Watershed health

July 2018

Cloquet River Watershed Monitoring and Assessment Report

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

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Contents

Tables

Figures

List of acronyms

CI Confidence Interval

CLMP Citizen Lake Monitoring Program

CSAH County State Aid Highway

CSMP Citizen Stream Monitoring Program

CWA Clean Water Act

CWLA Clean Water Legacy Act

DNR Minnesota Department of Natural Resources

DOP Dissolved Orthophosphate

EX Exceeds Criteria (Bacteria)

EXP Exceeds Criteria, Potential Impairment

EXS Exceeds Criteria, Potential Severe Impairment

FS Full Support

FWMC Flow Weighted Mean Concentration

H Hypereutrophic

HUC Hydrologic Unit Code

IBI Index of Biotic Integrity

IF Insufficient Information

K Potassium

LRVW Limited Resource Value Water

MDH Minnesota Department of Health

MGS Minnesota Geological Survey

MPCA Minnesota Pollution Control Agency

MSHA Minnesota Stream Habitat Assessment

MTS Meets the Standard

N Nitrogen

Nitrate-N Nitrate Plus Nitrite Nitrogen

NA Not Assessed

NHD National Hydrologic Dataset

NH3 Ammonia

OP Orthophosphate

PCB Polychlorinated Biphenyls

RNR River Nutrient Region

SWAG Surface Water Assessment Grant

SWCD Soil and Water Conservation District

TALU Tiered Aquatic Life Uses

TKN Total Kjeldahl Nitrogen

TMDL Total Maximum Daily Load

TP Total Phosphorus

TSS Total Suspended Solids

USGS United States Geological Survey

WID Waterbody Identification Number

WIMN What's In My Neighborhood

WPLMN Watershed Pollutant Load Monitoring Network

WRAPS Watershed Restoration and Protection Strategies

Executive summary

In 2015, the Minnesota Pollution Control Agency (MPCA) conducted Intensive Watershed Monitoring (IWM) within the Cloquet River Watershed. The primary goal of IWM is to describe the condition of rivers, streams and lakes within each of Minnesota's 80 major watersheds using a comprehensive suite of indicators. IWM is a comprehensive monitoring program that includes both biology and chemistry monitoring. Eventually, the data is used to assess surface waters for its ability to support uses such as aquatic life (biology) and aquatic recreation (swimming etc.). Near the outlet of the watershed, an analysis of mercury within fish tissue was also conducted to assess for aquatic consumption (how much mercury is in the fish). Additionally, the Watershed Pollutant Load Monitoring Network (WPLMN) computed pollutant loads. The work for this effort was completed by MPCA staff, Surface Water Assessment Grant (SWAG) recipients, and citizen volunteers.

In all, 31 (87%) of streams assessed for aquatic life fully support this use, whereas 13% did not. In terms of aquatic recreational use, six streams were assessed and all were fully supporting.

Assessment results for the Cloquet River Watershed indicate that the fish and macroinvertebrate communities are for the most part in very good to excellent condition. This is undoubtedly linked to the fact that the Cloquet River Watershed is dominated by forests, wetlands, and lakes with limited impact compared to other watersheds in the state. Therefore, very little to no anthropogenic (human induced) stressors are present.

A total of 28 lakes within the watershed had sufficient data collected to assess for aquatic recreation. Twenty-seven lakes were assessed as fully supporting recreational use; meeting the phosphorus and chlorophyll-a (Chl-a) water quality standards in the Northern Lakes and Forests Ecoregion. Sand (Loaine) Lake did not meet standards protective of its stream trout fishery; however an MPCA review of the data and lake's environmental setting determined these exceedances were due to natural conditions. The lakeshore is undeveloped and the watershed is dominated by forest. The Cloquet River reservoir lakes vary in quality; Island Lake had the lowest concentrations of phosphorus (P) and Chl-a. Most of the reservoir lakes have naturally low Secchi transparency due from tannin staining (i.e. root beer color). Fish, Boulder, and Wild Rice lakes are productive and classified as mesotrophic; their water quality is influenced by the riverine, wetland, and forest landscapes that were inundated when the reservoirs were created in the early 1900's.

Long-term trends in Secchi transparency vary among the lakes. A total of 23 lakes had sufficient data to determine temporal trends. Nine lakes have improving trends, while eight lakes have declining trends. Those lakes with declining trends had relatively high amounts of lake-shore development and are potentially more vulnerable to water quality declines. These lakes include Briar, Schultz, Pequaywan, Grand, and Rose.

Since the Cloquet River Watershed has experienced much less disturbance than many watersheds in Minnesota, the opportunity to experience truly wild and scenic locations is still a possibility in much of its area, particularly in the portions of the watershed upstream of Island Lake. At one time, the Cloquet River was studied for inclusion in the Minnesota's Wild and Scenic Rivers Act, and although it was not selected, the exceptional recreational and scientific value has been recognized in the St. Louis River Management Plan, and has since been managed to protect those values. Forest fragmentation and logging are the two primary anthropogenic activities that occur within the watershed. Although large blocks of public land do exist within its area, increasing amounts of privately owned land are evident. Forest-lands are being sold at an increasing rate and later sub-divided and cleared for secluded or secondary homes (NRCS, 2007).

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) which requires states to adopt water quality standards to protect their water resources and the designated uses of those waters, such as for drinking water, recreation, fish consumption and aquatic life. States are required to provide a summary of the status of their surface waters and develop a list of water bodies that do not meet established standards. Such waters are referred to as "impaired waters" and the state must make appropriate plans to restore these waters, including the development of total maximum daily loads (TMDLs). A TMDL is a comprehensive study determining the assimilative capacity of a waterbody, identifying all pollution sources causing or contributing to impairment, and an estimation of the reductions needed to restore a water body so that it can once again support its designated use.

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

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

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

This watershed-wide monitoring approach was implemented in the Cloquet River Watershed beginning in the summer of 2015. This report provides a summary of all water quality assessment results in the Cloquet River Watershed and incorporates all data available for the assessment process including watershed monitoring, volunteer monitoring and monitoring conducted by local government units.

The watershed monitoring approach

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

Watershed pollutant load monitoring

The WPLMN is a long-term statewide river monitoring network initiated in 2007 and designed to obtain pollutant load information from 199 river monitoring sites throughout Minnesota. Monitoring sites span three ranges of scale:

Basin – major river main stem sites along the Mississippi, Minnesota, Rainy, Red, Des Moines, Cedar and St. Croix rivers

Major Watershed – tributaries draining to major rivers with an average drainage area of 1,350 square miles (8-digit HUC scale)

Subwatershed – major branches or nodes within major watersheds with average drainage areas of approximately 300-500 square miles

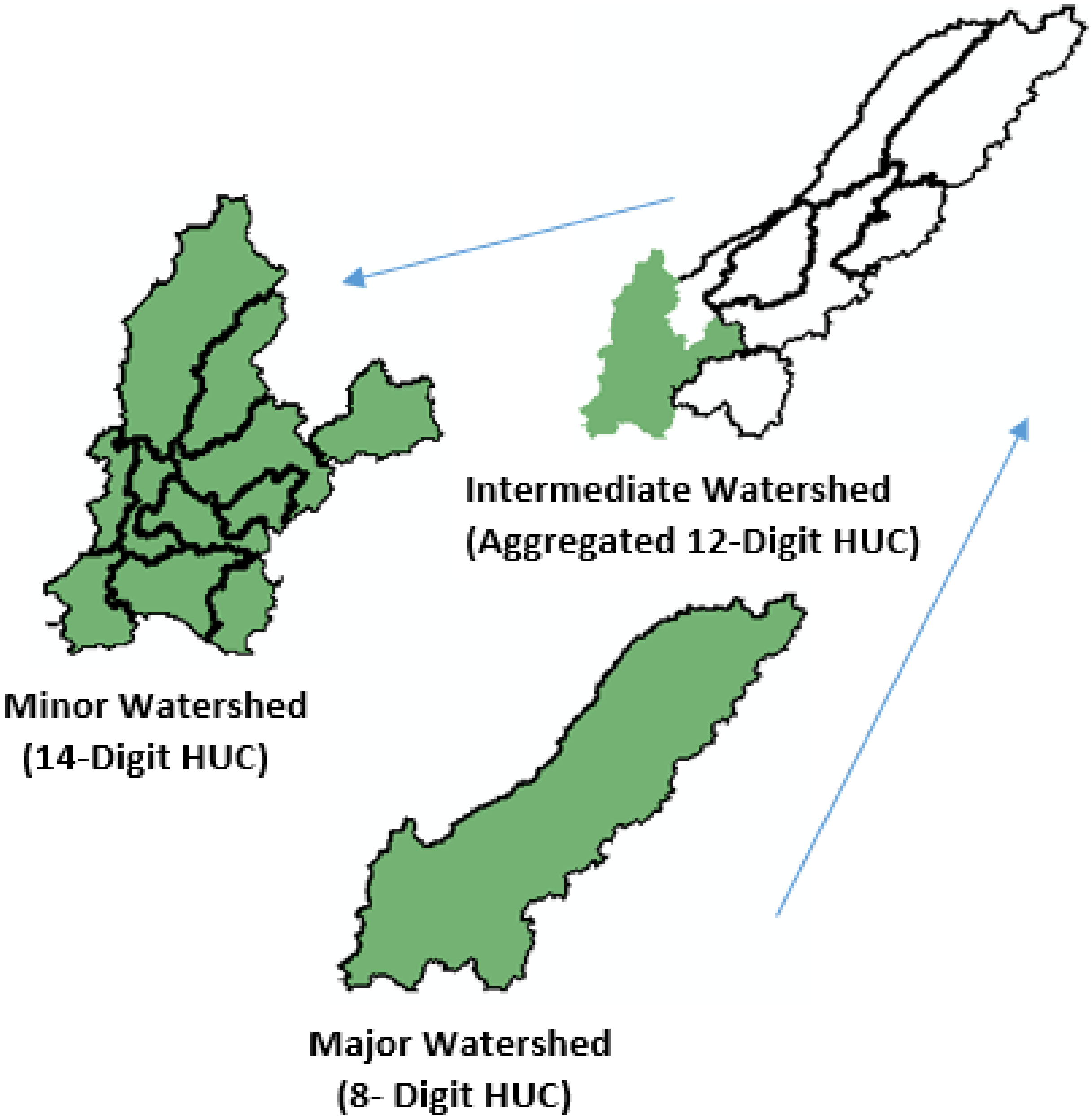
The program utilizes state and federal agencies, universities, local partners, and MPCA staff to collect water quality and flow data to calculate nitrogen, phosphorus, and sediment pollutant loads.

Intensive watershed monitoring

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

River/stream sites are selected near the outlet of each of three watershed scales, 8-HUC, aggregated 12-HUC and 14-HUC (Figure 1). Within each scale, different water uses are assessed based on the opportunity for that use (i.e., fishing, swimming, supporting aquatic life such as fish and insects). The major river watershed is represented by the 8-HUC scale. The outlet of the major 8-HUC watershed (green triangle in Figure 2) is sampled for biology (fish and macroinvertebrates), water chemistry and fish contaminants to allow for the assessment of aquatic life, aquatic recreation and aquatic consumption use support. The aggregated 12-HUC is the next smaller subwatershed scale which generally consists of major tributary streams with drainage areas ranging from 75 to 150 mi^2. Each aggregated 12-HUC outlet (pink dots in Figure 2) is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use support. Within each aggregated 12-HUC, smaller watersheds (14 HUCs, typically 10-20 mi^2), are sampled at each outlet that flows into the major aggregated 12-HUC tributaries. Each of these minor subwatershed outlets is sampled for biology to assess aquatic life use support (yellow dots in Figure 2).

Figure 1. The Intensive Watershed Monitoring Design.

