,508	2	1	0	0	0	1	0	0	3
Janesville Village	54,352	6	2	0	0	0	2	0	0	9
Madison Lake	12,202	1	0	0	0	0	0	0	0	2
Little Cobb River	84,543	7	1	0	0	0	1	1	0	12
Cobb River	114,306	10	4	1	0	0	3	2	0	12
Easton	43,703	7	1	0	0	0	1	1	0	12
Providence Creek	17,336	3	0	0	0	0	0	0	0	5
Rice Creek	52,149	4	1	0	0	0	1	1	1	5
Maple River	105,554	10	2	0	0	0	2	1	0	17

Lake quality

There are a total of 49 lakes greater than 10 acres in the LeSueur River Watershed. Eleven of those lakes have been monitored. Nine of the eleven lakes were able to be assessed during the 10-year assessment window. Two of the nine lakes were found to be supporting of Aquatic recreation standards. A summary of the morphometric characteristics of the lakes with enough data to allow for assessment within the LeSueur River watershed is presented in Table 2. Of the 49 total lakes (> 10 acres) within the HUC-8 watershed, only 22 percent have been monitored (Table 57). Percent littoral area refers to that portion of the lake that is 4.5 meters (15 feet) or less in depth, which often represents the depth to which rooted plants may grow in the lake. Lakes with a high percentage of littoral area often have extensive rooted plant (macrophyte) beds. These plant beds are a natural part of the ecology of these lakes and are important to protect.

Table 58. Lake assessment summary for the LeSueur River Watershed.

HUC 11	Area (Acres)	Total Lakes	Protected Lakes	Lakes > 10 Acres	Lakes < 10acres	Full Support	Non-Support	Insufficient Data
HUC 8 Total	710,832	228	51	50	1	2	5	47
Providence Creek	17,336	4	0	na	na	na	na	na
Rice Creek	52,149	16	6	6	na	na	1	5
Easton	43,703	7	0	na	na	na	na	na
Maple River	105,554	21	3	2	1	na	na	3
Cobb River	114,306	31	6	6	na	na	1	5
Boot Creek	32,015	2	0	na	na	na	na	na
Little Cobb River	84,543	33	8	8	na	na	na	8
LeSueur River	179,164	65	8	8	na	1	1	6
Little LeSueur River	15,508	4	1	1	na	na	na	4
Janesville Village	54,352	30	11	11	na	1	1	9
Madison Lake	12,202	15	8	8	na	na	1	7

Lake water chemistry

According to Table 58, the TP and chl-*a* standards for the support of aquatic recreation in lakes within the NCHF ecoregion are less than 40 µg/L and 14 µg/L respectively for deep lakes and less than 60 µg/L and 20 µg/L respectively for shallow lakes. The TP and chl-*a* standards for the support of aquatic recreation in lakes within the WCBP ecoregion are less than 65 µg/L and 22 µg/L respectively for deep lakes and less than 90 µg/L and 30 µg/L respectively for shallow lakes. For chl-*a* levels at or below 30

µg/L, "nuisance algal blooms" (chl-*a* > 20 µg/L) should occur less than 10 percent of the summer and transparency should remain at or above three meters (9.8 feet) over 85 percent of the summer.

Lakes within the LeSueur River watershed display a variety of recreational use conditions. Overall, the majority of these lakes possessing assessment level data have been determined to be non-supporting of recreational use. Of the four lakes (Buffalo, Minnesota, Bass, and Rice) that have sufficient data to complete an assessment, only one (Bass Lake) indicates improving water conditions. However, two lakes within the watershed have been determined to be fully supporting of recreational use.Reducing levels of TP will be required in order to reduce the occurrence of algal blooms for lakes within the LeSueur River watershed. Alternatively, should in-lake TP concentrations increase, the potential for nuisance algal blooms will increase. It is important to limit as much external (watershed) phosphorus loading to the lakes as possible to improve or maintain the current concentrations. Additionally, the watersheds for each of these lakes will need to be addressed through a TMDL study to determine the source and extent of pollution problems.

Table 59. Eutrophication standards by ecoregion and lake type (Heiskary and Wilson, 2005).

Ecoregion	TP µg/L	Chl-*a* µg/L	Secchi meters
NLF – Lake trout (Class 2A)	< 12	< 3	> 4.8
NLF – Stream trout (Class 2A)	< 20	< 6	> 2.5
NLF – Aquatic Rec. Use (Class 2B)	< 30	< 9	> 2.0
NCHF – Stream trout (Class 2a)	< 20	< 6	> 2.5
NCHF – Aquatic Rec. Use (Class 2b)	< 40	< 14	> 1.4
NCHF – Aquatic Rec. Use (Class 2b) Shallow lakes	< 60	< 20	> 1.0
WCBP & NGP – Aquatic Rec. Use (Class 2B)	< 65	< 22	> 0.9
WCBP & NGP – Aquatic Rec. Use (Class 2b) Shallow lakes	< 90	< 30	> 0.7

Fish contaminants results

Mercury

To assess mercury fish tissue concentrations for water quality impairment, at least five fish samples are required per species and only the last 10 years of data are used for statistical analysis. A waterbody is classified as impaired due to mercury in fish tissue if 10 percent or more of the fish samples (measured as the 90th percentile) exceed 0.2 mg/kg of mercury, which is Minnesota's water quality standard. Summary statistics for mercury concentrations and fish total length are summarized in Table 59. Both species in the LeSueur River—channel catfish and carp—were below the impairment threshold. Only four carp were collected, therefore, they do not meet the criteria for assessment; however, the collected fish were well below the 0.2 mg/kg threshold.

Northern pike, walleye, and yellow perch were collected from Bass Lake in 2002 and 2008. Only three samples were analyzed for yellow perch, but they were each composites of 9 or 10 fish; therefore, yellow perch results meet the minimum sample number requirement for assessment. None of the three fish species had 90th percentiles that exceeded the 0.2 mg/kg threshold for impairment, although the

walleye 90th percentile was exactly equal to the threshold. Northern pike remained at similar low mercury levels in both years. In contrast, the two years of mercury concentrations in walleye were very different despite similar size ranges of fish. In 2002, average walleye mercury concentration was 0.18 mg/kg, with a mean length of 20.8 in (N=13). In 2008, with the same mean length, average walleye mercury concentration was 0.05 mg/kg, (N=14). Mercury concentration distributions by species and year are shown in Figure 29. Northern pike data from 1996 are shown although they are too old for assessment. Within each species, the mercury distributions among years indicate mercury concentrations have declined over time in Bass Lake. This should be investigated further to see what changes have occurred in water quality or fish populations with the lake.

Madison Lake had five fish species collected in 2008 for mercury concentrations; however, only northern pike and walleye met the minimum sample number requirement. The 90th percentile for northern pike was 0.09 mg/kg and for walleye, 0.27 mg/kg. Consequently, Madison Lake is impaired for fish consumption because of mercury in walleye. A comparison of mercury concentrations in walleye from 1996 and 2008 suggest some reduction over time but not nearly as obvious as the decline in Bass Lake. Future sample collection should provide a better understanding the temporal changes of mercury in these lakes.

Northern pike and yellow perch were collected from Reeds Lake (81-0055) in 2006. Three composite samples of yellow perch contained three or four fish per sample. The 90th percentile for yellow perch mercury concentrations was 0.05 mg/kg – well below the impairment threshold. Northern pike had a 90th percentile mercury concentration of 0.34 mg/kg; therefore, Reeds Lake is classified as impaired for fish consumption.

Madison and Reeds Lakes qualify for inclusion in the Minnesota Statewide Mercury TMDL (http://www.pca.state.mn.us/water/tmdl/tmdl-mercuryplan.html), because the 90th percentiles are less than the upper threshold of 0.572 mg/kg. The goal for the statewide mercury TMDL is for the 90th percentile of mercury concentrations in top predator species to be less than 0.2 mg/kg. Implementation of the mercury TMDL is focused primarily on reducing mercury emissions to the atmosphere, because wastewater point source discharges are less than one percent of the total mercury load to the state.

As a benchmark for the mercury concentrations, summary statistics are shown for years 2000 to 2008 from the Minnesota Fish Contaminant Program database (Table 60). Walleye and northern pike have very similar ranges of mercury concentrations, with the statewide 90th percentile mercury concentrations of 0.72 mg/kg and 0.71 mg/kg, respectively. Most of the high mercury concentrations in sport fish are found in northern Minnesota lakes, because of the watershed and water chemistry characteristics of the northern waters.

Polychlorinated biphenyls (PCBs)

Concentrations of PCBs in fish have not been monitored as intensively as mercury in the last two decades, because historically concentrations of PCBs were most typically high downstream of large urban areas in large rivers, such as the Mississippi River, and in Lake Superior. Impairment assessment for PCBs in fish tissue is based on the fish consumption advisories prepared by the Minnesota Department of Health. If the consumption advice is to consume a particular fish species less than a meal per week because of PCBs, the MPCA considers the lake or river impaired. The threshold concentration for the more restrictive advice (one meal per month) is 0.22 mg/kg PCBs.

In 2008, the largest carp and the two largest channel catfish collected from the LeSueur River were analyzed for PCBs. There is no need to analyze smaller fish for PCBs, because the highest concentrations are found in the larger fish. Both channel catfish were below the impairment threshold. PCBs

concentration in the carp was 0.31 mg/kg, and therefore, exceeded the impairment threshold (Table 61). Consequently, the fish consumption advice for carp in the LeSueur River is one meal per month. This information was not available for the 2010 impaired waters assessment; therefore, it will be included in the next impairment assessment (2012) for the LeSueur River.

Several of the lakes in the LeSueur watershed were sampled for PCBs, but none have been sampled for PCBs since 1999. Most of the sample collections were around 1990 or earlier; the results indicated the lakes were not impaired by PCBs in fish. All PCBs concentrations were below or near the analytical detection limit (0.01-0.05 mg/kg PCBs).

Perfluorochemicals (PFCs)

Perfluorochemicals (PFCs) emerged as a global pollutant in 2001 when scientists reported perfluorooctane sulfonate (PFOS) was measured in wildlife throughout the world. Numerous studies have demonstrated that PFOS is the primary form of PFCs found in fish and other biota. The Minnesota Department of Health (MDH) has developed a reference dose for PFOS that allows for calculation of fish consumption advisories.