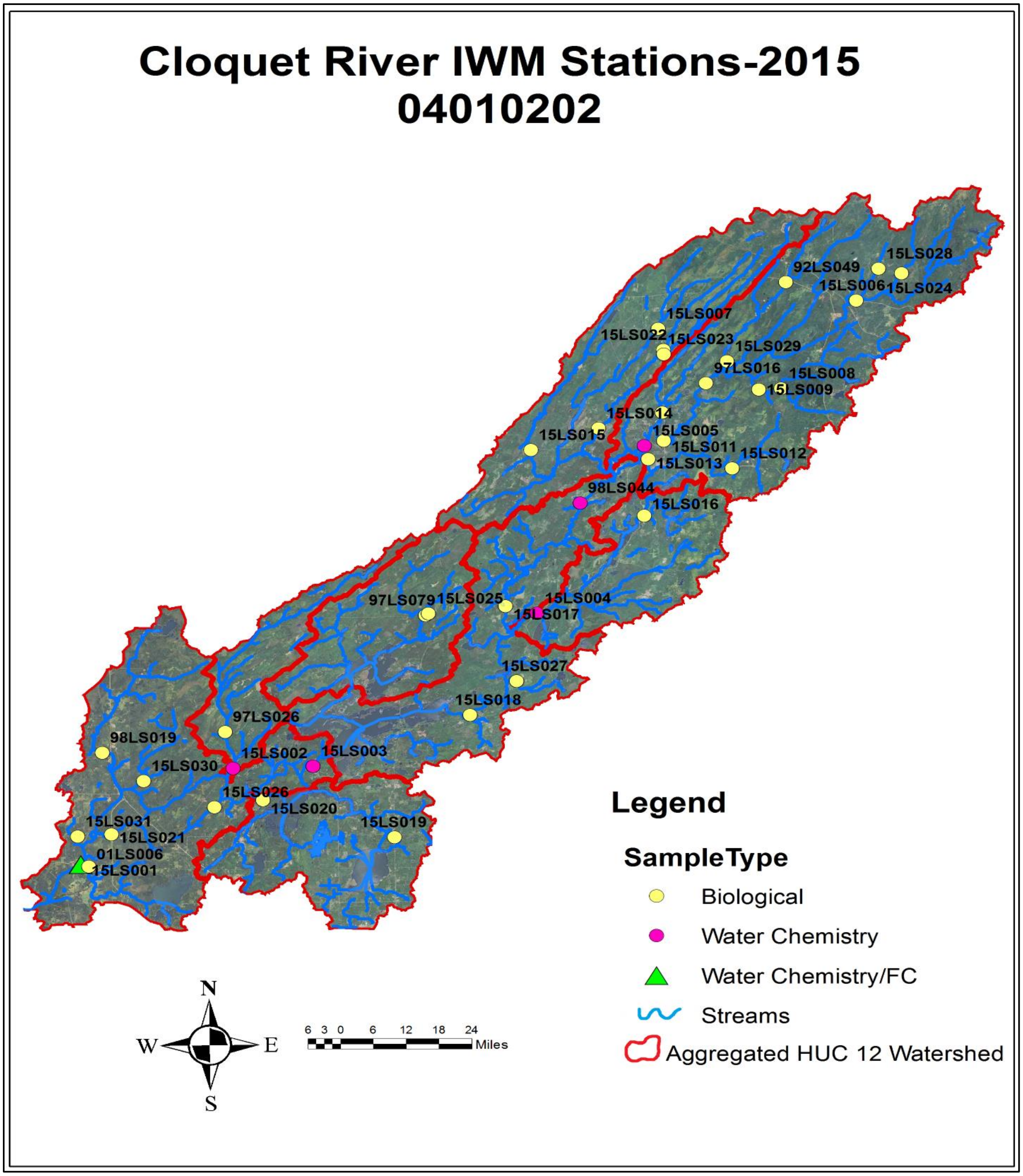


Lake monitoring

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

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

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

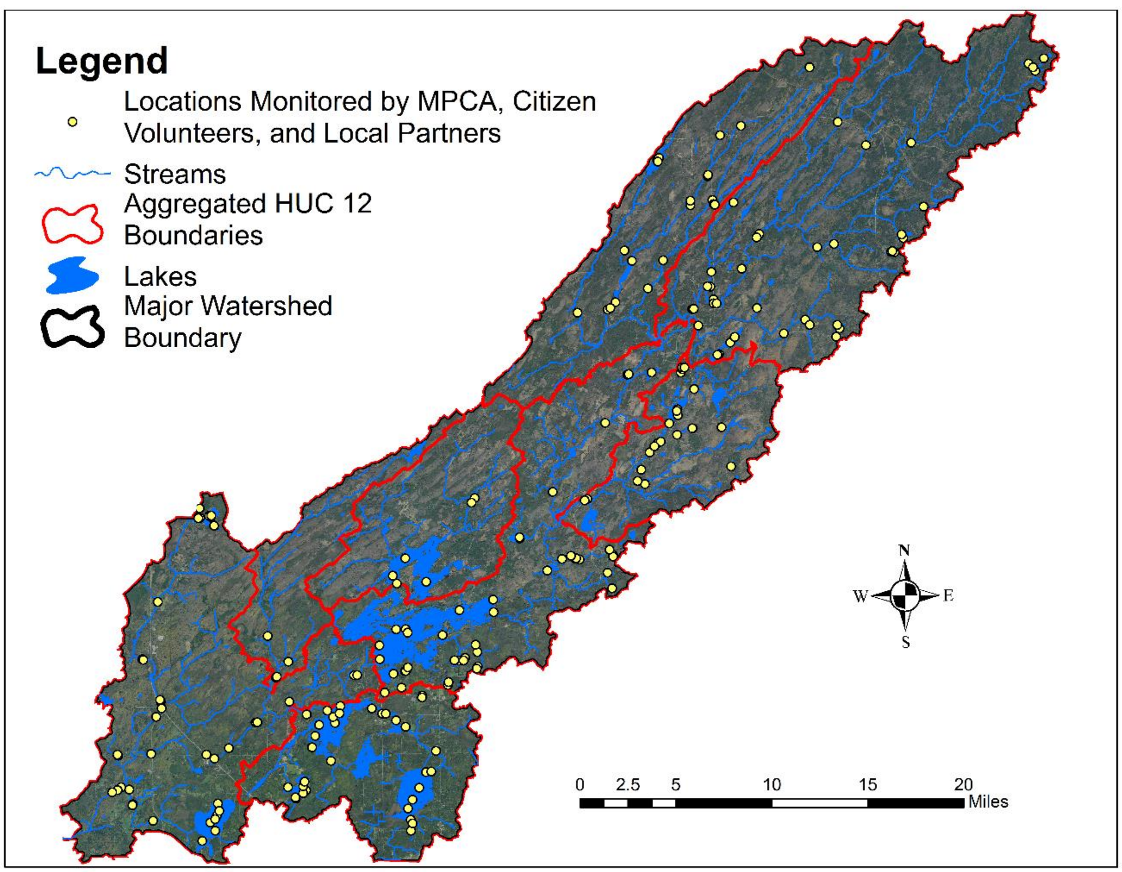


Citizen and local monitoring

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

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

Figure 3. Monitoring locations of local groups, citizens and the MPCA lake monitoring staff in the Cloquet River Watershed.



Assessment methodology

The CWA requires states to report on the condition of the waters of the state every two years. This biennial report to Congress contains an updated list of surface waters that are determined to be supporting or non-supporting of their designated uses as evaluated by the comparison of monitoring data to criteria specified by Minnesota Water Quality Standards (Minn. R. Ch. 7050 2008; https://www.revisor.leg.state.mn.us/rules/?id=7050). The assessment and listing process involves dozens of MPCA staff, other state agencies and local partners. The goal of this effort is to use the best data and best science available to assess the condition of Minnesota's water resources. For a thorough review of the assessment methodologies see: *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List (MPCA 2012)*. https://www.pca.state.mn.us/sites/default/files/wq-iw1-04.pdf.

Water quality standards

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

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

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

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

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

Table 1. Proposed tiered aquatic life use standards.

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

Proposed tiered aquatic life use	Acronym	Proposed use class code	Description
Coldwater Exceptional	CWe	2Ae	Coldwater Stream protected for aquatic life and recreation, capable of supporting and maintaining an exceptional and balanced, integrated, adaptive community of cold water aquatic organisms that meet or exceed the Exceptional Use biological criteria.

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

Assessment units

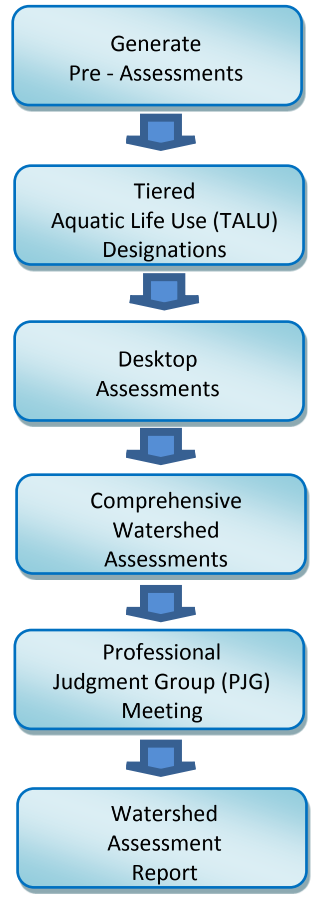
Assessments of use support in Minnesota are made for individual waterbodies. The waterbody unit used for river systems, lakes and wetlands is called the “assessment unit”. A stream or river assessment unit usually extends from one significant tributary stream to another or from the headwaters to the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

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

Determining use attainment

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

Figure 4. Flowchart of aquatic life use assessment process.



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

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

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

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

Watershed overview

The Cloquet River Watershed is located in the Lake Superior Basin of Northeast Minnesota and is within the Northern Lakes and Forests Ecoregion (Figure 5). The watershed drains roughly 793 square miles (507,862 acres) and includes portions of Lake and St. Louis Counties (NRCS, 2007). The Cloquet River is the primary river in this watershed and originates at the outlet of Katherine Lake within the Superior National Forest in Lake County. From there it flows in a primarily southwest direction roughly 70 miles before reaching the Island Lake Reservoir which is used as a hydroelectric power reservoir. From the outlet of Island Lake, the River flows approximately 21 more miles before its confluence with the St. Louis River, which ultimately flows into Lake Superior. Along its approximate 100 mile route, the Cloquet River receives water via numerous tributaries (e.g. Cloquet River West Branch, Langley River, Pine Creek, Beaver River, and Hellwig Creek).

Figure 5. The Cloquet River Watershed within the Northern Lakes and Forest ecoregion of NE Minnesota.

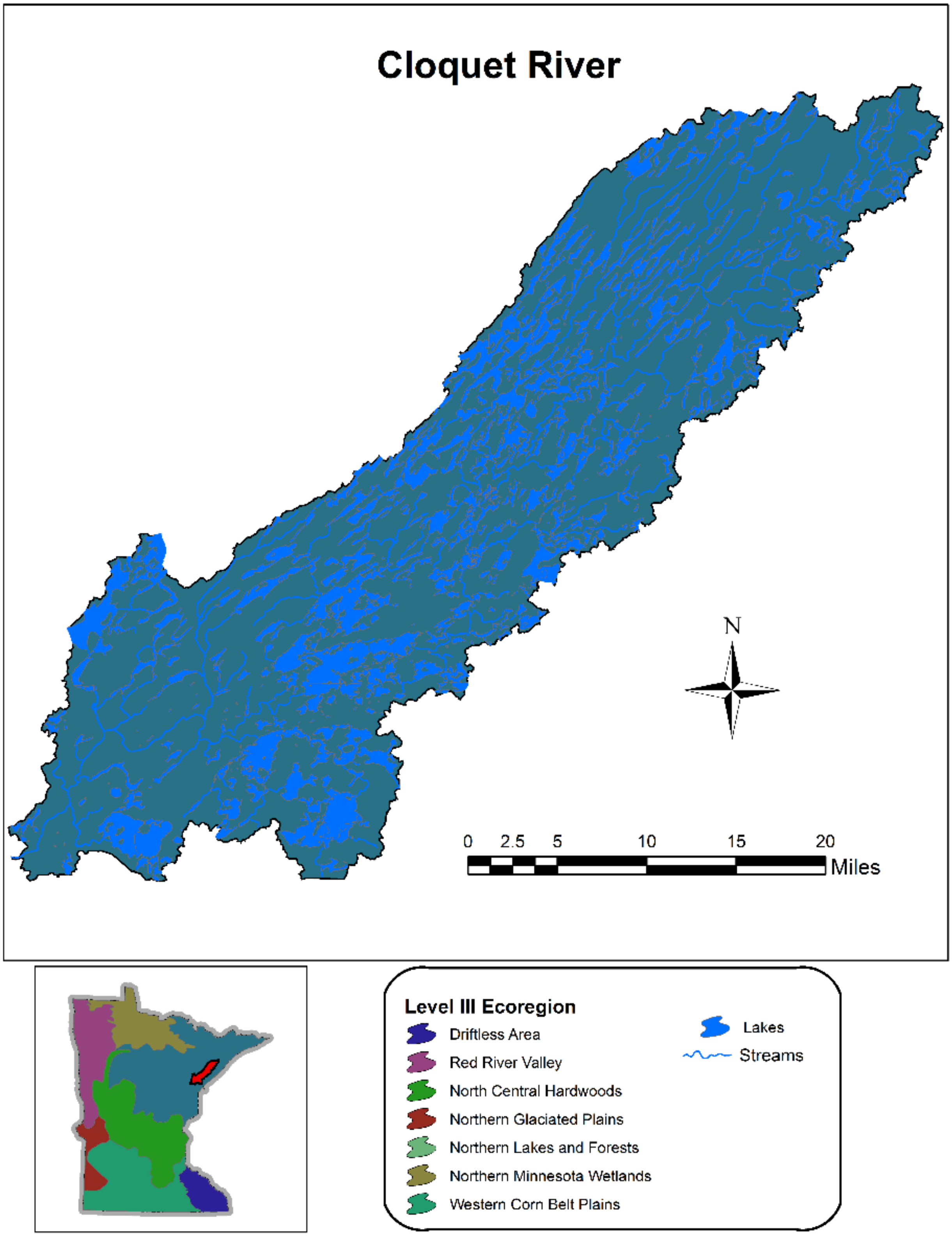
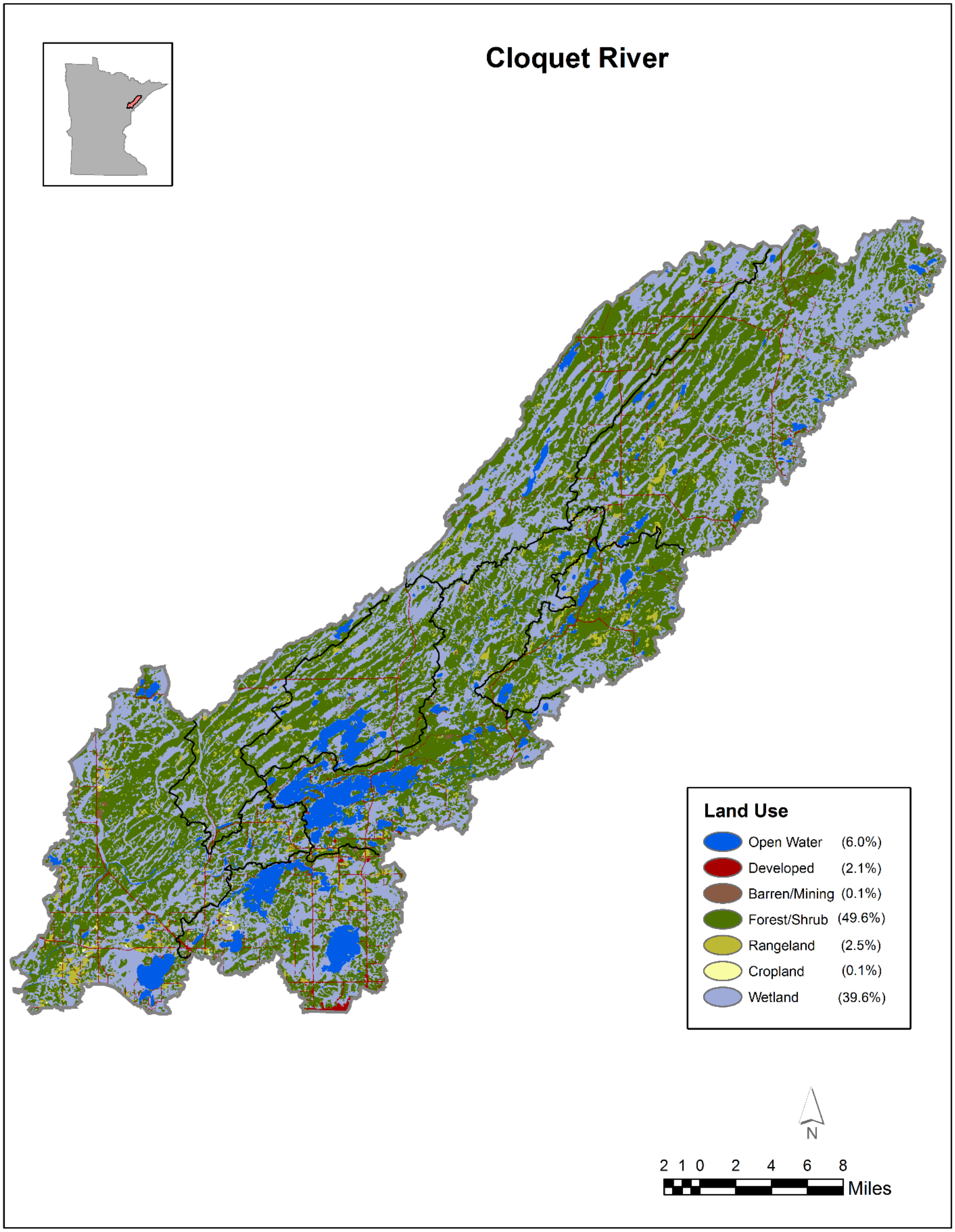


Figure 6. Collecting wild rice in the headwaters of the Cloquet River.