More recently, lakes and rivers throughout Minnesota have been analyzed for PFCs in fish. Madison Lake sampled for PFCs in 2009. Three northern pike and three walleye were analyzed separately; panfish species were composited into five fish per sample (Table 62). PFOS concentrations in all samples were at or below the laboratory reporting level (0.005 mg/kg PFOS). If the mean PFOS concentrations for a species is greater than 0.2 mg/kg the lake would be assessed as impaired.

Table 60. Summary of results for mercury concentrations in fish and total fish length

			Mercury (mg/kg)				Length (in)		
Waterway (Lake ID)	Species	N (fish/ sample)	Min	Max	Mean	90th Pctl	Min	Max	Mean
LeSueur River	Channel Catfish	5 (1)	0.087	0.147	0.112	0.15	14.8	18	16.6
	Carp	4 (1)	0.034	0.08	0.048	0.08	14.3	20.6	17.0
Bass (22-0074)	Northern Pike	28 (1)	0.015	0.142	0.053	0.09	14.6	30.4	19.4
	Walleye	27 (1)	0.028	0.232	0.110	0.20	10.9	24.7	20.8
	Yellow Perch	3 (9,9,10)	0.016	0.026	0.02	0.03	5.8	6.6	6.2
Madison (07-0044)	Black Crappie	1 (9)	NA	NA	0.047	NA	NA	NA	8.7
	Carp	1 (3)	NA	NA	0.071	NA	NA	NA	21.3
	Northern Pike	12 (1)	0.027	0.092	0.067	0.09	20.1	32.5	27.2
	Walleye	5 (1)	0.082	0.266	0.166	**0.27**	19.7	26.7	22.1
	Yellow Perch	2 (5,5)	0.021	0.023	0.022	0.02	5.8	6.8	6.0
Reeds (81-0055)	Northern Pike	21 (1)	0.130	0.352	0.258	**0.34**	23.0	31.1	27.2
	Yellow Perch	3 (3,3,4)	0.035	0.047	0.040	0.05	5.4	5.8	5.6

Based on data after 1999 (2000 – 2008)

Table 61. Mercury concentrations of ten most abundant species in the Minnesota fish contaminant database from 2000-2008, sorted from highest to lowest mercury concentration

Species		Mercury Concentration (mg/kg - ww)					Total Fish Length (in)		
Common Name	Scientific Name	N	90th pctl	Min	Max	Mean	Min	Max	Mean
Walleye	*Sander vitreus*	2525	0.72	0.02	2.63	0.34	6.8	29.7	17.1
Northern Pike	*Esox lucius*	5293	0.71	0.01	2.95	0.36	7.5	45.5	22.2
Channel Catfish	*Ictalurus punctatus*	325	0.53	0.01	1.19	0.22	10	36	19.9
Smallmouth Bass	*Micropterus dolomieu*	528	0.46	0.02	1.24	0.25	1.2	20.3	12.9
Largemouth Bass	*Micropterus salmoides*	518	0.41	0.01	1.39	0.22	5.3	18.9	12.9
Common Carp	*Cyprinus carpio carpio*	359	0.31	0.01	0.70	0.16	4.5	35.9	21.8
Black Crappie	*Pomoxis nigromaculatus*	278	0.26	0.01	0.62	0.12	4.0	16.1	8.7
White Sucker	*Catostomus commersonii*	161	0.26	0.01	0.53	0.12	4.4	21.1	16.0
Yellow Perch	*Perca flavescens*	596	0.20	0.01	0.84	0.10	1.5	12.6	7.0
Bluegill Sunfish	*Lepomis macrochirus*	353	0.17	0.01	0.40	0.09	2.6	9.6	6.9

Table 62. PCB concentrations in fish from the LeSueur River

Species	Year	N	Length (in)	PCBs (mg/kg)
Carp	2008	1	20.6	0.31
Channel Catfish	2008	1	17.5	0.08
Channel Catfish	2008	1	18.0	0.06

Table 63. Perfluorooctane sulfonate (PFOS) concentrations in fish from Madison Lake

Species	Year	No. fish per sample	Length (in)	PFOS (mg/kg)
Northern pike	2009	1	22.8	< 0.005
Northern pike	2009	1	27.2	< 0.005
Northern pike	2009	1	29.5	0.005
Walleye	2009	1	17.7	< 0.004
Walleye	2009	1	20.1	< 0.005
Walleye	2009	1	24.8	< 0.005
Bluegill sunfish	2009	5	6.9	< 0.004
Black crappie	2009	5	8.3	< 0.005
Yellow perch	2009	5	6.8	< 0.005

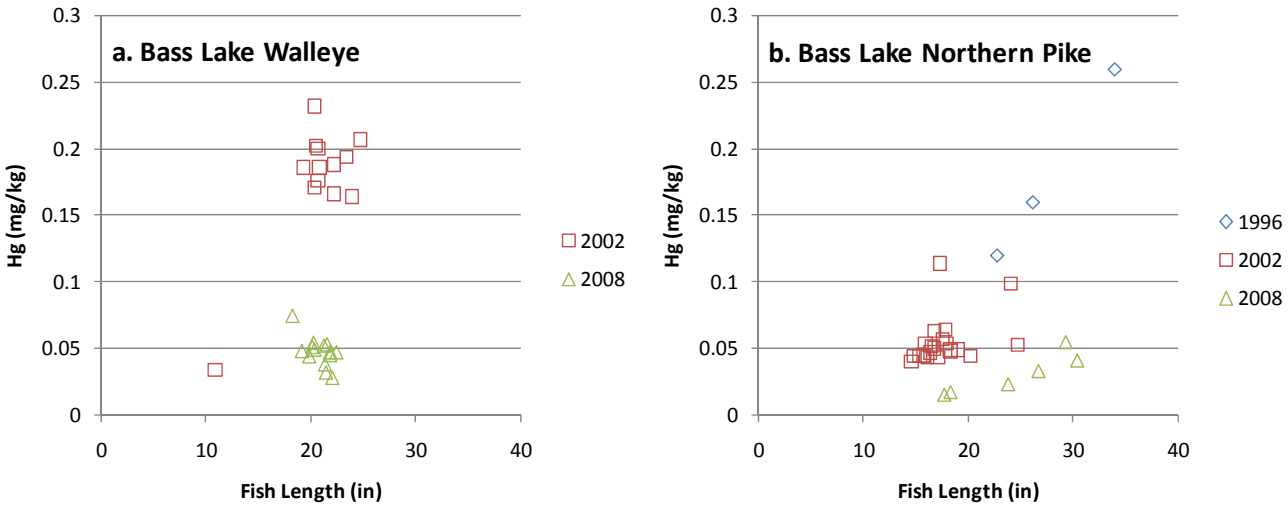

Figure 27. Mercury (Hg) concentrations versus fish length in Bass Lake (a) walleye and (b) northern pike

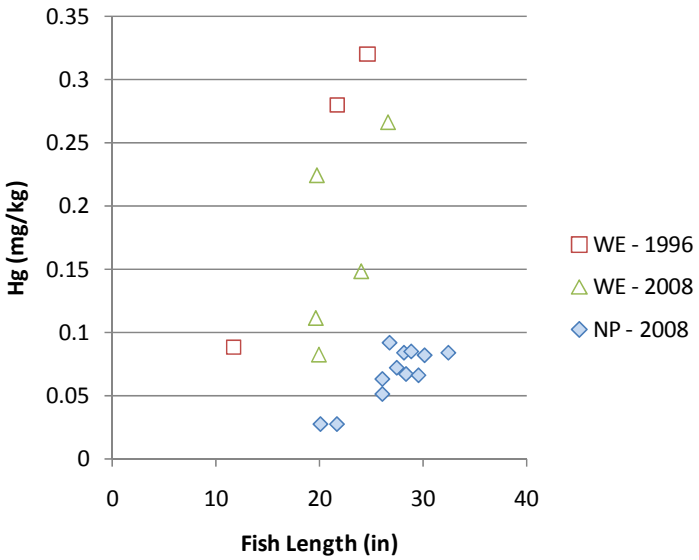

Figure 28. Mercury (Hg) concentrations versus fish length in Madison Lake walleye and northern pike

Water chemistry trends

Trend data for water chemistry parameters has typically been obtained using the MPCA's Milestone Monitoring sites. There are no Milestone site locations in the LeSueur River Watershed, therefore, trends for water chemistry in cannot be calculated at this time. In the future, there will be enough data from the watershed outlet load monitoring station to obtain trends for water chemistry. Other possible trend data are available for the watershed from MPCA's CSMP and the CLMP. CSMP transparency was seen to be increasing in three of six stream reaches where there was enough data available to calculate trends. The three stream reaches where transparency is increasing are: the LeSueur River in Wildwood Park, 2.75 mi N of St. Clair; the Maple River at CSAH 35, 5.2 mi S of Mankato; and the Maple River 0.9 MI SE of Good Thunder. Other sites on a tributary to the Cobb River, the Cobb River, and Maple River showed no trend in transparency. CLMP data was available to calculate trends for six lakes in the watershed. Bass Lake and Reeds Lake showed a trend of increasing water transparency. St. Olaf Lake and Lake Elysian showed a trend of decreasing water transparency. Water transparency data for Madison and Lura lakes showed no trend in transparency readings.

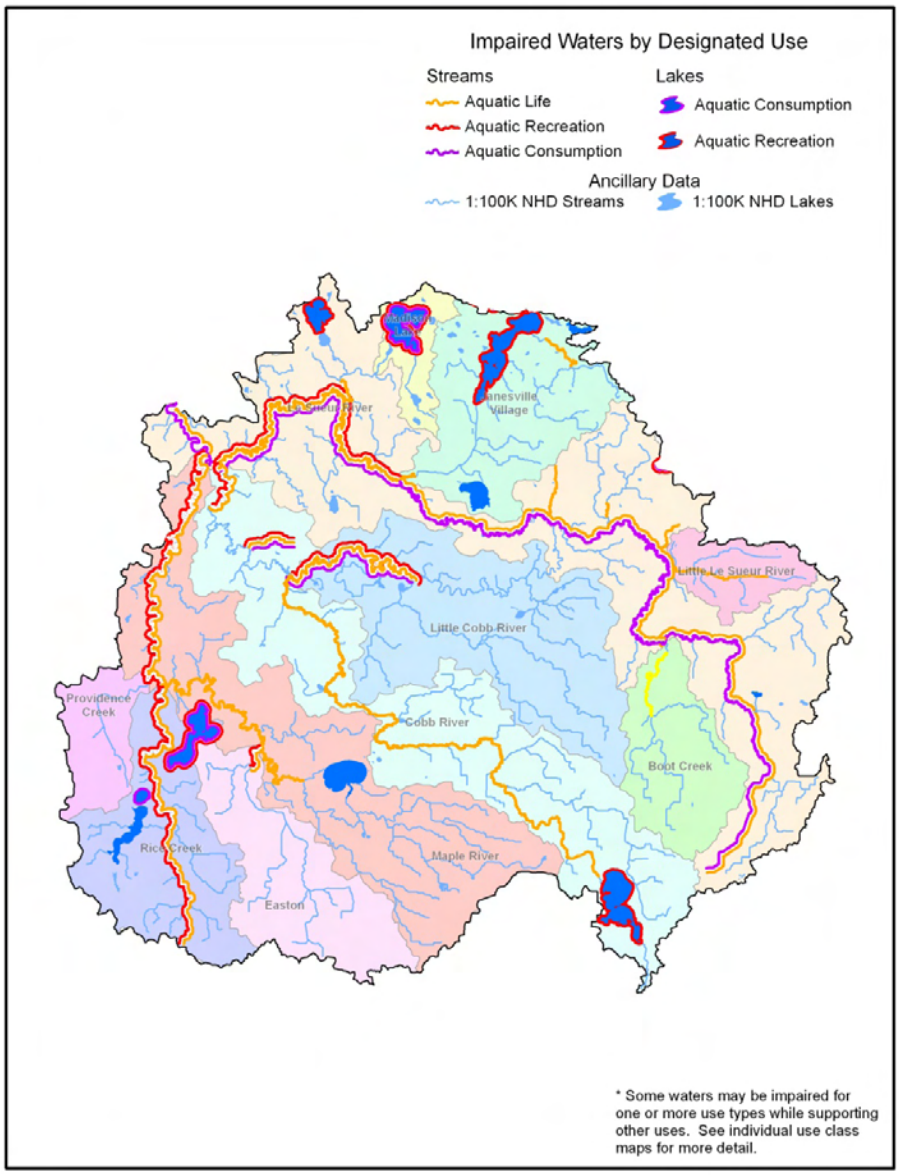

Figure 29. Map of identified impaired waters for the LeSueur River Watershed

Figure 30. Map of all supporting waters in the LeSueur Watershed

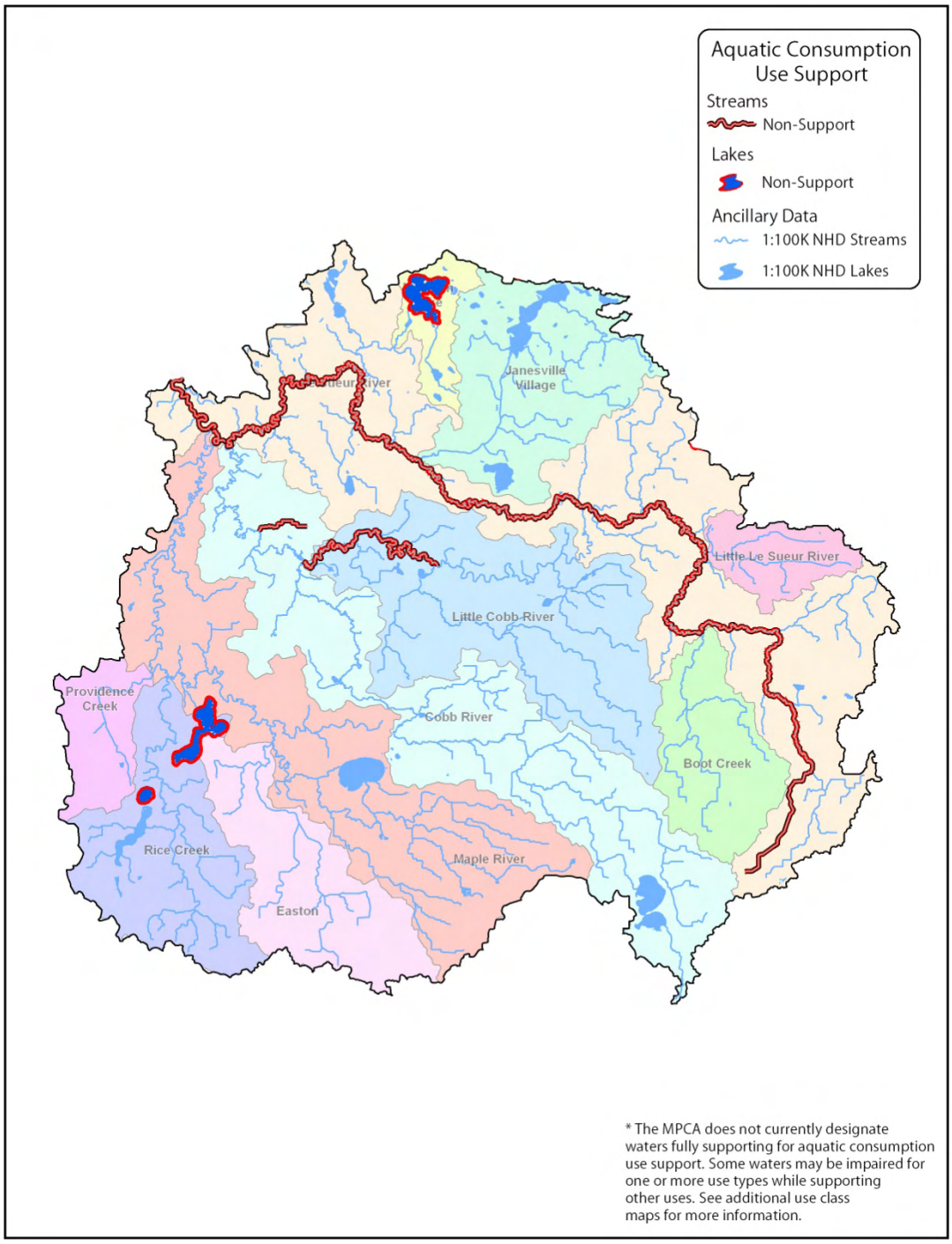

Figure 31. Aquatic Consumption support map for the LeSueur Watershed

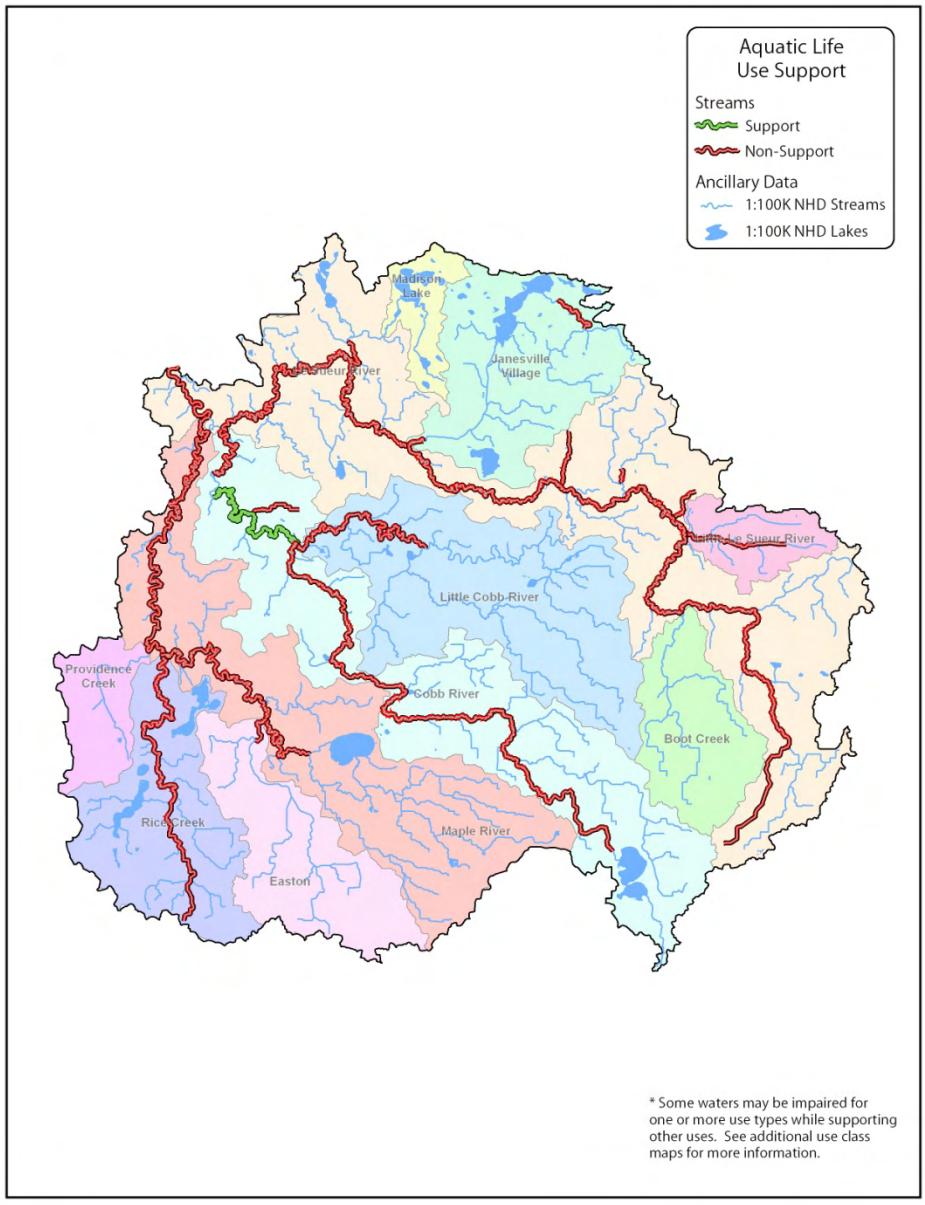

Figure 32. Aquatic Life Support map for the LeSueur Watershed

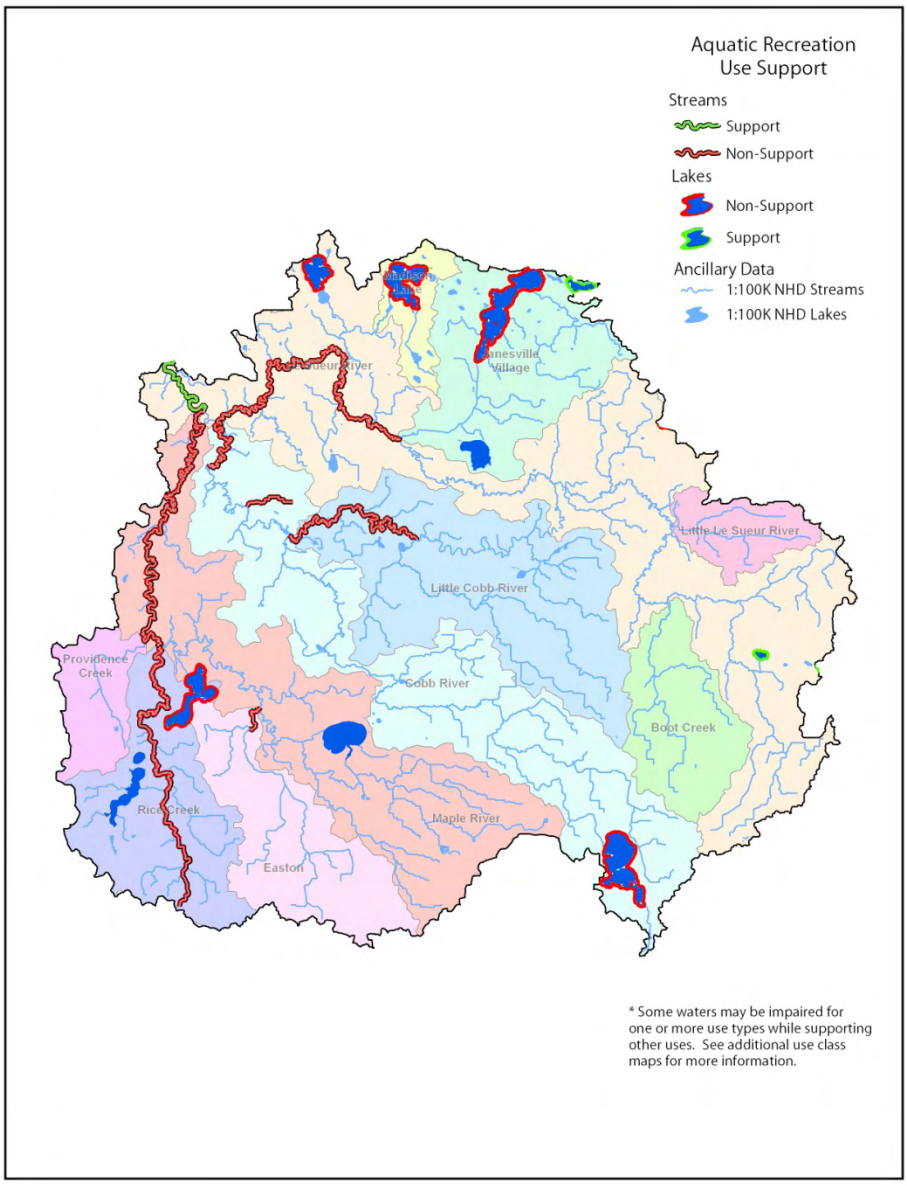

Figure 33. Aquatic Recreation Use Support map for the LeSueur River

VIII. Summary and Recommendations

The Stressor ID monitoring plan should be based on the best currently available information from the Assessment results in order to begin the Stressor ID process. All reaches listed as impaired will be considered in the TMDL study to be completed based on the Stressor ID findings. Due to the vast number of impairments in found in the LeSueur Watershed during the Intensive Watershed Monitoring (IWM) project, there is a great need for exploration of major stressors in the watershed. The LeSueur River watershed has been extensively ditched and tiled since settlement to utilize the landscape for agricultural and residential development. There were a total of 129 sites sampled in the watershed and of those only 48 were assessable due to channelization, which does not allow the reaches to be considered natural channels with expectations for normal biological communities. The unassessed sites will be considered in the future under the Tiered Aquatic Life Use (TALU) framework which will account for the changes in habitat through the channelization process.

Considering the extensive number of biological and water quality impairments, and that a large proportion of this watershed was not formally assessed due to channelized stream condition, this suggests that it is best to target areas in the watershed that have been assessed. These targeted areas could then be used to identify the leading stressors to the watershed. This information could then be extrapolated to the entire watershed. Therefore, stressor ID work should occur in three main areas in the watershed and are Rice Creek (070200110401 and 070200110403), the Upper LeSueur (070200110101 and 070200110103) including County Ditch 15-2 (070200110106) and the Lower Cobb (070200110305) reaches of the watershed. Due to the large size of the watershed, these reaches were selected as representative of various landscape features that are present in the watershed to study the variety of stream and land type variations that exist throughout the watershed as a whole. The stressor ID process will help to identify the causes of biological impairments within the watershed so that the TMDL study can be completed to address the pollutants and contributing mechanisms that have led to the impaired state. Three 12 digit watersheds should be selected to undergo further investigation into the causes of the biological listings for the 2010 draft list.