Land use summary

Much of the Cloquet River Watershed remains in its natural state, particularly the area above Island Lake. Due to the relatively high gradient and relatively low soil fertility, it is not desirable for agricultural production and fewer than 100 farms exist within its area. Most of them are under 180 acres in size. The land is not classified as highly erodible; however, the potential does exist on some of the steeper side slope areas. Forest is the dominant land use (roughly 80%), and logging activities still occur in some portions of the watershed. The remaining land cover is comprised of wetlands (roughly 6%), open water (roughly 6%), and shrub-land (roughly 4%) (Figure 7). Development pressure remains moderate as areas continue to be parceled out for lake/country homes and or recreational purposes (NRCS, 2007). Roughly 50% of the land in the Cloquet Watershed is State owned, and approximately 25% is held privately. Federal lands account for approximately 13% of the watershed and less than 1% is county land. Members of the Fond du Lac Band of Lake Superior Chippewa own some lands in the southern portion of the watershed. Due to the relatively high percentage of public lands and pristine nature of much of the Cloquet River Watershed, the area provides numerous recreational opportunities such as canoeing, camping, collecting wild rice, hiking, hunting, and fishing.

Figure 7. Land use in the Cloquet River Watershed.



Surface water hydrology

The Cloquet River Watershed includes eight intermediate (aggregated HUC 12) sized watersheds and 58 minor (HUC 14) sized watersheds. Major stream tributaries within the system include the West Branch of the Cloquet River, Langley River, Little Cloquet River, Us Kab Wan Ka River, and Beaver River. Average elevation within the Cloquet River Watershed is roughly 938 feet, ranging from about 1,220 feet down to approximately 640 feet.

The Cloquet River originates at the outlet of Katherine Lake, which is roughly 70 acres in size and located in the far northeastern corner of the watershed in Lake County. As the river meanders to the southwest, it picks up water from coldwater tributaries such as Cloudy Spring Creek, Whyte Creek, and Kinny Creek. The headwaters portion of the Cloquet River still appears to have the most potential to support coldwater assemblages, such as trout; however much of it is inaccessible by road. Further downstream, additional coldwater tributaries also contribute to the Cloquet River (e.g. Sullivan Creek, Trappers Creek, and Indian Creek), however the distance between the confluences with these tributaries is more spread out, which minimizes their coldwater influence.

Still further downstream, the Cloquet River receives water from “major” tributaries including the West Branch of the Cloquet River and Little Cloquet River prior to entering Island Lake Reservoir. This Reservoir is formed by Island Lake Dam, which was built in 1915 to augment Minnesota Power generating stations further downstream. Island Lake is an approximately 8,000 acre reservoir and provides exceptional fishing and recreational opportunities. Average elevation of the reservoir is 1,370 feet above sea level.

After flowing out of Island lake Reservoir, the Cloquet River receives water from another major tributary, the Beaver River which flows into the Cloquet River from the East. Although the Beaver River is relatively small, it drains out of Fish Lake Reservoir, which was created through the construction of Fish Lake Dam, built in 1911. Much like Island Lake Reservoir it also provides exceptional recreational opportunities, such as fishing. Slightly downstream of the Beaver River/Cloquet River confluence, the Us Kab Wan Ka River flows into the Cloquet River from the north. The Us Kab Wan Ka is a coldwater reach, and still has good potential to support these assemblages, however the amount of coldwater influence the reach has on the Cloquet River is questionable.

Between the Cloquet Rivers confluence with the Us Kab Wan Ka and its outlet into the St. Louis River, several additional coldwater reaches such as Chicken Creek, Hellwig Creek, Challberg Creek, Cemetary Creek, and Beartrap Creek adjoin the river. Although most of these reaches have relatively small drainage areas, significant groundwater influence still allows them to support coldwater assemblages.

In total, there are 17 dams within the Cloquet River Watershed. Compared to other watersheds in Minnesota, the Cloquet has a relatively small percentage of streams that have been altered/channelized (Figure 8 and Figure 9). Typically, areas of the state with higher agricultural land use have more streams that have been altered/channelized. For the Cloquet River Watershed, aside from minimal channelization where streams meet roads etc., ditching is a relatively rare occurrence.

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

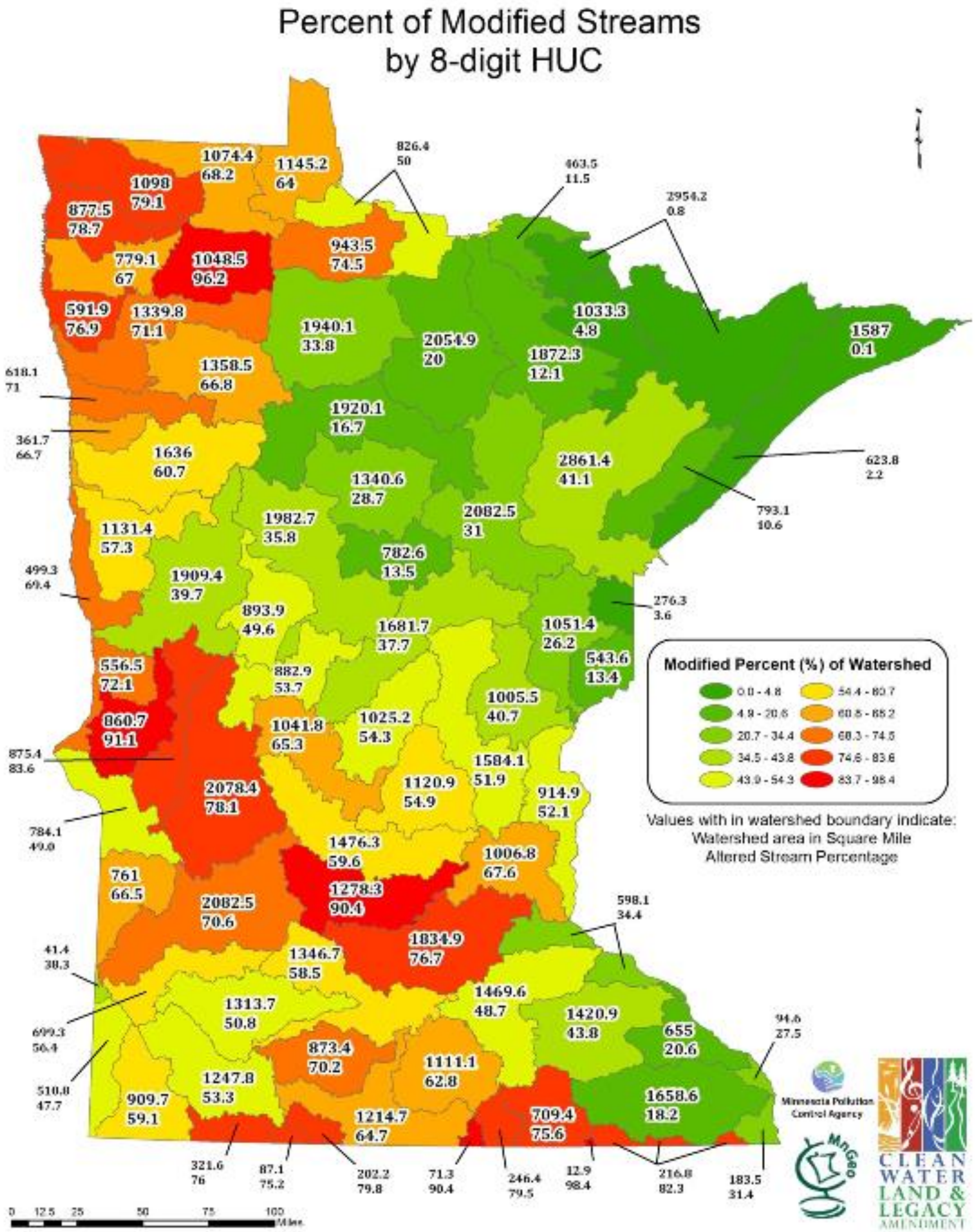
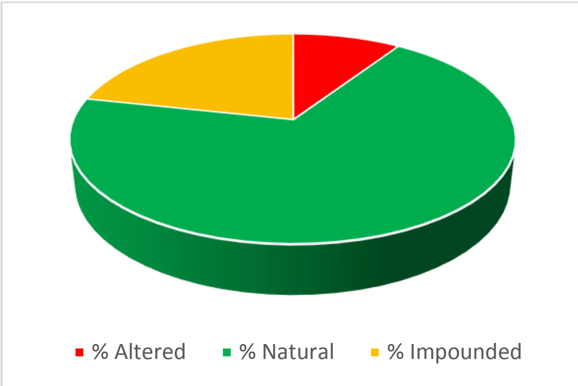


Figure 9. Comparison of natural to altered streams in the Cloquet River Watershed (percentages derived from the State-wide Altered Water Course project).

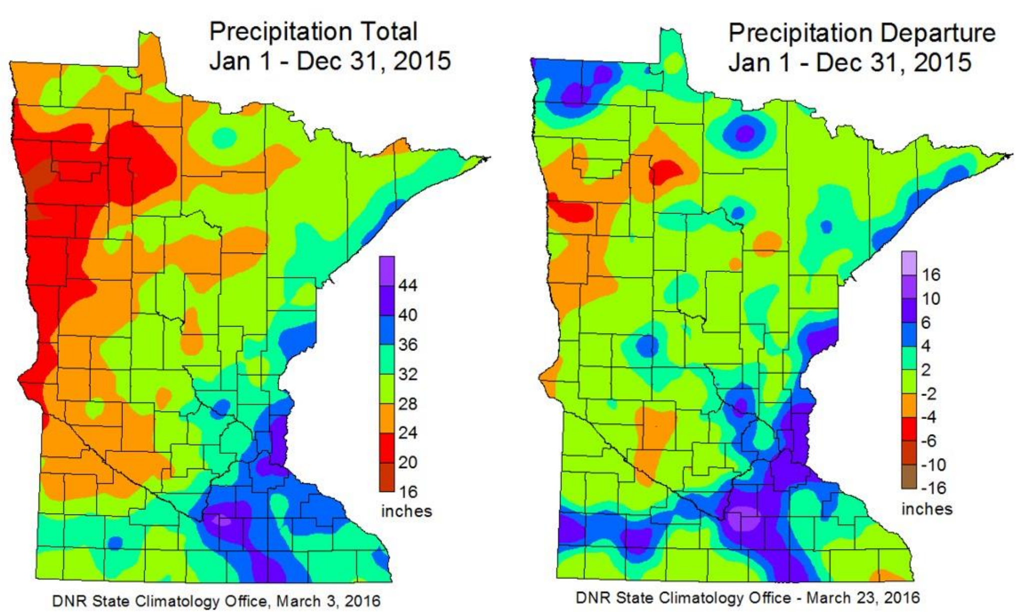


Climate and precipitation

Minnesota has a continental climate, marked by warm summers and cold winters. The mean annual temperature for Minnesota is 4.6˚C (NOAA, 2016); the mean (1981-2010) summer (June-August) temperature for the Cloquet River Watershed is 16.7˚C and the mean winter (December-February) temperature is -11.7˚ C (DNR: Minnesota State Climatology Office, 2017).

Precipitation is an important source of water input to a watershed. Figure 10 displays two representations of precipitation for calendar year 2015. On the left is total precipitation, showing the typical pattern of increasing precipitation toward the eastern portion of the state. According to this figure, the Cloquet River Watershed area received 28 to 32 inches of precipitation in 2015. The display on the right shows the amount that precipitation levels departed from normal. The watershed area experienced precipitation that ranged from two inches below normal to two inches above normal in 2015.

Figure 10. Statewide precipitation total (left) and precipitation departure (right) during 2015 (Source: DNR State Climatology Office, 2016).



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

Figure 11. Precipitation trends in Northeast Minnesota (1996-2015) with five-year running average (Source: WRCC, 2017).

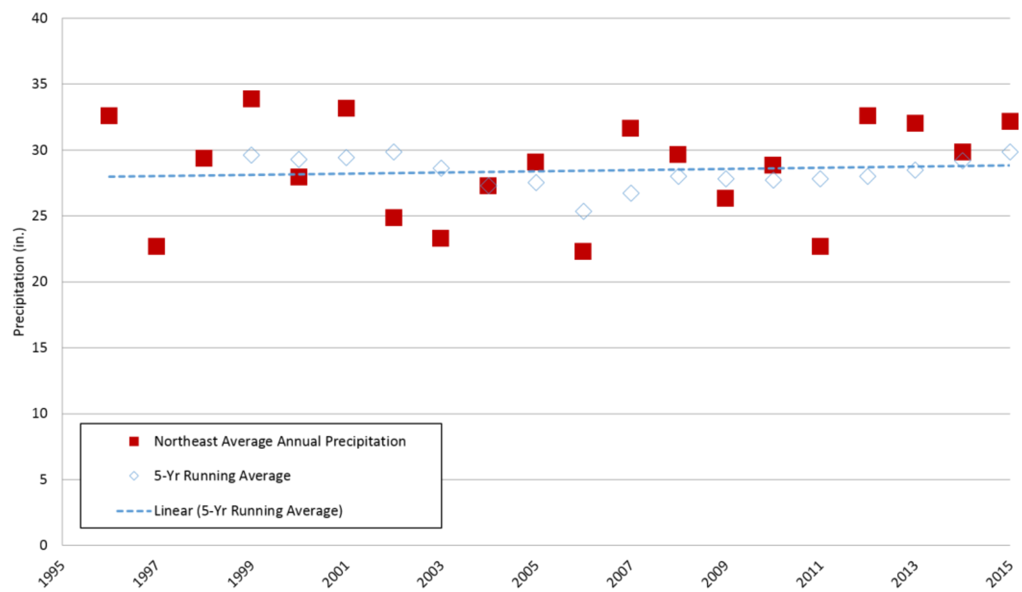
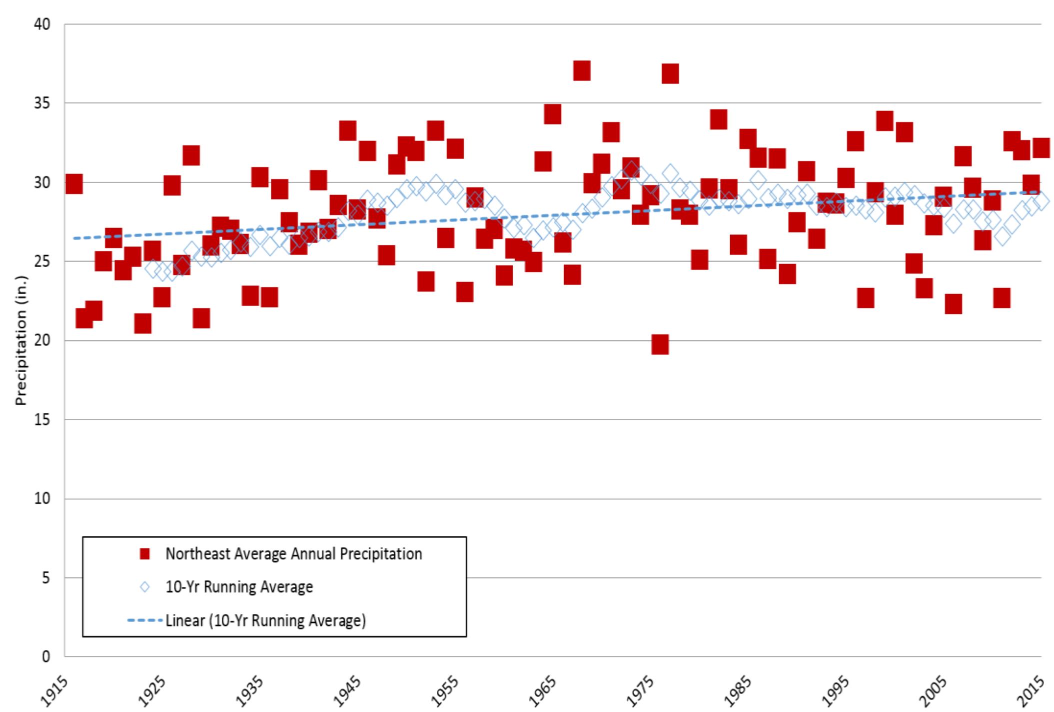


Figure 12. Precipitation trends in Northeast Minnesota (1916-2015) with ten-year running average (Source: WRCC, 2017).