A few goals of the Stressor ID work for the LeSueur Watershed should be a thorough evaluation of existing biological monitoring data to characterize the extent and nature of the impairments. Where information is lacking, additional biological data should be collected to strengthen the case for impairment and improve watershed coverage. In addition to the biological work, additional sampling of geochemistry and stable isotope analysis should be conducted to study the hydrologic pathways and processes of the watershed. Considering that preliminary habitat work was mostly qualitative in scope, quantitative physical habitat and geomorphology assessments should occur in select stream reaches of the watershed. Due to the extensive channelization, future work should also focus on comparing how much the drainage networks have changed over time in select areas. Once these stressors have been identified and thoroughly examined the next step would be the development and implementation of TMDLs to help remedy the impairments.

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Appendix 1. Biological monitoring stations in the LeSueur Watershed.

Field Number	Stream name	Location Description	Drainage Area (Sq. Mi^2)
01MN004	County Ditch 70	E of CR 19, approx. 4 mi S of Easton	1.56
01MN014	Rice Creek	downstream of road, 1 mi W of CR 13, 2 mi S of Delavan	15.85
01MN030	Judicial Ditch 51	downstream of CR 30, 6 mi NE of Minnesota Lake	11.33
01MN036	Cobb Creek Ditch	0.3 mi upstream of CR 10, about 1 mi. N of Freeborn	15.32
01MN039	Cobb River	S of CR 13, 4 mi. E of Good Thunder	295.32
01MN040	Unnamed creek	W of Jct. Of CR7 and CR4	13.04
03MN067	Rice Creek	Upstream of CR, 5 mi. SW of Mapleton	77.84
03MN070	LeSueur River	3 mi SW of Waseca on CR 27 (CR 75)(USGS site)	187.16
03MN071	LeSueur River	3.5 mi N. of St. Clair, 0.5 mi E of MN 83, MRAP site @ Wildwood County Park	374.44
07MN057	LeSueur River	Downstream of 730th Ave, 1.5 mi. NW of Bath	9.46
07MN062	County Ditch 3	Downstream of Hwy 19, 2 mi. NW of Easton	34.40
07MN066	Little Cobb River (County Ditch 8)	Upstream of 240th Ave, 2 mi. SE of Waldorf	13.70
07MN067	Boot Creek	Upstream of Hwy 30, 1.5 mi. W of New Richland	40.26
08MN008	Providence Creek (Judicial Ditch 49)	Downstream of 542nd Ave. 3 mi. SE of Amboy	23.23
08MN009	Unnamed creek	Downstream of 400th Ave, 3 mi. NW of Delavan	23.57
08MN010	Rice Creek	Downstream of Hwy 109, 1 mi. W of Delavan	18.05
08MN011	Judicial Ditch 1	Downstream of 210th St, 2 mi. NW of Delavan	10.11
08MN012	County Ditch 7	Upstream of 200th St, 2 mi. NW of Easton	9.52
08MN013	Judicial Ditch 9	Downstream of 445th Ave., 7 mi. NE of Delavan	9.55
08MN014	County Ditch 7	Upstream of 210th St, 2 mi. N of Easton	19.10
08MN015	County Ditch 85	Downstream of CR 34, 4 mi. S of Minnesota Lake	18.03
08MN016	Unnamed ditch	Downstream of Hwy 30, 0.5 mi. W of New Richland	9.04
08MN017	Cobb River	Upstream of CR 67, 3m. W of Matawan	58.16
08MN018	Cobb Creek	Upstream of 610th Ave, 2.5 mi. S of Matawan	29.34
08MN019	Maple River	Downstream of CR 18, 5 mi. W of Mapleton	308.21
08MN020	County Ditch 12	Downstream of CR 9, 3 mi. SW of Waseca	10.46
08MN021	Boot Creek	Downstream of 220th Ave, 2 mi. SW of New Richland	28.14
08MN022	Maple River	Downstream of CR 27, 3 mi. NW of Wells	14.24
08MN023	Maple River	Upstream of CR 46, 6 mi. S of Mapleton	86.49
08MN024	Maple River	Upstream of Hwy 30, 5 mi. SW of Mapleton	194.39