Hydrogeology and groundwater quality and quantity

Hydrogeology

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

Surficial and bedrock geology

Surficial geology is identified as the earth material located below the topsoil and overlying the bedrock. Glacial sediment is at the surface in the majority of the Cloquet River Watershed and is the parent material for the soils that have developed since glaciation. The depth to bedrock ranges from exposed at the surface to nearly 280 feet and is buried by deposits of the various ice lobes that reached this watershed during the last glacial period, as well as during previous glaciations in the last 2.58 million years. The deposits at the surface are associated with three ice lobes, the Des Moines, Superior and Rainy Lobe, and post-glacial alterations to that sediment, including soil formation and peat accumulation. The geomorphology includes lake modified till, end and ground moraines (Superior-Mill Lacs-Highland, Des Moines-Culver, Rainy-St. Croix), peat and outwash (Figure 13) (Hobbs & Goebel, 1982). The glacial sediment consists of sand and gravel sediment and sandy glacial till with a predominantly sandy or gravelly texture.

Bedrock is the main mass of rocks that form the Earth, located underneath the surficial geology and can be seen in only a few places where weathering has exposed the bedrock. Precambrian bedrock lies under the extent of the Cloquet River Watershed, displaying evidence of volcanic activity. The main terrane groups include the Animiki Group, Beaver Bay Complex, Duluth Complex-Anorthositic series, Duluth Complex-Felsic series, Duluth Complex-Layered series, and North Shore Volcanic Group-lower and upper sequence (Jirsa et al., 2011). Miscellaneous intrusions (felsic and gabbroic) are also present throughout the watershed. The rock types that are found in the uppermost bedrock include anorthosite, basalt, gabbro, granite, shale, and troctolite (Figure 14) (Morey & Meints, 2000).

Figure 13. Quarternary geology within the Cloquet River Watershed (GIS Source: Hobbs & Goebel, 1982; Morey & Meints, 2000).

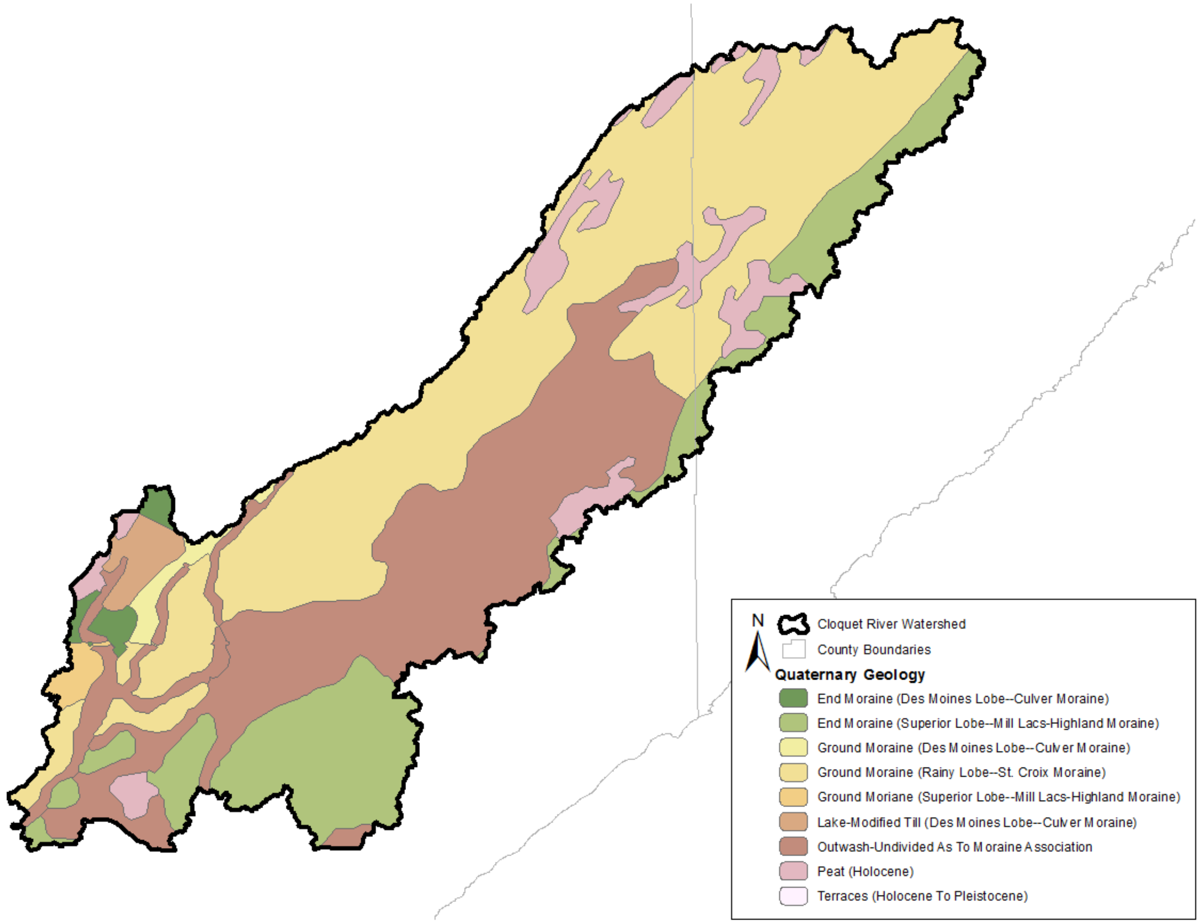
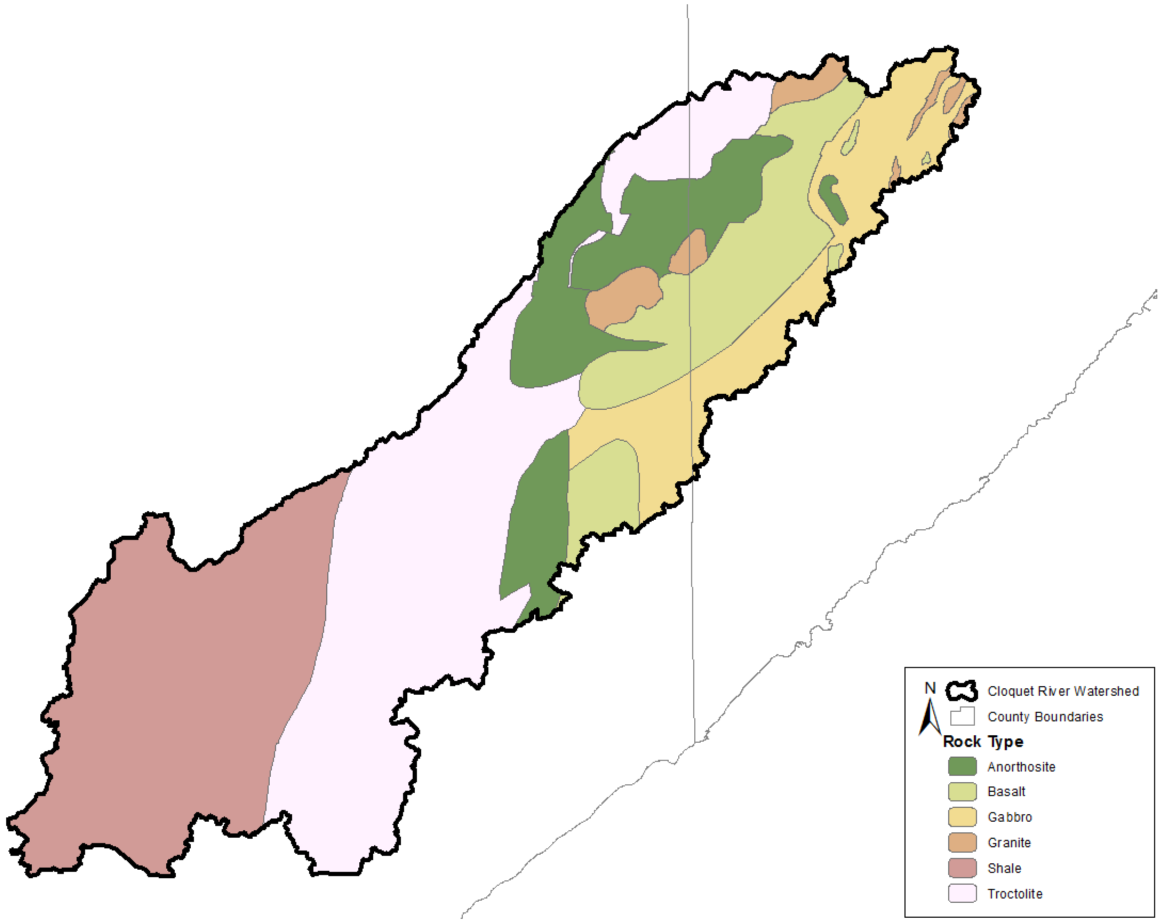


Figure 14. Bedrock geology rock types within the Cloquet River Watershed (GIS Source: Hobbs & Goebel, 1982; Morey & Meints, 2000).



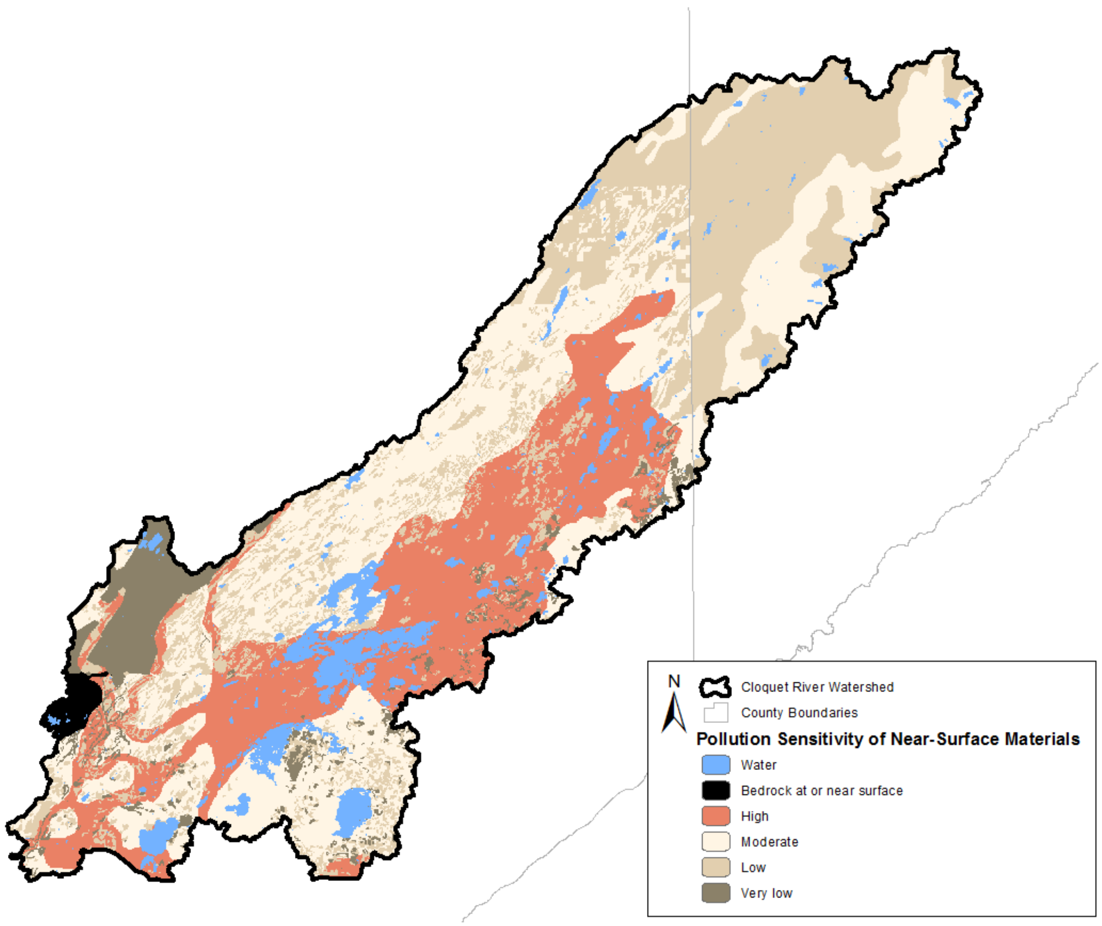
Aquifers

Groundwater aquifers are layers of water-bearing units that readily transmit water to wells and springs (USGS, 2016). As precipitation hits the surface, it infiltrates through the soil zone and into the void spaces within the geologic materials underneath the surface, saturating the material and becoming groundwater (Zhang, 1998). The water table is the uppermost portion of the saturated zone, where the pore-water pressure is equal to local atmospheric pressure. The geologic material determines the permeability and availability of water within the aquifer. Minnesota's groundwater system is comprised of three types of aquifers: 1) igneous and metamorphic bedrock aquifers, 2) sedimentary rock aquifers, and 3) glacial sand and gravel aquifers (MPCA, 2005). The Cloquet River Watershed has fractured igneous and metamorphic bedrock aquifers with thin or absent unconsolidated sediments (DNR, 2017a). The general availability of groundwater for this watershed is very limited due to the hard fractured bedrock and what is withdrawn is predominately taken from the Precambrian Duluth Complex aquifer.

Groundwater pollution sensitivity

Since bedrock aquifers are typically covered with thick till, they would normally be better protected from contaminant releases at the land surface. It is also less likely that withdrawals from these wells would have a direct and significant impact on local surface water bodies. In contrast, surficial aquifers are typically more likely to 1) be vulnerable to contamination, 2) have direct hydrologic connections to local surface water, and 3) influence the quality and quantity of local surface water. The DNR is working on a hydrogeological atlas focused on the pollution sensitivity of the bedrock surface. It is being produced county-by-county, and awaiting completion for those counties within the Cloquet River Watershed. Until the hydrogeological atlas is finished, a 2016 statewide evaluation of pollution sensitivity of near-surface materials completed by the DNR is utilized to estimate pollution vulnerability up to ten feet from the land surface. This display is not intended to be used on a local scale, but as a coarse-scale planning tool. According to this data, the Cloquet River Watershed is estimated to have primarily low and moderate with some high pollution sensitivity areas concentrated in the south and central areas of the watershed, which are also associated with the presence of sand and gravel Quaternary geology (Figure 15) (DNR, 2016).

Figure 15. Pollution Sensitivity of Near-Surface Materials for the Cloquet River Watershed (GIS Source: DNR, 2016).



Groundwater potential recharge

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

Recharge of these aquifers is important and limited to areas located at topographic highs, those with surficial sand and gravel deposits, and those along the bedrock-surficial deposit interface (Figure 16).

Typically, recharge rates in unconfined aquifers are estimated at 20 to 25% of precipitation received, but can be less than 10% of precipitation where glacial clays or till are present (USGS, 2007). For the Cloquet River Watershed, the average annual potential recharge rate to surficial materials ranges from 2.5 to 14.1 inches per year, with an average of 8.2 inches per year (Figure 17). The statewide average potential recharge is estimated to be four inches per year with 85% of all recharge ranging from three to eight inches per year. When compared to the statewide average potential recharge, the Cloquet River Watershed receives approximately twice the average potential recharge.

Figure 16. Average annual potential recharge rate to surficial materials in Cloquet River Watershed (1996-2010) (GIS Source: USGS, 2015).

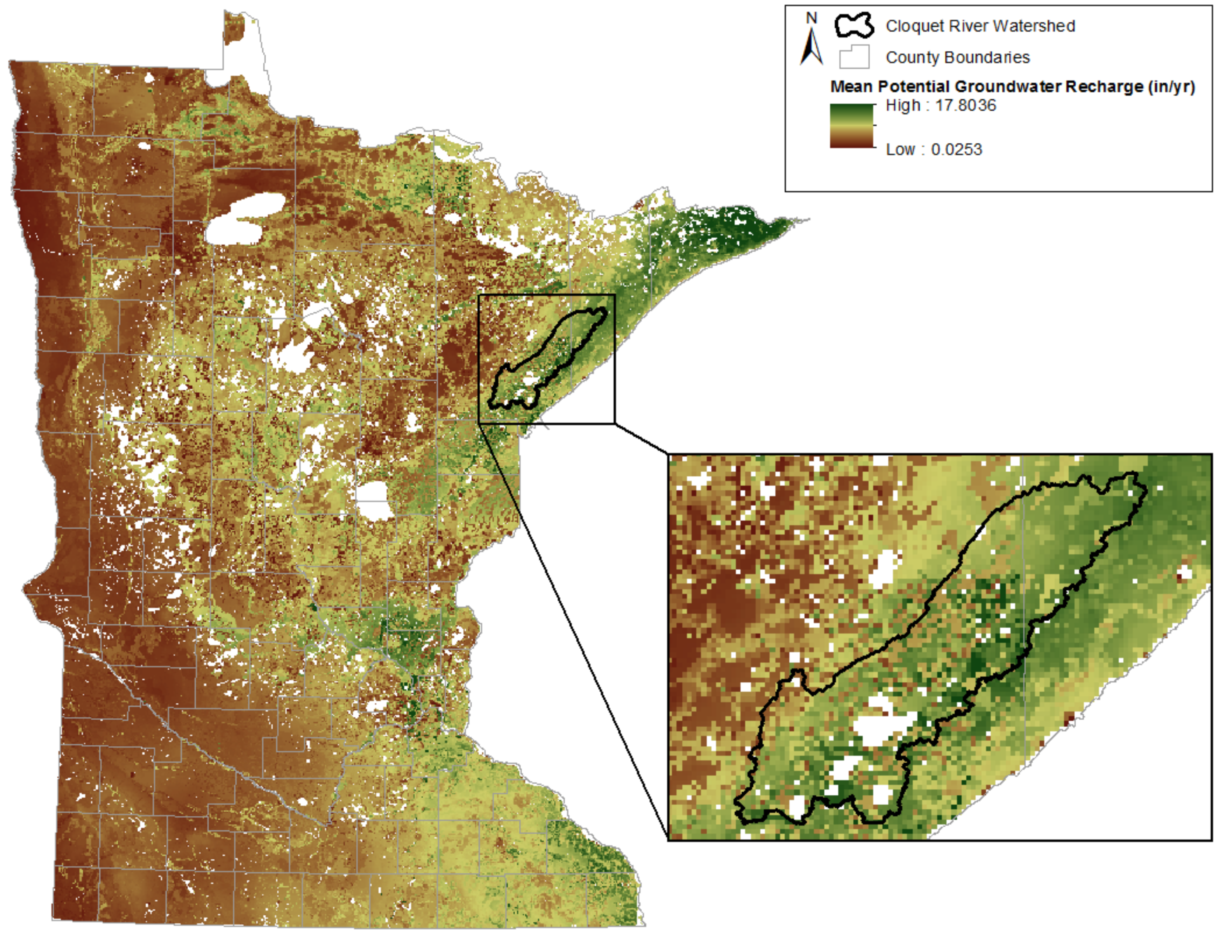
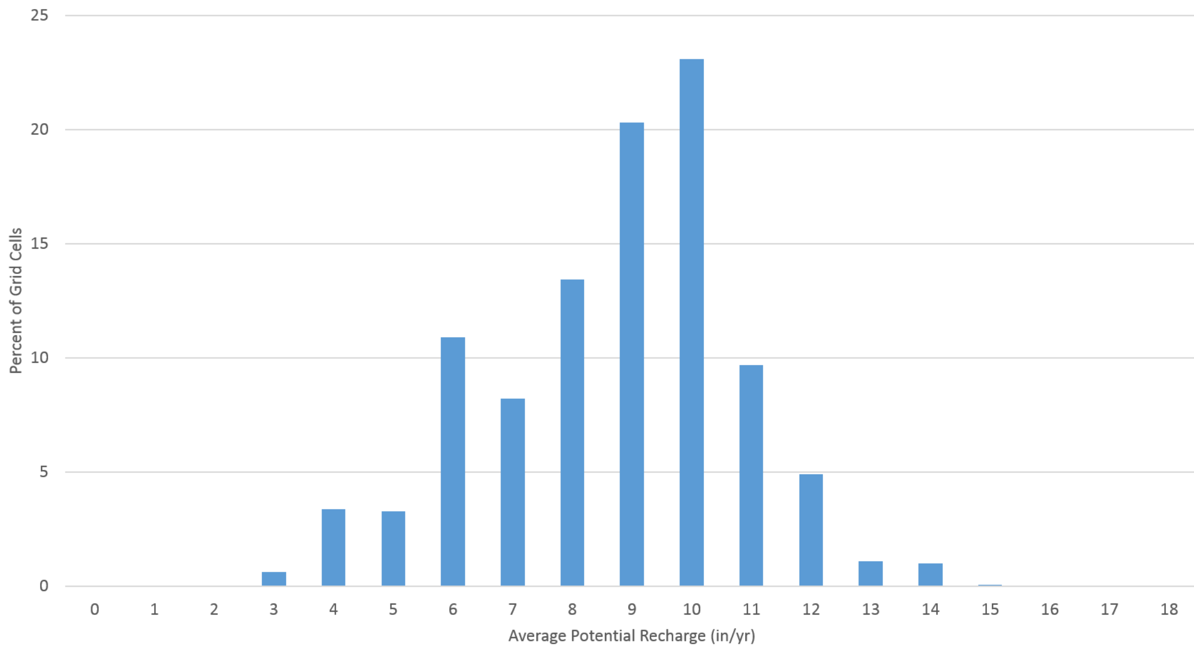


Figure 17. Average annual potential recharge rate percent of grid cells in the Cloquet River Watershed (1996-2010).

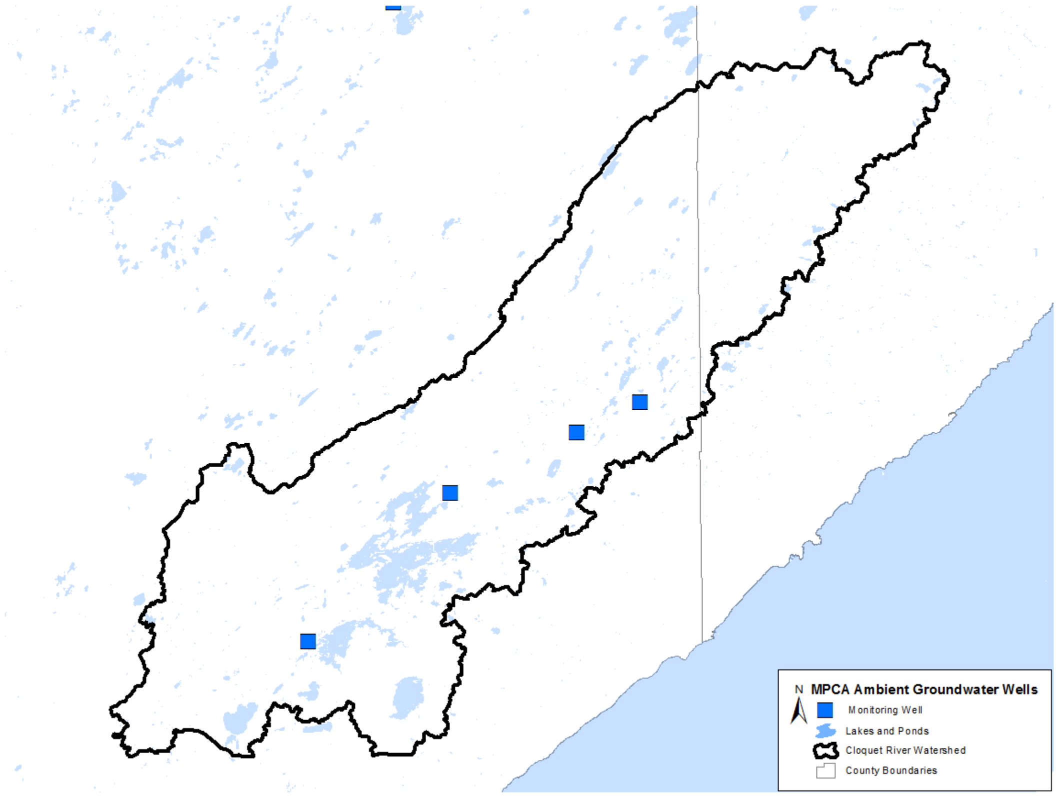


Groundwater quality

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

There are currently four MPCA ambient groundwater monitoring wells within the Cloquet River Watershed (Figure 18). Data collection for the groundwater monitoring network ranges from 2004 to 2016; however, the wells within this watershed were added in 2014 and 2015. Therefore, due to the limited amount of data available, data analysis was not conducted on the current MPCA ambient groundwater wells within the Cloquet River Watershed.

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

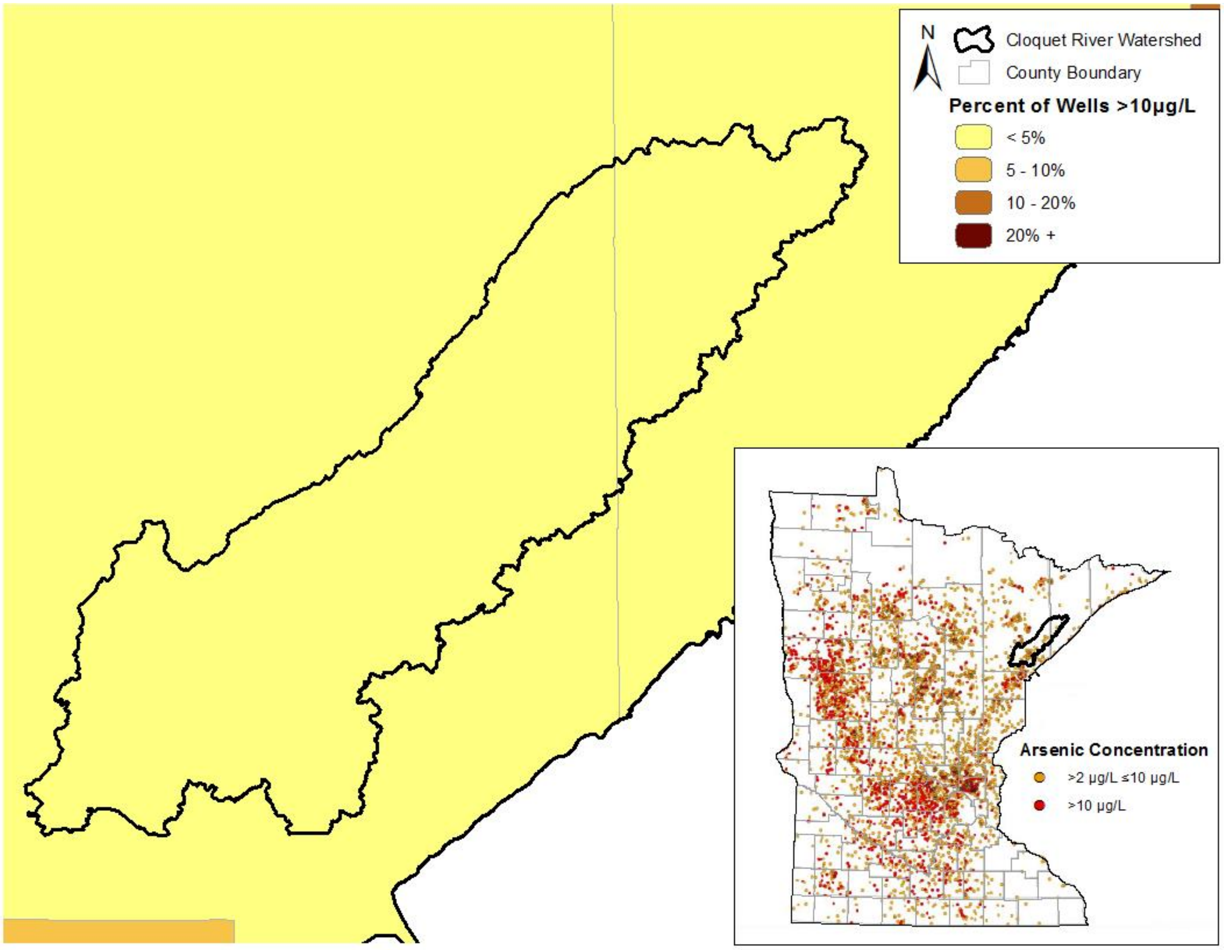


Regional groundwater quality

From 1992 to 1996, the MPCA conducted baseline water quality sampling and analysis of Minnesota's principal aquifers. The Cloquet River Watershed lies entirely within the Northeast Region, which determined that the groundwater quality in this region is considered good when compared to other areas with similar aquifers, but with exceedances of drinking water criteria in arsenic, beryllium, boron, manganese and selenium (MPCA, 1999). Concentrations of chemicals within the precambrian aquifers were comparable to similar aquifers throughout the state and concentrations of major cations and anions were lower in the surficial and buried drift aquifers when compared to similar aquifers statewide (MPCA, 1999). Many of the exceedances identified were contributed to geology, but some trace inorganic chemicals may be of concern locally. Volatile organic compounds were also detected in this region, with the most commonly detected compounds associated with well disinfection, atmospheric deposition and fuel oils (MPCA, 1999).