Field Number	Stream name	Location Description	Drainage Area (Sq. Mi^2)
08MN025	Unnamed creek	Downstream of 211 LN W of 615th Ave, 3 mi. E of Eagle Lake	19.54
08MN026	Iosco Creek	Upstream of 420th Ave, 5 mi. SE of Elysian	18.26
08MN027	Little LeSueur River	Upstream of Hwy 13, 1.5 mi. N of Otisco	21.39
Field Number	**Stream name**	**Location Description**	**Drainage Area (Sq. Mi^2)**
08MN028	Unnamed creek	Downstream of CR 63, 5 mi. NE of New Richland	21.24
08MN029	LeSueur River	Upstream of CR 51, 3 mi. SW of Otisco	86.15
08MN030	County Ditch 35	Upstream of 70th St, portion nearest CR 9; 1 mi. E of St. Mary	9.56
08MN032	Unnamed creek	Upstream of CR 184, 1.5 mi. SE of Eagle Lake	39.97
08MN033	County Ditch 88	Downstream of CR 15, 1 mi. W of St. Clair	14.32
08MN034	Unnamed creek	Upstream of CR 15, 5 mi. W of St. Clair	6.29
08MN035	LeSueur River	Downstream of CR 8, 7 mi. W of St. Clair	448.97
08MN036	LeSueur River	Downstream of CR 16, 8 mi. W of St. Clair	759.73
08MN037	Unnamed creek	Upstream of 50th St, 1 mi. E of Waldorf	11.95
08MN038	Little Cobb River (County Ditch 8)	Downstream of CR 4, 0.5 mi. W of Waldorf	16.86
08MN039	Little Cobb River (County Ditch 8)	Downstream of CR 53, 4 mi. S of Pemberton	44.89
08MN040	Bull Run Creek	Upstream of W County Line Road / 631st Ave., 2 mi. SE of Pemberton	38.55
08MN041	Big Slough	Upstream of TR 15 (588th Ave), 4 mi. S of Mapleton	12.03
08MN042	Silver Creek (County Ditch 3)	Downstream of CR 68, 6 mi NE of Janesville	9.12
08MN043	Unnamed creek	Upstream of 557th Ave, 2.5 mi. SE of Good Thunder	5.59
08MN044	County Ditch 70	Upstream of CR 19, 2 mi. S of Easton	6.26
08MN045	County Ditch 20	Upstream of CR 113, 1.5 SE of Easton	16.93
08MN046	County Ditch 29	Upstream of CR 54, 1.5 mi. S of Janesville	5.02
08MN047	County Ditch 6	Downstream of CR 54, 2mi. S of Janesville	68.88
08MN048	LeSueur River	Downstream of CR 14, 2 mi. NE of Pemberton	249.97
08MN049	County Ditch 19	Downstream of CR 26, 4 mi. SW of St. Mary	5.41
08MN050	County Ditch 38	Downstream of CR 9, 1.5 mi. NE of St. Mary	10.67
08MN051	County Ditch 15-2	Downstream of CR 4, 4 mi. S of Waseca	5.29
08MN052	LeSueur River	Upstream of CR 4, in Wilton	179.10
08MN053	LeSueur River	Downstream of 120 th St, 1 mi. W of Otisco	150.25
08MN054	Judicial Ditch 10	Downstream of 145th St, 3 mi. E of Wilton	6.14
08MN055	LeSueur River	Upstream of 260th Ave, 2 mi. SE of Vista	51.42
08MN057	Unnamed creek	Downstream of 211th St, 1 mi. SE of Eagle Lake	11.11
08MN059	Unnamed creek	Downstream of 187th St, 1 mi. NE of St. Clair	9.07

Field Number	Stream name	Location Description	Drainage Area (Sq. Mi^2)
08MN060	Judicial Ditch 8	Upstream of CR 1, 3 mi. SW of New Richland	6.23
08MN061	Unnamed creek	Upstream of CR 4, 2 mi. SE of Waldorf	5.92
08MN062	County Ditch 20	Upstream of CR 71, 5 mi. SE of Waldorf	6.74
08MN064	Unnamed creek	Upstream of CR 168, 5 mi. W of Pemberton	4.05
08MN065	Cobb River	Downstream of 586th Ave, 1 mi. E of Beauford	277.07
08MN066	County Ditch 57	Downstream of 586th Ave, 2 mi. NE of Mapleton	8.98
08MN067	Cobb River	Upstream of CR 4, 3 mi. NE of Mapleton	130.60
08MN068	Unnamed creek	Downstream of 55th St, 1mi. W of Matawan	4.60
08MN069	County Ditch 46	Downstream of CR 20, In Bath	14.38
08MN070	Little Cobb River	Downstream of CR 169, 3 mi. W of Pemberton	119.05
08MN071	Cobb River	Upstream of 108th St, 2 mi. N of Minnesota Lake	90.43
08MN072	Maple River	Downstream 235th St, 1.5 mi. W of Minnesota Lake	70.63
08MN073	Unnamed creek	Downstream of CR 150, 2.5 mi. W of Mapleton	5.85
08MN074	Providence Creek (Judicial Ditch 49)	Downstream of Hwy 30, 1.5 mi. E of Amboy	18.03
08MN075	Providence Creek (Judicial Ditch 49)	Upstream of CR 148, 2 mi. SE of Amboy	8.01
08MN076	Rice Creek	Upstream of CR 18, 4.5 mi. NW of Delavan	60.81
08MN077	Judicial Ditch 1	Upstream of Hwy 109, 1 mi. S of Delavan	4.24
08MN078	Unnamed ditch	Upstream of Hwy 30, 0.5 mi. E of New Richland	4.72
08MN079	Maple River	Upstream of 200th St, 3 mi. NW of Wells	13.29
08MN080	Cobb Creek Ditch	Upstream of CR 29, 1 mi. SE of Freeborn	6.94
08MN081	Cobb River	Upstream of CR 35, 5mi. S of Matawan	21.81
08MN082	County Ditch 6	Upstream of CR 172, 4 mi. SE of St. Clair	84.97
08MN083	County Ditch 6	Upstream of Hwy 14, 0.5 mi W of Janesville	49.99
08MN084	County Ditch 12	Upstream of CR 9, 3 mi. SW of Waseca	10.42
08MN086	Rice Creek	Downstream of CR 1, 5.5 mi. SE of Amboy	71.46
90MN105	LeSueur River	West of CR 28, in Wildwood County Park, 3.5 mi. N of St. Clair	374.55
91MN102	Maple River	Downstream of Hwy 22, 2.5 mi NW of Wells	8.53
91MN104	Unnamed creek (Little Beauford Ditch)	Upstream of Hwy 22, 5.5 mi E of Good Thunder	8.20
97MN002	Cobb River	near Mapleton, MN	111.88
97MN008	LeSueur River	near Wilton, MN	187.36

Appendix 2. 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.

Orthophosphate - Orthophosphate (OP) is a water soluble form of phosphorus that is readily available to algae (bioavailable). While orthophosphates occur naturally in the environment, river and stream concentrations may become elevated with additional inputs from waste water treatment plants, noncompliant septic systems and fertilizers in urban and agricultural runoff.

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.

Specific Conductance - The amount of ionic material dissolved in water. Specific conductance is influenced by the conductivity of rainwater, evaporation and by road salt and fertilizer application.

Temperature - Water temperature in streams varies over the course of the day similar to diurnal air temperature variation. Daily maximum temperature is typically several hours after noon, and the minimum is near sunrise. Water temperature also varies by season as doe's air temperature.

Total Kjehldahl nitrogen (TKN) - The combination of organically bound nitrogen and ammonia in wastewater. TKN is usually much higher in untreated waste samples then in effluent samples.

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.

Total Suspended Volatile Solids (TSVS) - Volatile solids are solids lost during ignition (heating to 500 degrees C.) They provide an approximation of the amount of organic matter that was present in the water sample. ‘‘Fixed solids’’ is the term applied to the residue of total, suspended, or dissolved solids after heating to dryness for a specified time at a specified temperature. The weight loss on ignition is called ‘‘volatile solids.’’

Unnionized 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 3. Intensive watershed monitoring stations in the LeSueur Watershed.

Biological Station ID	STORET-ID	Stream Name	Location Description	11-Digit HUC
07MN068	S000-654	County Ditch 6	Downstream of CR 37, 3.5 mi. SW of Jamesville	7020011040
08MN001	S000-340	LeSueur River	Upstream of Hwy 66, 1.5 mi NE of Rapidan	7020011010
08MN002	S002-473	County Ditch 3 (Judicial Ditch 9)	Upstream of CR 46, 6 mi. S of Mapleton	7020011080
08MN003	S002-427	Maple River	Downstream of CR 35, 6 mi. N of Good Thunder	7020011110
08MN004	S002-431	Rice Creek	Downstream of CR 151, 0.5 mi. S of Sterling Center	7020011090
08MN005	S003-446	Cobb River	Downstream of CR 16, 3.5 mi. NW of Beauford	7020011070
08MN006	S003-574	Little Cobb River	Downstream of CR 174, 3 mi E of Beauford	7020011060
08MN007	S004-836	Boot Creek	Downstream of 260th Ave. 3 mi. NW of New Richland	7020011020

Appendix 4. AUID table of results (by parameter and beneficial use)

					USES					BIOLOGICAL CRITERIA		WATER QUALITY STANDARDS											ECOREGION EXPECTATIONS			
National Hydrography Dataset (NHD) Assessment Segment ID	Stream Segment Name	Segment Description	NHD Length (Miles)	USE Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Limited Resource Value		Fish IBI	Invert IBI	Acetochlor	Alachlor	Atrazine	Chloride	Bacteria (Aquatic Rec)	Metolachlor	DO	pH	Un-ionzed ammonia		Oxygen Demand (BOD)	Nitrite/Nitrate	Total Phosphorus	Suspended Solids
HUC 11: 7020011010 (LeSueur River)																									
07020011-501	LeSueur River	Maple R to Blue Earth R	6.15	2B	NS	FS				NS	FS	NS	FS	FS	FS	FS	FS	IF	FS	FS		IF	NS	NS	NS
07020011-506	LeSueur River	Cobb R to Maple R	1.91	2B	IF	NA				FS	FS														
07020011-507	LeSueur River	CD 6 to Cobb R	32.02	2B	NS	NS				NS	FS					NS		IF	FS	FS			NS	NS	NS
07020011-510	Unnamed creek	Unnamed cr to LeSueur R	2.21	2B	NS	NA				FS	NS														
07020011-511	County Ditch 35	Headwaters to LeSueur R	7.1	2B	IF	NA				NS	NS														
07020011-512	County Ditch 38	Headwaters to Unnamed cr	9.15	2B	NA	NA																			
07020011-513	County Ditch 12	Unnamed ditch to T107 R23W S22, south line	1.78	7				NA																	
07020011-544	Unnamed creek	Unnamed cr to Unnamed cr	2.07	2B	NA	NA																			
07020011-546	Unnamed creek	Unnamed cr to LeSueur R	0.98	2B	NA	NA																			
07020011-558	County Ditch 12	T107 R23W S27, north line to Unnamed cr	0.89	2B	NS	NA				NS	NS														
07020011-601	Unnamed creek	CD 26 to LeSueur R	0.88	2B	NA	NA																			
07020011-602	County Ditch 88	Unnamed cr to LeSueur R	3.15	2B	NA	NA																			
07020011-603	Unnamed creek	Headwaters to Unnamed cr	6.92	2B	IF	NA				NS															
07020011-606	Unnamed creek	Eagle Lk to Unnamed cr	2.18	2B	IF	NA				NS	NS														
07020011-608	County Ditch 19	Headwaters to LeSueur R	3.4	2B	NS	NA				NS	NS														
07020011-609	County Ditch 15-2	Headwaters to LeSueur R	2.57	2B	NS	NA				NS	NS														
07020011-618	County Ditch 46	Unnamed ditch to LeSueur R	1.46	2B	NA	NA																			
07020011-619	LeSueur River	Headwaters to Boot Cr	27.6	2B	NS	NA				NS	FS														NS

07020011-620	LeSueur River	Boot Cr to CD 6	43.26	2B	FS	NA				FS	FS															NS
HUC 11: 7020011020 (Boot Creek)																										
07020011-516	Boot Creek	Unnamed cr to T105 R22W S6, north line	6.91	7				NS							FS	NS		IF	FS	FS			FS	FS	FS
07020011-622	Boot Creek	T105 R23W S24, south line to Unnamed ditch	0.64	7				NA																	
07020011-518	Unnamed ditch	T105 R22W S17, east line to Boot Cr	2.81	7				NA																	
07020011-561	Unnamed ditch	Headwaters to T105 R22W S16, west line	6.28	2B	NA	NA																			
07020011-617	Judicial Ditch 8	Headwaters to Boot Cr	5.9	2B	NA	NA																			
HUC 11: 7020011030 (Little LeSueur River)																										
07020011-573	Little LeSueur River	T106 R22W S12, east line to LeSueur R	6.82	2C	NS	NA				NS	FS															
07020011-610	Judicial Ditch 10	Headwaters to Little LeSueur R	6.02	2B	IF	NA				NS	NS															
HUC 11: 7020011040 (Janesville Village)																										
07020011-520	County Ditch 6	Lk Elysian to T108 R24W S33, south line	1.44	2B	NA	NA																			
07020011-521	County Ditch 6	T107 R24W S4, north line to T107 R25W S13, west line	5.25	7				IF							FS	FS		IF	FS	FS					
07020011-522	County Ditch 6	T107 R25W S14, east line to LeSueur R	1.73	2B	NS	NA				FS	NS														
07020011-574	Silver Creek (County Ditch 3)	Unnamed ditch to Iosco Cr	7.24	2C	IF	NA				NS	NS														
07020011-576	Iosco Creek	Silver Cr to T108 R23W S7, west line	3.5	2C	NS	NA				NS	NS														
07020011-607	County Ditch 29	Unnamed ditch to CD 6	3.19	2B	NA	NA																			
HUC 11: 7020011050 (Madison Lake)																										
07020011-605	Unnamed creek	Mud Lk (07-0034-00) to Unnamed cr	1.59	2B	IF	NA				NS															
HUC 11: 7020011060 (Little Cobb River)																										
07020011-504	Little Cobb River	Bull Run Cr to Cobb R	17.5	2C	NS	NS						FS	FS	FS	FS	NS	FS	NS	FS	FS			NS	NS	NS
07020011-524	Little Cobb River (County Ditch 8)	Unnamed ditch to Severson Lk	16.25	2C	NA	NA				NA	NA														
07020011-525	Bull Run Creek	Silver Lk outlet to Little Cobb R	14.87	2C	NA	NA																			
07020011-566	County Ditch 20	Headwaters to Silver Lk outlet	4.87	2B	NA	NA																			
07020011-599	Unnamed creek	Unnamed lk (Hobza Marsh 07-0019-00) to Unnamed cr	4.63	2B	NA	NA																			
07020011-611	Unnamed creek	Headwaters to Unnamed cr	7.27	2B	NA	NA																			
07020011-613	Unnamed creek	Headwaters to Unnamed cr	13.12	2B	IF	NA				NS															
HUC 11: 7020011070 (Cobb River)																										
07020011-503	Unnamed creek (Little Beauford Ditch)	Headwaters to Cobb R	3.09	2B	NS	NS						NS	FS	FS		NS	FS	IF	FS	FS			NS	NS	NS
07020011-505	Cobb River	Little Cobb R to T107 R27W S36, west line	14.63	2C	FS	FS				FS	FS														
07020011-529	Cobb Creek	T104 R23W S17, east line to Cobb R	7.88	7				NA																	

07020011-530	County Ditch 57	Unnamed ditch to Cobb R	3.58	2B	NA	NA																				
07020011-541	Judicial Ditch 51	Unnamed ditch to Kremers Marsh	4.54	2B	NA	NA																				
07020011-556	Cobb River	T107 R26W S30, west line to LeSueur R	6.76	2C	NS	NS				NS	FS				FS	NS		IF	FS	FS			NS	NS	NS
07020011-562	Cobb Creek Ditch	Headwaters to T103 R23W S1, west line	4.7	2B	NA	NA																				
07020011-568	Cobb River	T104 R23W S34, south line to Little Cobb R	53.92	2C	NS	NA				NS	NS															NS
07020011-583	Cobb Creek Ditch	T103 R23W S2, east line to Unnamed ditch	6.74	7				NA																		
07020011-615	Unnamed creek	Headwaters to Unnamed cr	4.26	2B	NA	NA																				
HUC 11: 7020011080 (Easton)																										
07020011-547	County Ditch 70	Headwaters to Unnamed cr	1.44	2B	NA	NA																				
07020011-548	County Ditch 70	Unnamed cr to CD 3	3.27	2B	NA	NA																				
07020011-550	County Ditch 3	Unnamed cr to CD 7	4.59	2B	NA	NA																				
07020011-552	County Ditch 3 (Judicial Ditch 9)	JD 9 to Maple R	2.33	2B	NS	NS									FS	NS		IF	FS	FS			NS	FS	NS
07020011-590	County Ditch 20	Headwaters to CD 3	4.58	2B	NA	NA																				
07020011-591	County Ditch 7	Headwaters to CD 3	7.36	2B	NA	NA																				
07020011-594	Judicial Ditch 9	Unnamed cr to CD 3	1.34	2B	NA	NA																				
HUC 11: 7020011090 (Rice Creek)																										
07020011-531	Rice Creek	Headwaters to Maple R	27.97	2B	NS	NS				NS	NS				FS	NS		IF	FS	FS			NS	FS	NS
07020011-532	Judicial Ditch 1	Headwaters to T103 R27W S1, north line	3.8	2B	IF	NA																				IF
07020011-533	Judicial Ditch 1	T104 R27W S36, south line to Rice Cr	3.7	2B				NA																		
07020011-589	Unnamed creek	Rice Lk to Rice Cr	1.71	2B	NA	NA																				
HUC 11: 7020011100 (Providence Creek)																										
07020011-502	Providence Creek (Judicial Ditch 49)	T105 R27W S19, south line to T105 R27W S18, east line	2.5	7				NA																		
07020011-539	Providence Creek (Judicial Ditch 49)	Headwaters to T105 R27W S30, north line	2.86	2B	NA	NA																				
07020011-540	Providence Creek (Judicial Ditch 49)	T105 R27W S17, west line to Maple R	2.82	2B	IF	NA																				IF
HUC 11: 7020011110 (Maple River)																										
07020011-534	Maple River	Rice Cr to LeSueur R	30.79	2B	NS	NS				FS	NS				FS	NS		IF	FS	FS			NS	NS	NS
07020011-535	Maple River	Minnesota Lk outlet to Rice Cr	26.35	2B	NS	NA				NS	NS															NS
07020011-537	Maple River	Headwaters (Penny Lk 24-0048-00) to Unnamed cr	14.79	2B	NA	NA																				
07020011-565	Unnamed ditch (Minnesota Lake Inlet)	Headwaters to Minnesota Lk	2.06	2B	IF	NA																				FS
07020011-580	Maple River	Unnamed cr to Minnesota Lk outlet	8.36	2B	NA	NA																				
07020011-592	County Ditch 7	Unnamed cr to Maple R	6.76	2B	NA	NA																				
07020011-593	County Ditch 85	Unnamed cr to Maple R	1.8	2B	IF	NA				NS	NS															

07020011-596	Big Slough	Unnamed cr to CD 35	3.58	2B	NA	NA																					
07020011-597	Unnamed creek	Unnamed cr to Maple R	1.22	2B	NA	NA																					
07020011-598	Unnamed creek	Unnamed lk to Maple R	3.47	2B	NA	NA																					

Appendix 4.1. Minnesota statewide IBI thresholds and confidence limits

Class #	Class Name	Use Class	Threshold	Confidence Limit	Upper	Lower
Fish						
1	Southern Rivers	2B	39	±11	50	28
2	Southern Streams	2B	45	±9	54	36
3	Southern Headwaters	2B	51	±7	58	44
4	Northern Rivers	2B	35	±9	44	26
5	Northern Streams	2B	50	±9	59	41
6	Northern Headwaters	2B	40	±16	56	24
7	Low Gradient	2B	40	±10	50	30
Invertebrates						
1	Northern Forest Rivers	2B	51.3	±10.8	62.1	40.5
2	Prairie Forest Rivers	2B	30.7	±10.8	41.5	19.9
3	Northern Forest Streams RR	2B	50.3	±12.6	62.9	37.7
4	Northern Forest Streams GP	2B	52.4	±13.6	66	38.8
5	Southern Streams RR	2B	35.9	±12.6	48.5	23.3
6	Southern Forest Streams GP	2B	46.8	±13.6	60.4	33.2
7	Prairie Streams GP	2B	38.3	±13.6	51.9	24.7

Appendix 4.2 - Biological monitoring results - fish IBI

National Hydrography Dataset (NHD)AUID	Biological Station ID	Stream Segment Name	Drainage Area (Mi2)	Fish Class	IBI Threshold	Fish IBI
HUC11:07020011010 (LeSueur River)						
07020011-501	08MN001	Le Sueur River	1109.3	1	39	38
07020011-506	08MN036	Le Sueur River	759.7	1	39	48
07020011-507	03MN071	Le Sueur River	374.4	1	39	32
07020011-507	08MN035	Le Sueur River	448.9	1	39	47
07020011-507	90MN105	Le Sueur River	374.5	1	39	45
07020011-510	08MN032	Unnamed creek	39.9	2	45	46
07020011-619	08MN029	Le Sueur River	86.1	2	45	38
07020011-619	08MN055	Le Sueur River	51.4	2	45	56
07020011-620	03MN070	Le Sueur River	187.1	2	45	52
07020011-620	08MN048	Le Sueur River	249.9	2	45	44
07020011-620	08MN052	Le Sueur River	179.1	2	45	47
07020011-620	08MN053	Le Sueur River	150.2	2	45	50
07020011-620	97MN008	Le Sueur River	187.3	2	45	42
07020011-511	08MN030	County Ditch 35	9.5	3	51	32
07020011-558	08MN020	County Ditch 12	10.4	3	51	38
07020011-603	08MN034	Unnamed creek	6.2	3	51	24
07020011-606	08MN057	Unnamed creek	11.1	3	51	0
07020011-608	08MN049	County Ditch 19	5.4	3	51	42
07020011-609	08MN051	County Ditch 15-2	5.3	3	51	47
HUC 11: 07020011020 (Boot Creek)						
07020011-516	08MN007	Boot Creek	49.3	2	45	28
HUC 11:07020011030 (Little LeSueur River)						
07020011-573	08MN027	Little Le Sueur River	21.4	3	51	46
07020011-610	08MN054	Judicial Ditch 10	6.1	3	51	29
HUC11:07020011040 (Janesville Village)						
07020011-522	08MN082	County Ditch 6	84.9	2	45	48