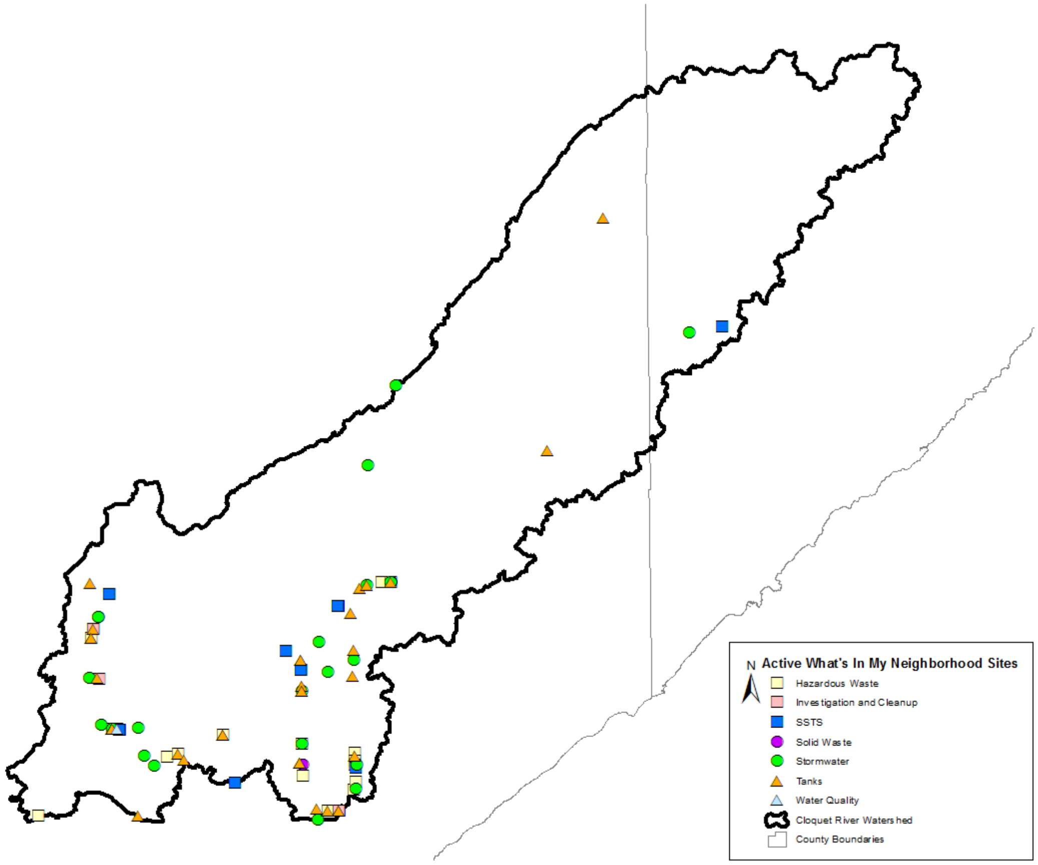
Another source of information on groundwater quality comes from the Minnesota Department of Health (MDH). Mandatory testing for arsenic, a naturally occurring but potentially harmful contaminant for humans, of all newly constructed wells has found that 10.7% of all wells installed from 2008 to 2015 have arsenic levels above the maximum contaminant level (MCL) for drinking water of 10 micrograms per liter (ug/L) (MDH, 2016a). In the Cloquet River Watershed, the majority of new wells are within the water quality standards for arsenic levels, but there are exceedances to the MCL. When observing concentrations of arsenic by percentage of wells that exceed the MCL per county, the watershed lies within counties with less than 5% exceedances. By county, the percentages of wells identified with concentrations exceeding the MCL are 3.7% for both St. Louis (81/2,161 wells tested) and Lake (11/299 wells tested) counties (Figure 19). It is important to reiterate that the percentages of arsenic concentration exceedances are per county, not specifically for Cloquet River Watershed. For more information on arsenic in private wells, please refer to the MDH's website: https://apps.health.state.mn.us/mndata/arsenic_wells.

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



A statewide dataset of potentially contaminated sites and facilities with environmental permits and registrations is available at the MPCA's website, through a web-based application called, "What's In My Neighborhood" (WIMN). This MPCA resource provides the public with a method to access a wide variety of environmental information about communities across the state. The data is divided into two groups. The first is potentially contaminated sites, and includes contaminated properties, formerly contaminated sites, and those that are being investigated for suspicion of being contaminated. The second category is made up of businesses that have applied for and received different types of environmental permits and registrations from the MPCA. An example of an environmental permit would be for a business acquiring a permit for a storm water or wastewater discharge, requiring it to operate within limits established by the MPCA. In the Cloquet River Watershed, there are currently 146 active sites identified by WIMN: 52 subsurface sewage treatment systems (SSTS), 34 tanks (aboveground and underground), 28 stormwater (construction and industrial), 19 hazardous waste sites, 10 investigation and cleanup sites (remediation and superfund), 2 solid waste sites, and 1 water quality (wastewater) site (Figure 20). For more information regarding "What's in My Neighborhood", refer to the MPCA webpage at http://www.pca.state.mn.us/index.php/data/wimn-whats-in-my-neighborhood/whats-in-my-neighborhood.html.

Figure 20. Active "What's In My Neighborhood" site programs and locations for the Cloquet River Watershed (Source: MPCA, 2017).



Groundwater quantity

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

The three largest permitted consumers of water in the state for 2015 are (in order) power generation, public water supply (municipals), and irrigation (DNR, 2017b). According to the most recent DNR Permitting and Reporting System, in 2015 the withdrawals within the Cloquet River Watershed are primarily utilized for industrial processing (47.4%) for sand and gravel washing. The remaining withdrawals include water level processing (47.1%) for construction dewatering and water supply (5.5%).

Figure 21 displays total high capacity withdrawal locations within the watershed with active permit status in 2015. During 1996 to 2015, groundwater withdrawals within the Cloquet River Watershed exhibit a significant increasing withdrawal trend ($p<0.01$) (Figure 22), while surface water withdrawals also have increased ($p<0.1$) (Figure 23). Surface water withdrawals have been stable with an average of 27.9 million gallons withdrawn from the watershed; until 2015 when water level processing was permitted, which almost doubled the amount of water withdrawn from surface waterbodies.

Figure 21. Locations of active status permitted high capacity withdrawals in 2015 within the Cloquet River Watershed.

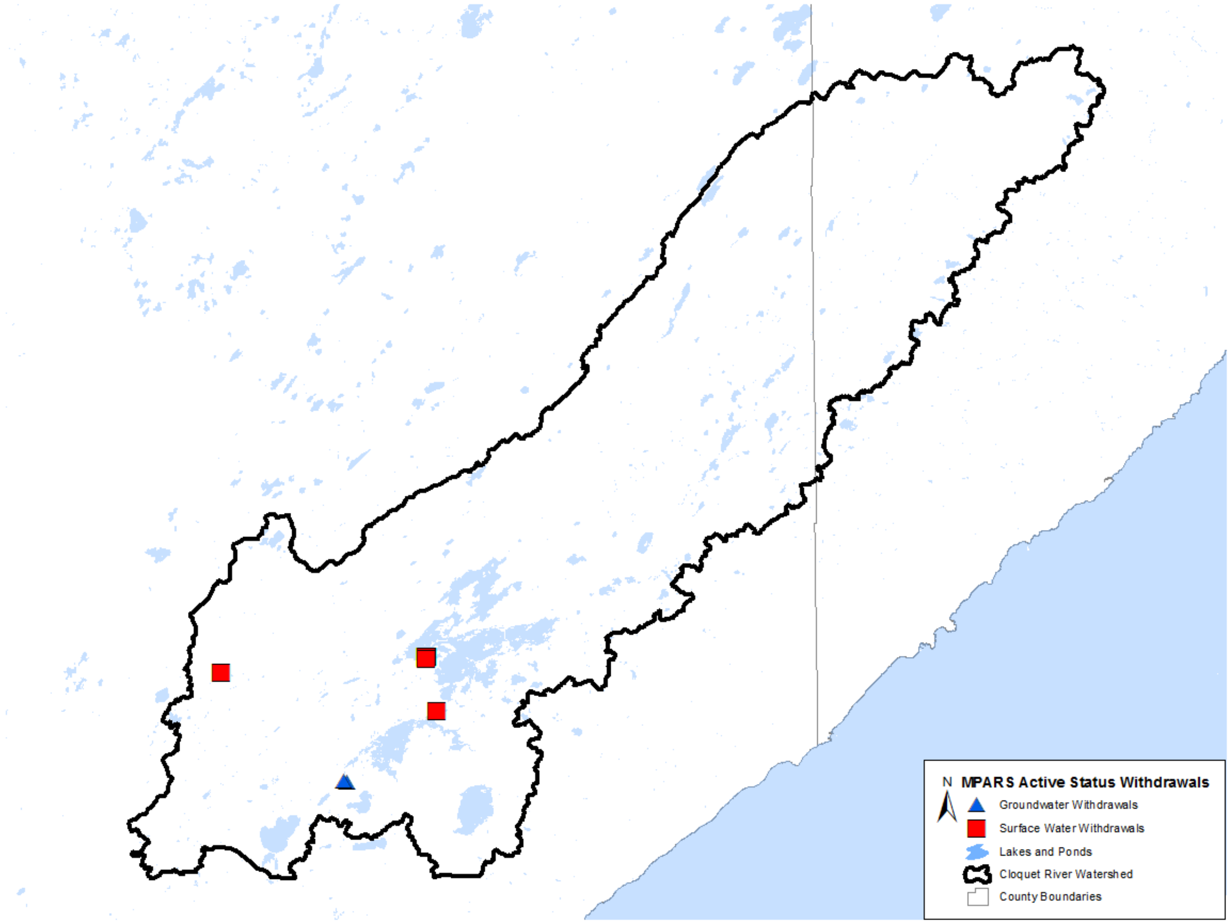


Figure 22. Total annual groundwater withdrawals in the Cloquet River Watershed (1996-2015).

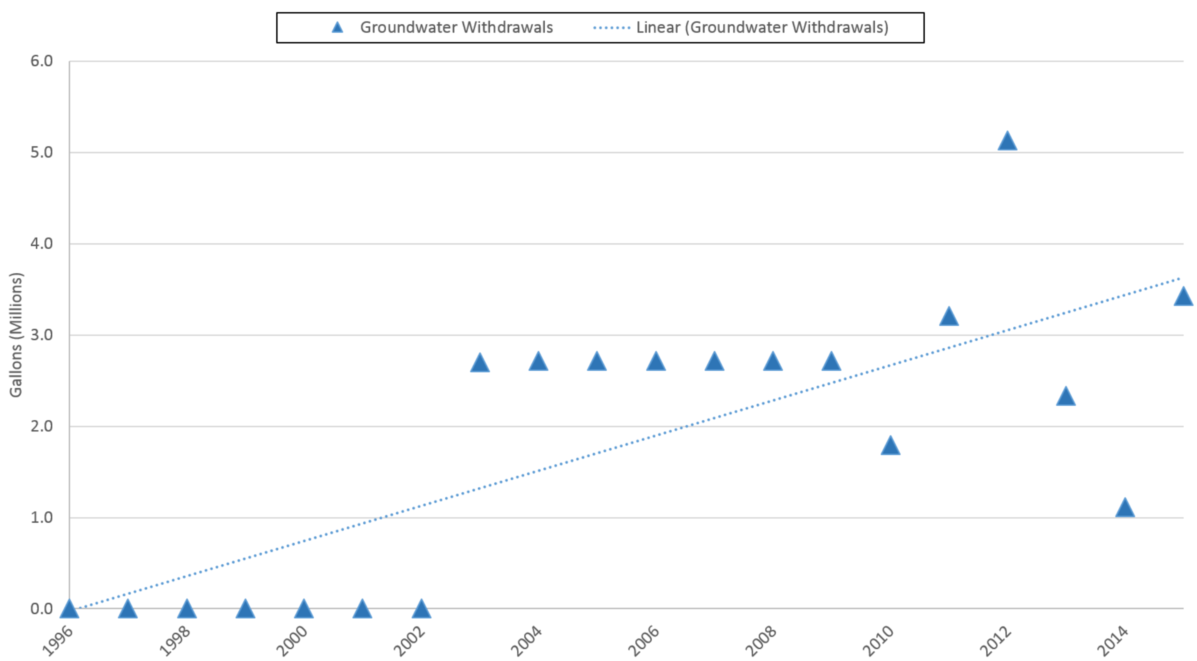
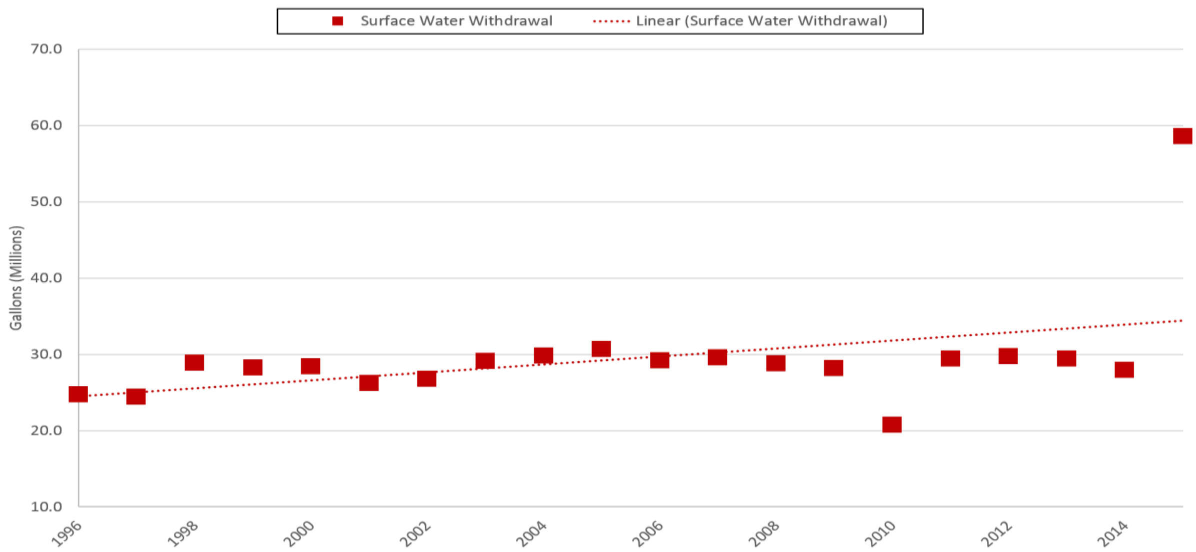


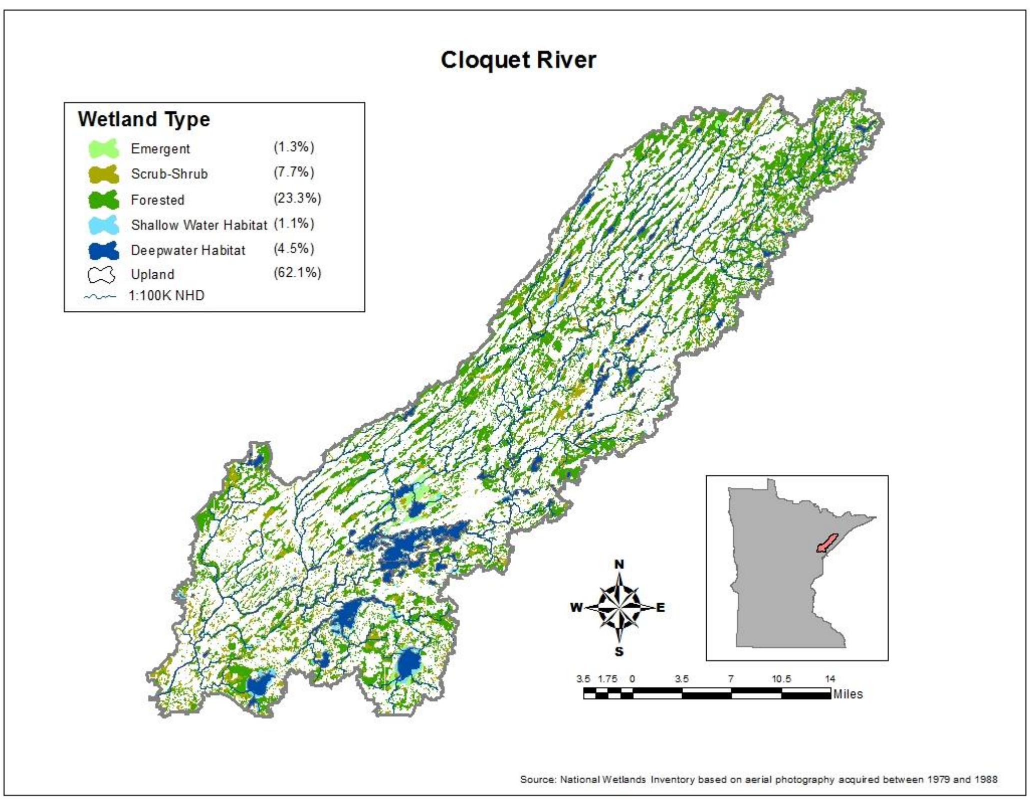
Figure 23. Total annual surface water withdrawals in the Cloquet River Watershed (1996- 2015).



Wetlands

Wetlands are common in the Cloquet River Watershed. National Wetlands Inventory (NWI) data estimate 169,619 acres of wetlands—which covers approximately 33% of the watershed (Figure 24). This area is above the statewide wetland coverage rate of 19% (Kloiber and Norris 2013). Forested wetlands are the predominant type and include: coniferous swamps and bogs (dominated by black spruce, tamarack, and/or white cedar) and hardwood (black ash) swamps.

Figure 24. Wetlands and surface water in the Cloquet River Watershed. Watershed coverage by general wetland type is provided in the legend.



Ground moraine and glacial outwash plains and channels are the predominant glacial landforms in the watershed (MGS 1997). These landforms have gentle to rolling topography and promote the formation of moderate to large sized wetlands that are often complex and interconnected over long distances in the topographical low areas. The Toimi drumlins (streamlined hills aligned in parallel to ice flow) that occur over approximately the northwestern half of the watershed is a noteworthy example of this, where narrow and extensive wetland complexes have formed in the glacial swales. Due to the relatively cool-wet climate of the region, the majority of these wetlands are peat forming swamps and bogs—where organic soils have developed due to saturated conditions. As peat has low hydrologic conductivity, excess precipitation can slowly runoff the wetlands via saturation-overland flow (Acerman and Holden, 2013). These peat-forming wetlands serve as the source waters and/or significantly contribute water for the vast majority of the streams in the watershed. Saturation-overland flow waters from wetlands typically are high in dissolved organic material (e.g., staining), low in dissolved oxygen, and may have low pH. In addition, beaver activity is high in the watershed and numerous beaver ponds and meadows (grass and sedge dominated wetlands that form when dams fail and ponds partially drain) occur along small streams throughout the watershed. Wetland drainage is minimal in the watershed, as development pressure is low. Finally, wild rice has been documented in many of the lakes and ponds throughout the northeastern portion of the watershed and in several lakes near the southern boundary.

Watershed-wide data collection methodology

Lake water sampling

MPCA sampled the larger lakes and reservoirs in the Cloquet River Watershed in 2015 and 2016 for the purpose of enhancing the dataset for assessment of aquatic recreation. These waters included Boulder, Wild Rice, Island, and Fish Lake Reservoirs, and the large natural lakes Caribou and Grand.

Local partners with the North St. Louis SWCD and the University of Minnesota's Natural Resources Research Institute (NRRI) monitored 14 other smaller lakes in the watershed, through grant agreements with the MPCA. These lakes included several in more remote portions of the headwaters such as Cloquet, Thomas, and Indian.

There are currently 20 volunteers enrolled in the CLMP that are conducting lake monitoring within the watershed.

Sampling methods are similar among monitoring groups and are described in the document entitled "*MPCA Standard Operating Procedure for Lake Water Quality*" found at http://www.pca.state.mn.us/publications/wq-s1-16.pdf. The lake recreation use assessment requires eight observations/samples within a 10-year period (June to September) for phosphorus, chlorophyll-a and Secchi depth.

No lakes were monitored for fish community health in the Cloquet River Watershed. The DNR is in the process of developing biological health metrics for Canadian Shield lakes within the Lake Superior and Rainy River drainage basins.

Stream water sampling

Six water chemistry stations were sampled from May through September in 2015, and again June through August of 2016 to provide sufficient water chemistry data to assess all components of the aquatic life and recreation use standards. Water chemistry stations were placed at the outlet of each aggregated 12 HUC subwatershed that was greater than 40 square miles in area (pink circles and green triangle in (Figure 2). A SWAG was awarded to the University of Minnesota's NRRI to conduct this monitoring. (See Appendix 2.1 for locations of stream water chemistry monitoring sites. See Appendix 1 for definitions of stream chemistry analytes monitored in this study).

Three streams in the watershed were monitored by volunteers, through the CSMP, including Beaver and Cloquet Rivers.

Stream flow methodology

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

Stream biological sampling

The biological monitoring component of the intensive watershed monitoring in the Cloquet River Watershed was completed during the summer of 2015. A total of 24 sites were newly established across the watershed and sampled. These sites were located near the outlets of most minor HUC-14 watersheds. In addition, 10 existing biological monitoring stations within the watershed were revisited. These monitoring stations were initially established as part of a Lake Superior Basin wide survey in 1997. While data from the last 10 years contributed to the watershed assessments, the majority of data utilized for the 2017 assessment was collected in 2015. A total of 28 WIDs were sampled for biology in the Cloquet River Watershed. Waterbody assessments to determine aquatic life use support were conducted for 28 WIDs. Biological information that was not used in the assessment process will be crucial to the stressor identification process and will also be used as a basis for long term trend results in subsequent reporting cycles.

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

Fish contaminants

DNR fisheries staff collect most of the fish for the Fish Contaminant Monitoring Program. In addition, MPCA's biomonitoring staff collect up to five piscivorous (top predator) fish and five forage fish near the HUC-8 pour point, as part of the Intensive Watershed Monitoring. All fish collected by the MPCA are analyzed for mercury and the two largest individual fish of each species are analyzed for PCBs.

Captured fish were wrapped in aluminum foil and frozen until they were thawed, scaled (or skinned), filleted, and ground to a homogenized tissue sample. Homogenized fillets were placed in 60 mL glass jars with Teflon™ lids and frozen until thawed for lab analysis. The Minnesota Department of Agriculture

Laboratory analyzed the samples for mercury and PCBs. If fish were tested for perfluorochemicals (PFCs), whole fish were shipped to AXYS Analytical Laboratory, which analyzed the homogenized fish fillets for 13 PFCs. Of the measured PFCs, only perfluorooctane sulfonate (PFOS) is reported because it bioaccumulates in fish to levels that are potentially toxic and a reference dose has been developed.

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

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

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

Pollutant load monitoring

Intensive water quality sampling occurs at all WPLMN sites. Thirty-five samples per year are allocated for basin and major watershed sites and 25 samples per season (ice out through October 31) for subwatershed sites. Because concentrations typically rise with streamflow for many of the monitored pollutants, and because of the added influence elevated flows have on pollutant load estimates, sampling frequency is greatest during periods of moderate to high flow. All major snowmelt and rainfall events are sampled. Low flow periods are also sampled although sampling frequency is reduced as pollutant concentrations are generally more stable when compared to periods of elevated flow.

Water sample results and daily average flow data are coupled in the $FLUX_{32}$ pollutant load model to estimate the transport (load) of nutrients and other water quality constituents past a sampling station over a given period of time. Loads and flow weighted mean concentrations (FWMCs) are calculated for total suspended solids (TSS), total phosphorus (TP), dissolved orthophosphate (DOP), nitrate plus nitrite nitrogen (NO_3+NO_2-N), and total Kjeldahl nitrogen (TKN).

More information can be found at the WPLMN website.

Groundwater monitoring

The MPCA maintains an Ambient Groundwater Monitoring Network that monitors the aquifers that are most likely to be polluted with non-agricultural chemicals. This network primarily targets the shallow aquifers that underlie the urban parts of the state, due to the higher tendency of vulnerability to pollution. The MPCA's Ambient Groundwater Monitoring Network as of 2018, when this report was produced, consisted of approximately 270 wells that are primarily located in the sand and gravel and Prairie du Chien- Jordan aquifers in southern Minnesota.

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

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

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

Wetland monitoring

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

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

As few open water depressional wetlands exist in the watershed the focus will be on vegetation quality results of all wetland types.

Individual aggregated 12-HUC subwatershed results

Aggregated 12-HUC subwatersheds

Assessment results for aquatic life and recreation use are presented for each Aggregated HUC-12 subwatershed within the Cloquet River Watershed. The primary objective is to portray all the full support and impairment listings within an aggregated 12-HUC subwatershed resulting from the complex and multi-step assessment and listing process. This scale provides a robust assessment of water quality condition at a practical size for the development, management, and implementation of effective TMDLs and protection strategies. The graphics presented for each of the aggregated HUC-12 subwatersheds contain the assessment results from the 2017 assessment cycle as well as any impairment listings from previous assessment cycles. Discussion of assessment results focuses primarily on the 2015 intensive watershed monitoring effort, but also considers available data from the last ten years.

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

Stream assessments

A table is provided in each section summarizing aquatic life and aquatic recreation assessments of all assessable stream reaches within the aggregated HUC-12 subwatershed (i.e., where sufficient information was available to make an assessment). Primarily, these tables reflect the results of the 2017 assessment process (2018 EPA reporting cycle); however, impairments from previous assessment cycles are also included and are distinguished from new impairments via cell shading (see footnote section of each table). These tables also denote the results of comparing each individual aquatic life and aquatic recreation indicator to their respective criteria (i.e., standards); determinations made during the desktop phase of the assessment process (Figure 4). Assessment of aquatic life is derived from the analysis of biological (fish and invert IBIs), dissolved oxygen, total suspended solids, chloride, pH, total phosphorus, chlorophyll-a, biochemical oxygen demand and un-ionized ammonia (NH3) data, while the assessment of aquatic recreation in streams is based solely on bacteria (Escherichia coli) data. Included in each table is the specific aquatic life use classification for each stream reach: cold water community (2A); cool or warm water community (2B); or indigenous aquatic community (2C). Where applicable and sufficient data exists, assessments of other designated uses (e.g., Class 7, drinking water, aquatic consumption) are discussed in the summary section of each aggregated HUC-12 subwatershed as well as in the Watershed-wide results and discussion section.

Lake assessments

A summary of lake water quality is provided in the Aggregated HUC-12 subwatershed sections where available data exists. This includes aquatic recreation (phosphorus, chlorophyll-a, and Secchi) and aquatic life, where available (chloride). Similar to streams, parameter level and over all use decisions are included in the table.

Upper Cloquet Aggregated 12-HUC — HUC 0401020201-01

The Upper Cloquet Subwatershed is located in the far Northeastern corner of the Cloquet Watershed. It includes portions of Lake and St. Louis Counties and drains approximately 183 square miles of land. The small towns of Brimson and Rollins also exist within its drainage. This headwater watershed includes the upper most portion of the Cloquet River that originates from the outlet of Katherine Lake. The subwatershed also includes several tributaries of the Cloquet River, many of which are coldwater streams such as Cloudy Spring Creek, Whyte Creek, Kinney Creek, Sullivan Creek, Trappers Creek, Indian Creek, and Murphy Creek. This subwatershed has the most coldwater influence. The two largest tributaries within the subwatershed, Langley River and Pine Creek, both flow into the Cloquet from the east. Development and accessibility to streams within this subwatershed is limited making it one of the most pristine areas remaining in the Cloquet Watershed. For those seeking wild areas, this portion of the Cloquet system in particular provides that opportunity.

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

				Aquatic life indicators:											
AUID ***Reach name, Reach description***	**Biological station ID**	**Reach length (miles)**	**Use class**	**Fish IBI**	**Invert IBI**	**Dissolved oxygen**	**TSS**	**Secchi Tube**	**Chloride**	**pH**	**Ammonia -NH_3**	**Pesticides *****	**Eutrophication**	**Aquatic life**	**Aquatic rec. (Bacteria)**
04010202-669 Cloquet River Headwaters (Katherine Lk 38-0538-00) to T57 R10W S32 (South Line)	15LS006	13.95	CWe	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA
04010202-670 Cloquet River T57 R10W S32 (South Line) to Cloquet River, West Branch 04010202-634	14LS007,97LS016,15LS011,15LS005	26.44	WWe	MTS	MTS	IF	MTS	MTS	-	MTS	MTS	-	MTS	SUP	SUP
04010202-558 Murphy Creek Headwaters (Driller Lk 38-0652-00) to Murphy Lk	92LS049	13.08	CWg	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA

AUID *Reach name,* *Reach description*	Biological station ID	Reach length (miles)	Use class	Aquatic life indicators: Fish IBI	Invert IBI	Dissolved oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	Aquatic life	Aquatic rec. (Bacteria)
04010202-660 **Little Langley River** **Unnamed cr to Langley R**	15LS008	1.66	WWg	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA
04010202-659 **Langley River** **Little Langley R to Cloquet R**	15EM089	2.49	WWg	-	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA
04010202-548 **Indian Creek** **Salo Lk to Indian Lk (69-0023-00)**	15LS010	5.52	CWg	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA
04010202-663 **Pine Creek** **Headwaters to Unnamed Cr**	15LS032	2.19	WWg	-	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA
04010202-657 **Pine Creek** **Unnamed cr to Unnamed cr**	15LS012, 10EM029	4.58	CWg	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA
04010202-575 **Pine Creek** **Unnamed cr (Stone Lk outlet) to Cloquet R**	15LS013	2.27	WWg	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2016 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐ = insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 3. Lake assessments: Upper Cloquet Aggregated 12-HUC.