National Hydrography Dataset (NHD)AUID	Biological Station ID	Stream Segment Name	Drainage Area (Mi2)	Fish Class	IBI Threshold	Fish IBI
07020011-574	08MN042	Silver Creek (County Ditch 3)	9.1	3	51	35
07020011-576	08MN026	Iosco Creek	18.2	3	51	12
HUC11:07020011050 (Madison Lake)						
07020011-605	08MN025	Unnamed creek	19.5	3	51	49
HUC11: 07020011060 (Little Cobb River)						
07020011-613	08MN037	Unnamed creek	11.9	3	51	47
HUC11: 07020011070 (Cobb River)						
07020011-556	08MN005	Cobb River	303.5	1	39	37
07020011-505	01MN039	Cobb River	295.3	2	45	42
07020011-505	08MN065	Cobb River	277	2	45	60
07020011-568	08MN017	Cobb River	58.1	2	45	33
07020011-568	08MN071	Cobb River	90.4	2	45	35
07020011-568	97MN002	Cobb River	111.8	2	45	28
07020011-529	08MN018	Cobb Creek	29.3	3	51	22
07020011-568	08MN081	Cobb River	21.8	3	51	27
HUC11:07020011080 (Easton)						
HUC11:07020011090 (Rice Creek)						
07020011-531	03MN067	Rice Creek	77.8	2	45	43
07020011-531	08MN004	Rice Creek	81.3	2	45	44
07020011-531	08MN076	Rice Creek	60.8	2	45	40
07020011-531	08MN086	Rice Creek	71.4	2	45	45
07020011-531	08MN010	Rice Creek	18	3	51	52
HUC11: 07020011100 (Providence Creek)						
HUC11: 07020011110 (Maple River)						
07020011-534	08MN003	Maple River	340.4	1	39	53
07020011-534	08MN019	Maple River	308.2	1	39	49
07020011-535	08MN023	Maple River	86.4	2	45	40
07020011-535	08MN024	Maple River	194.3	2	45	49
07020011-593	08MN015	County Ditch 85	18	3	51	21

Appendix 4.3 - Biological monitoring results - macroinvertebrate IBI

AUID	FieldNum	Stream Segment Name	Drainage Area (Mi2)	Invert Class	IBI Threshold	Invert IBI
HUC11:07020011010 (LeSueur River)						
07020011-501	08MN001	Le Sueur River	1109.3	2	30.7	43
07020011-506	08MN036	Le Sueur River	759.7	2	30.7	40
07020011-507	03MN071	Le Sueur River	374.4	5	35.9	47
07020011-507	08MN035	Le Sueur River	449	5	35.9	44
07020011-510	08MN032	Unnamed creek	40	5	35.9	34
07020011-558	08MN020	County Ditch 12	10.5	5	35.9	14
07020011-606	08MN057	Unnamed creek	11.1	5	35.9	10
07020011-608	08MN049	County Ditch 19	5.4	5	35.9	30
07020011-609	08MN051	County Ditch 15-2	5.3	5	35.9	26
07020011-619	08MN055	Le Sueur River	51.4	5	35.9	39
07020011-620	03MN070	Le Sueur River	187.2	5	35.9	57
07020011-620	08MN053	Le Sueur River	150.2	5	35.9	38
07020011-619	08MN029	Le Sueur River	86.2	6	46.8	51
07020011-620	08MN048	Le Sueur River	250	6	46.8	52
07020011-620	08MN052	Le Sueur River	179.1	6	46.8	57
07020011-511	08MN030	County Ditch 35	9.6	7	38.3	27
HUC 11: 07020011020 (Boot Creek)						
07020011-516	08MN007	Boot Creek	49.4	7	38.3	55
HUC 11:07020011030 (Little LeSueur River)						
07020011-573	08MN027	Little Le Sueur River	21.4	6	46.8	50
07020011-610	08MN054	Judicial Ditch 10	6.1	6	46.8	50
HUC11:07020011040 (Janesville Village)						
07020011-522	08MN082	County Ditch 6	85	5	35.9	33
07020011-576	08MN026	Iosco Creek	18.3	5	35.9	25
07020011-574	08MN042	Silver Creek (County Ditch 3)	9.1	6	46.8	40
HUC11: 07020011060 (Little Cobb River)						
HUC11: 07020011070 (Cobb River)						
07020011-505	01MN039	Cobb River	295.3	5	35.9	53

AUID	FieldNum	Stream Segment Name	Drainage Area (Mi2)	Invert Class	IBI Threshold	Invert IBI
07020011-505	08MN065	Cobb River	277.1	5	35.9	39
07020011-529	08MN018	Cobb Creek	29.3	5	35.9	41
07020011-556	08MN005	Cobb River	303.5	5	35.9	41
07020011-568	08MN017	Cobb River	58.2	5	35.9	25
07020011-568	08MN081	Cobb River	21.8	7	38.3	22
HUC11:07020011080 (Easton)						
HUC11:07020011090 (Rice Creek)						
07020011-531	03MN067	Rice Creek	77.8	5	35.9	36
07020011-531	08MN010	Rice Creek	18	5	35.9	23
07020011-531	08MN004	Rice Creek	81.3	7	38.3	46
07020011-531	08MN076	Rice Creek	60.8	7	38.3	38
07020011-531	08MN086	Rice Creek	71.5	7	38.3	31
HUC11: 07020011100 (Providence Creek)						
HUC11: 07020011110 (Maple River)						
07020011-534	08MN003	Maple River	340.4	5	35.9	32
07020011-534	08MN019	Maple River	308.2	7	38.3	48
07020011-535	08MN023	Maple River	86.5	7	38.3	21
07020011-535	08MN024	Maple River	194.4	7	38.3	62
07020011-593	08MN015	County Ditch 85	18	7	38.3	13

Appendix 5.1 - Good/Fair/Poor thresholds for biological stations on non-assessed channelized AUIDs

Ratings of **Good** for channelized streams are based on Minnesota's general use threshold for aquatic life (Appendix 4.1). Stations with IBIs that score above this general use threshold would be given a rating of **Good**. The **Fair** rating is calculated as a 15 point drop from the general use threshold. Stations with IBI scores below the general use threshold, but above the **Fair** threshold would be given a rating of **Fair**. Stations scoring below the Fair threshold would be considered **Poor**.

Class #	Class Name	Good	Fair	Poor
Fish				
1	Southern Rivers	>38	38-24	<24
2	Southern Streams	>44	44-30	<30
3	Southern Headwaters	>50	50-36	<36
4	Northern Rivers	>34	34-20	<20
5	Northern Streams	>49	49-35	<35
6	Northern Headwaters	>39	39-25	<25
7	Low Gradient Streams	>39	39-25	<25
Invertebrates				
1	Northern Forest Rivers	>51	52-36	<36
2	Prairie Forest Rivers	>31	31-16	<16
3	Northern Forest Streams RR	>50	50-35	<35
4	Northern Forest Streams GP	>52	52-37	<37
5	Southern Streams RR	>36	36-21	<21
6	Southern Forest Streams GP	>47	47-32	<32
7	Prairie Streams GP	>38	38-23	<23

Appendix 5.2 - Channelized stream AUID IBI score FISH

National Hydrography Dataset (NHD)AUID	Biological Station ID	Stream Segment Name	Drainage Area (Mi2)	Fish Class	Good	Fair	Poor	Fish IBI
HUC11:07020011010 (LeSueur River)								
07020011-512	08MN050	County Ditch 38	10.7	3	100-51	50-36	35-0	49
07020011-513	08MN084	County Ditch 12	10.4	3	100-51	50-36	35-0	43
07020011-544	01MN040	Unnamed creek	13	3	100-51	50-36	35-0	47
07020011-546	08MN028	Unnamed creek	21.2	3	100-51	50-36	35-0	41
07020011-601	08MN059	Unnamed creek	9.1	3	100-51	50-36	35-0	37
07020011-602	08MN033	County Ditch 88	14.3	3	100-51	50-36	35-0	27
07020011-618	08MN069	County Ditch 46	14.3	3	100-51	50-36	35-0	47

National Hydrography Dataset (NHD)AUID	Biological Station ID	Stream Segment Name	Drainage Area (Mi2)	Fish Class	Good	Fair	Poor	Fish IBI
07020011-619	07MN057	Le Sueur River	9.4	3	100-51	50-36	35-0	48
HUC 11: 07020011020 (Boot Creek)								
07020011-516	07MN067	Boot Creek	40.2	2	100-45	44-30	30-0	20
07020011-518	08MN016	Unnamed ditch	9	3	100-51	50-36	35-0	39
07020011-561	08MN078	Unnamed ditch	4.7	3	100-51	50-36	35-0	33
07020011-617	08MN060	Judicial Ditch 8	6.2	3	100-51	50-36	35-0	40
07020011-622	08MN021	Boot Creek	28.1	3	100-51	50-36	35-0	36
HUC 11:07020011030 (Little LeSueur River)								
HUC11:07020011040 (Janesville Village)								
07020011-520	08MN083	County Ditch 6	49.9	2	100-45	44-30	30-0	29
07020011-521	07MN068	County Ditch 6	82.6	2	100-45	44-30	30-0	39
07020011-521	08MN047	County Ditch 6	68.8	2	100-45	44-30	30-0	23
07020011-607	08MN046	County Ditch 29	5	3	100-51	50-36	35-0	0
HUC11:07020011050 (Madison Lake)								
HUC11: 07020011060 (Little Cobb River)								
07020011-504	08MN006	Little Cobb River	127.8	2	100-45	44-30	30-0	38
07020011-504	08MN070	Little Cobb River	119.1	2	100-45	44-30	30-0	43
07020011-524	08MN039	Little Cobb River (County Ditch 8)	44.9	2	100-45	44-30	30-0	27
07020011-525	08MN040	Bull Run Creek	38.5	2	100-45	44-30	30-0	18
07020011-524	07MN066	Little Cobb River (County Ditch 8)	13.7	3	100-51	50-36	35-0	48
07020011-524	08MN038	Little Cobb River (County Ditch 8)	16.8	3	100-51	50-36	35-0	47
07020011-566	08MN062	County Ditch 20	6.7	3	100-51	50-36	35-0	0
07020011-611	08MN061	Unnamed creek	5.9	3	100-51	50-36	35-0	56
07020011-599	08MN064	Unnamed creek	4.1	7	100-40	39-25	24-0	10
HUC11: 07020011070 (Cobb River)								
07020011-568	08MN067	Cobb River	130.6	2	100-45	44-30	30-0	40
07020011-503	91MN104	Unnamed creek (Little Beauford Ditch)	8.1	3	100-51	50-36	35-0	33
07020011-530	08MN066	County Ditch 57	8.9	3	100-51	50-36	35-0	24
07020011-541	01MN030	Judicial Ditch 51	11.3	3	100-51	50-36	35-0	49

National Hydrography Dataset (NHD)AUID	Biological Station ID	Stream Segment Name	Drainage Area (Mi2)	Fish Class	Good	Fair	Poor	Fish IBI
07020011-562	08MN080	Cobb Creek Ditch	6.9	3	100-51	50-36	35-0	33
07020011-583	01MN036	Cobb Creek Ditch	15.3	3	100-51	50-36	35-0	44
07020011-615	08MN068	Unnamed creek	4.5	3	100-51	50-36	35-0	37
HUC11:07020011080 (Easton)								
07020011-550	07MN062	County Ditch 3	34.4	2	100-45	44-30	30-0	19
07020011-552	08MN002	County Ditch 3 (Judicial Ditch 9)	67	2	100-45	44-30	30-0	18
07020011-547	01MN004	County Ditch 70	1.5	3	100-51	50-36	35-0	3
07020011-548	08MN044	County Ditch 70	6.2	3	100-51	50-36	35-0	41
07020011-590	08MN045	County Ditch 20	16.9	3	100-51	50-36	35-0	40
07020011-591	08MN012	County Ditch 7	9.5	3	100-51	50-36	35-0	40
07020011-594	08MN013	Judicial Ditch 9	9.5	3	100-51	50-36	35-0	36
HUC11:07020011090 (Rice Creek)								
07020011-531	01MN014	Rice Creek	15.8	3	100-51	50-36	35-0	18
07020011-532	08MN077	Judicial Ditch 1	4.2	3	100-51	50-36	35-0	37
07020011-533	08MN011	Judicial Ditch 1	10.1	3	100-51	50-36	35-0	28
07020011-589	08MN009	Unnamed creek	23.5	3	100-51	50-36	35-0	34
HUC11: 07020011100 (Providence Creek)								
07020011-502	08MN074	Providence Creek (Judicial Ditch 49)	18	3	100-51	50-36	35-0	30
07020011-539	08MN075	Providence Creek (Judicial Ditch 49)	8	3	100-51	50-36	35-0	25
07020011-540	08MN008	Providence Creek (Judicial Ditch 49)	23.2	3	100-51	50-36	35-0	22
HUC11: 07020011110 (Maple River)								
07020011-580	08MN072	Maple River	70.6	2	100-45	44-30	30-0	42
07020011-537	08MN022	Maple River	14.2	3	100-51	50-36	35-0	41
07020011-537	08MN079	Maple River	13.2	3	100-51	50-36	35-0	23
07020011-537	91MN102	Maple River	8.5	3	100-51	50-36	35-0	46
07020011-592	08MN014	County Ditch 7	19.1	3	100-51	50-36	35-0	11
07020011-597	08MN073	Unnamed creek	5.8	3	100-51	50-36	35-0	25
07020011-598	08MN043	Unnamed creek	5.5	3	100-51	50-36	35-0	22

National Hydrography Dataset (NHD)AUID	Biological Station ID	Stream Segment Name	Drainage Area (Mi2)	Fish Class	Good	Fair	Poor	Fish IBI
07020011-596	08MN041	Big Slough	12	7	100-40	39-25	24-0	19

Appendix 5.3 - Channelized stream AUID IBI score macroinvertbrate

AUID	FieldNum	Stream Segment Name	Drainage Area (Mi2)	Invert Class	Good	Fair	Poor	Invert IBI
HUC11:07020011010 (LeSueur River)								
07020011-512	08MN050	County Ditch 38	10.7	6	100-48	47-32	31-0	48
07020011-544	01MN040	Unnamed creek	13	6	100-48	47-32	31-0	24
07020011-546	08MN028	Unnamed creek	21.2	6	100-48	47-32	31-0	38
07020011-601	08MN059	Unnamed creek	9.1	6	100-48	47-32	31-0	40
07020011-618	08MN069	County Ditch 46	14.4	6	100-48	47-32	31-0	24
07020011-602	08MN033	County Ditch 88	14.3	7	100-39	38-23	22-0	18
07020011-619	07MN057	Le Sueur River	9.5	7	100-39	38-23	22-0	35
HUC 11: 07020011020 (Boot Creek)								
07020011-518	08MN016	Unnamed ditch	9	5	100-37	36-21	20-0	19
07020011-622	08MN021	Boot Creek	28.1	5	100-37	36-21	20-0	20
07020011-561	08MN078	Unnamed ditch	4.7	7	100-39	38-23	22-0	17
07020011-617	08MN060	Judicial Ditch 8	6.2	7	100-39	38-23	22-0	29
HUC 11:07020011030 (Little LeSueur River)								
HUC11:07020011040 (Janesville Village)								
07020011-607	08MN046	County Ditch 29	5	5	100-37	36-21	20-0	29
07020011-520	08MN083	County Ditch 6	50	6	100-48	47-32	31-0	16
07020011-521	07MN068	County Ditch 6	82.7	6	100-48	47-32	31-0	10
07020011-521	08MN047	County Ditch 6	68.9	6	100-48	47-32	31-0	29
HUC11: 07020011060 (Little Cobb River)								
07020011-524	08MN038	Little Cobb River (County Ditch 8)	16.9	7	100-39	38-23	22-0	19

AUID	FieldNum	Stream Segment Name	Drainage Area (Mi2)	Invert Class	Good	Fair	Poor	Invert IBI
07020011-611	08MN061	Unnamed creek	5.9	7	100-39	38-23	22-0	37
HUC11: 07020011070 (Cobb River)								
07020011-503	91MN104	Unnamed creek (Little Beauford Ditch)	8.2	7	100-39	38-23	22-0	21
07020011-530	08MN066	County Ditch 57	9	7	100-39	38-23	22-0	16
07020011-562	08MN080	Cobb Creek Ditch	6.9	7	100-39	38-23	22-0	15
07020011-568	08MN067	Cobb River	130.6	7	100-39	38-23	22-0	29
07020011-583	01MN036	Cobb Creek Ditch	15.3	7	100-39	38-23	22-0	33
07020011-615	08MN068	Unnamed creek	4.6	7	100-39	38-23	22-0	22
HUC11:07020011080 (Easton)								
07020011-548	08MN044	County Ditch 70	6.3	5	100-37	36-21	20-0	14
07020011-550	07MN062	County Ditch 3	34.4	5	100-37	36-21	20-0	53
07020011-547	01MN004	County Ditch 70	1.6	7	100-39	38-23	22-0	7
07020011-552	08MN002	County Ditch 3 (Judicial Ditch 9)	67.1	7	100-39	38-23	22-0	1
07020011-590	08MN045	County Ditch 20	16.9	7	100-39	38-23	22-0	37
07020011-591	08MN012	County Ditch 7	9.5	7	100-39	38-23	22-0	28
07020011-594	08MN013	Judicial Ditch 9	9.6	7	100-39	38-23	22-0	21
HUC11:07020011090 (Rice Creek)								
07020011-589	08MN009	Unnamed creek	23.6	5	100-37	36-21	20-0	36
07020011-531	01MN014	Rice Creek	15.8	7	100-39	38-23	22-0	17
07020011-532	08MN077	Judicial Ditch 1	4.2	7	100-39	38-23	22-0	18
07020011-533	08MN011	Judicial Ditch 1	10.1	7	100-39	38-23	22-0	18
HUC11: 07020011100 (Providence Creek)								
07020011-502	08MN074	Providence Creek (Judicial Ditch 49)	18	7	100-39	38-23	22-0	25
07020011-539	08MN075	Providence Creek (Judicial Ditch 49)	8	7	100-39	38-23	22-0	9
07020011-540	08MN008	Providence Creek (Judicial Ditch 49)	23.2	7	100-39	38-23	22-0	21
HUC11: 07020011110 (Maple River)								
07020011-537	08MN022	Maple River	14.2	5	100-37	36-21	20-0	29
07020011-537	08MN079	Maple River	13.3	7	100-39	38-23	22-0	31
07020011-537	91MN102	Maple River	8.5	7	100-39	38-23	22-0	33

AUID	FieldNum	Stream Segment Name	Drainage Area (Mi2)	Invert Class	Good	Fair	Poor	Invert IBI
07020011-580	08MN072	Maple River	70.6	7	100-39	38-23	22-0	20
07020011-592	08MN014	County Ditch 7	19.1	7	100-39	38-23	22-0	25
07020011-596	08MN041	Big Slough	12	7	100-39	38-23	22-0	31
07020011-598	08MN043	Unnamed creek	5.6	7	100-39	38-23	22-0	18

Appendix 6.1. Minnesota's Ecoregion–Based Lake Eutrophication Standards

Ecoregion	TP µg/L	Chl-a µg/L	Secchi meters
NLF – Lake Trout (Class 2A)	< 12	< 3	> 4.8
NLF – Stream trout (Class 2A)	< 20	< 6	> 2.5
NLF – Aquatic Rec. Use (Class 2B)	< 30	< 9	> 2.0
NCHF – Stream trout (Class 2A)	< 20	< 6	> 2.5
NCHF – Aquatic Rec. Use (Class 2B)	< 40	< 14	> 1.4
NCHF – Aquatic Rec. Use (Class 2B) Shallow lakes	< 60	< 20	> 1.0
WCBP & NGP – Aquatic Rec. Use (Class 2B)	< 65	< 22	> 0.9
WCBP & NGP – Aquatic Rec. Use (Class 2B) Shallow lakes	< 90	< 30	> 0.7