Lake name	DNR ID	Area (acres)	Max depth (ft)	Assessment method	Ecoregion	Secchi trend	Aquatic life indicators:			Aquatic recreation indicators:			Aquatic life use	Aquatic recreation use
							Fish IBI	Chloride	Pesticides ***	Total phosphorus	Chlorophyll-a	Secchi		
Katherine	38-0538-00	67	6	Shallow Lake	NLF		NA	NA	NA	IF	IF		NA	IF
Cloquet	38-0539-00	182	7	Shallow Lake	NLF	--	NA	NA	NA	MTS	MTS	IF	NA	FS
Sink	38-0540-00	16	20	Deep Lake	NLF		NA	NA	NA				NA	
Marble	38-0650-00	157	18	Deep Lake	NLF	--	NA	NA	NA			IF	NA	IF
Kane	38-0651-00	109	17	Deep Lake	NLF	I	NA	NA	NA	MTS	MTS	MTS	NA	FS
Thomas	38-0751-00	145	20	Deep Lake	NLF	--	NA	NA	NA	MTS	MTS	IF	NA	FS
Sullivan	38-0755-00	51	8.5	Shallow Lake	NLF	--	NA	NA	NA	MTS	MTS	IF	NA	FS
Indian	69-0023-00	53	19	Deep Lake	NLF	--	NA	NA	NA	IF	EX	IF	NA	IF
Little Stone	69-0028-00	185	17	Deep Lake	NLF	--	NA	NA	NA	MTS	MTS	MTS	NA	FS
Salo	69-0036-00	134	20	Deep Lake	NLF	--	NA	NA	NA	MTS	IF	IF	NA	FS

Abbreviations for Ecoregion: **DA** = Driftless Area, **NCHF** = North Central Hardwood Forest, **NGP** = Northern Glaciated Plains, **NLF** = Northern Lakes and Forests, **NMW** = Northern Minnesota Wetlands, **RRV** = Red River Valley, **WCBP** = Western Corn Belt Plains
Abbreviations for Secchi Trend: **D** = decreasing/declining trend, **I** = increasing/improving trend, **NT** = no detectable trend, -- = not enough data
Abbreviations for Indicator Evaluations: **--** = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: = existing impairment, listed prior to 2016 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

The Upper Cloquet River Subwatershed is dominated by forest and wetlands. Of the subwatersheds in the Cloquet River Watershed, the Upper Cloquet is the least disturbed. Notable streams include the main-stem of the Cloquet River, Murphy Creek, Langley River, Little Langley River, Indian Creek, and Pine Creek. Two reaches on the main-stem Cloquet River as well as seven tributary reaches were assessed for aquatic life. Aquatic communities and the habitat throughout the watershed were in very good condition.

Both reaches of the Cloquet River were designated as exceptional based on the fish and macroinvertebrate communities. The uppermost reach on the Cloquet (04010202-669) contained Brook Trout and a diverse coldwater macroinvertebrate community. Based on the biology and the cold water temperatures, this reach and a portion of Pine Creek (04010202-657) were re-classified from warmwater to coldwater. Other streams in the subwatershed were in excellent condition but they were not officially designated as exceptional because only one assemblage met the threshold for exceptional streams. Langley River and Pine Creek had exceptional macroinvertebrate communities and the Little Langley River had an exceptional fish community with the macroinvertebrates also indicating near exceptional condition. This subwatershed is truly unique in that compared to others it is virtually free of human impact. Streams in this subwatershed should be protected to preserve their high quality.

The water chemistry monitoring site was located at North Loop Road, about one mile west of the community of Rollins. Most of the landscape above this location is remote public forest, wetlands, and lakes. As such, water quality at this location was excellent. Nutrient concentrations were consistently low. Other conventional parameters, such as oxygen and total suspended solids, were clearly meeting water quality standards. For example, all 66 dissolved oxygen observations were above the 5 mg/L standard. *E. coli* bacteria concentrations were also consistently low in the Upper Cloquet River, and indicated full support for aquatic recreation.

Lakes with assessment-level data in this watershed include Cloquet, Kane, Thomas, Sullivan, Little Stone, Salo, and Indian. Most of these lakes are moderately productive, shallow and naturally bog-stained from the surrounding wetlands. All, except Indian, fully supported aquatic recreation. Indian Lake, which has a swimming beach and campground, is a flow through lake. Indian Creek enters from the north and the Cloquet River exits on the western side of the lake. Phosphorus was elevated and nuisance algal blooms occasionally occur on the lake. Indian Lake is a fairly unique. Its rapid flushing rate was a complicating factor in assessing aquatic recreation; overall it was determined that insufficient information was available to assess the lake.

Figure 25. Water quality summary of assessed lakes in the Upper Cloquet River.

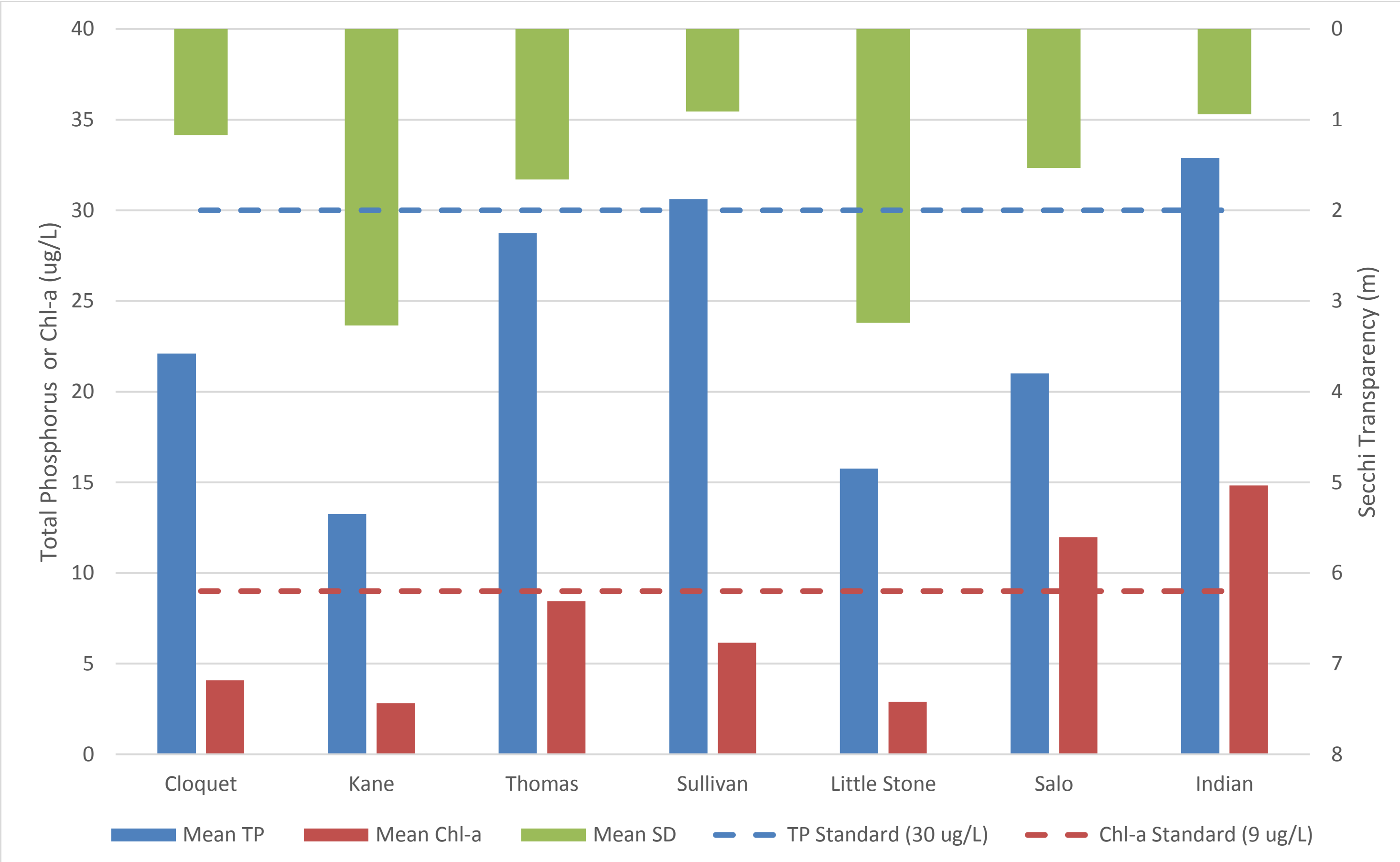
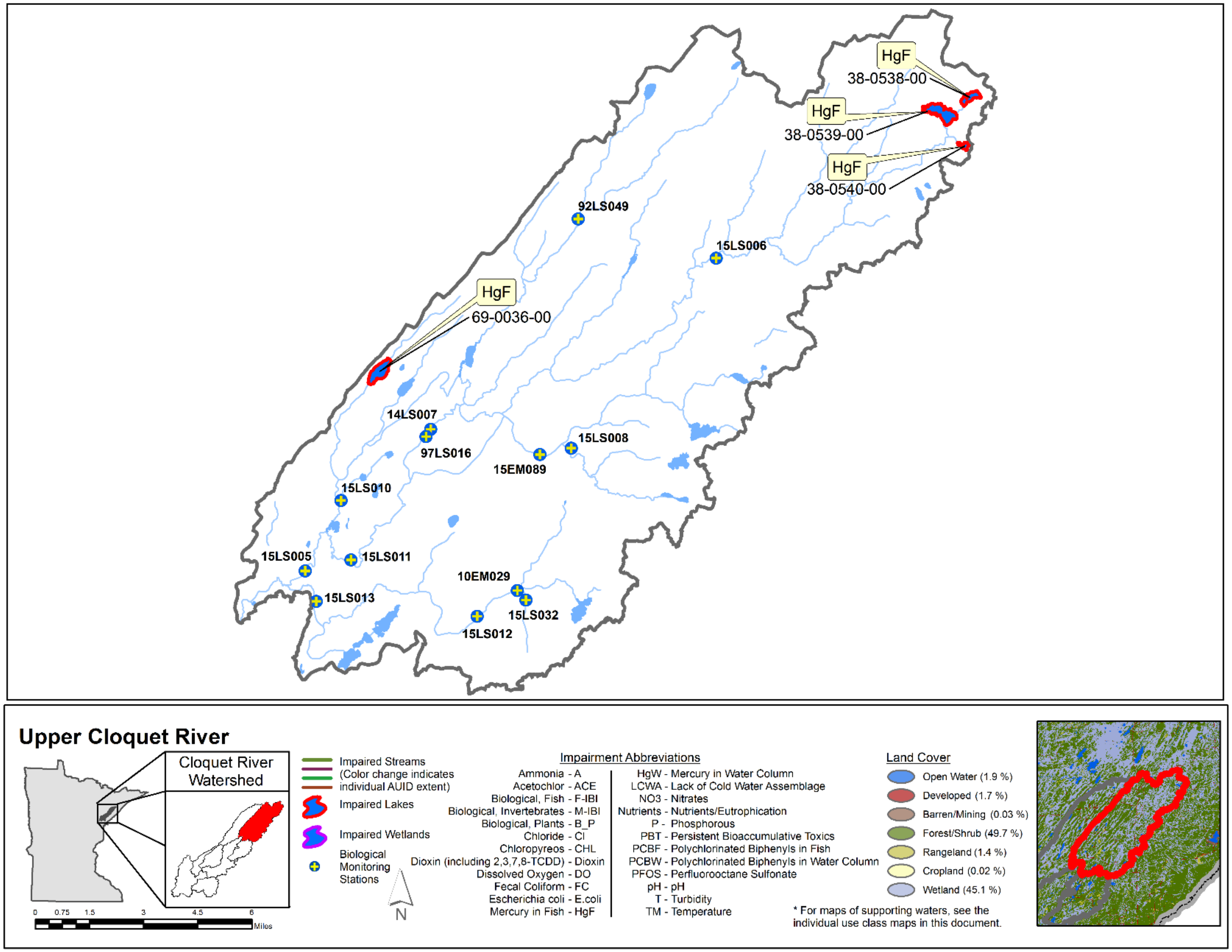


Figure 26. Currently listed impaired waters by parameter and land use characteristics in the Upper Cloquet Aggregated 12-HUC.



West Branch Cloquet Aggregated 12-HUC — HUC 0401020202-01

The West Branch Cloquet River Subwatershed is located in the northern portion of the Cloquet River Watershed in Lake and St. Louis counties. The subwatershed drains roughly 106 square miles of land. The West Branch of the Cloquet River is the primary stream. It originates from Bassett Lake located in the far Northwestern portion of the watershed. Major tributaries to the West Branch of the Cloquet River within this subwatershed include Wolf Creek (Downstream of Wolf Lake and Petrel Creek) and Berry Creek, which is formed by the confluence of Nelson Creek and Breda Creek. Wetlands are fairly prevalent in this subwatershed and account for approximately 65% of its area. The small community of Fairbanks lies within this subwatershed.

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

AUID *Reach name*, *Reach Description*	Biological station ID	Reach length (miles)	Use class	Aquatic life indicators: Fish IBI	Invert IBI	Dissolved oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	Aquatic life	Aquatic rec. (Bacteria)
04010202-666 **Petrel Creek** **Toimi Cr to Breda Lk**	15LS007	2.39	WWg	EXP	-	IF	IF	IF	-	IF	IF	-	-	IMP	NA
04010202-528 **Nelson Creek** **T56 R12W S15, north line to Berry Cr**	15LS022	0.66	CWg	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA
04010202-524 **Breda Creek** **Headwaters (Crest Lk 38-0757-00) to Berry Cr**	15LS023	12.42	CWg	MTS	MTS	IF	IF	MTS	-	IF	IF	-	-	SUP	NA
04010202-571 **Cloquet River, West Branch** **Unnamed Cr to Civet Cr**	15LS015	14.06	WWg	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA
04010202-515 **Berry Creek** **Breda Cr to T55 R12W S6, west line**	15LS014	8.98	CWg	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA

Abbreviations for Indicator Evaluations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **MTS** = Meets criteria; **EXP** = Exceeds criteria, potential impairment; **EXS** = Exceeds criteria, potential severe impairment; **EX** = Exceeds criteria (Bacteria)

Abbreviations for Use Support Determinations: **NA** = Not Assessed, **IF** = Insufficient Information, **NS** = Non-Support, FS = Full Support

Key for Cell Shading: ☐ = existing impairment, listed prior to 2012 reporting cycle; ☐ = new impairment; ☐ = full support of designated use.

Table 5. Lake water aquatic recreation assessments: West Branch Cloquet Aggregated 12-HUC.

							Aquatic life indicators:			Aquatic recreation indicators:				
Lake name	DNR ID	Area (acres)	Max depth (ft)	Assessment method	Ecoregion	Secchi Trend	Fish IBI	Chloride	Pesticides ***	Total phosphorus	Chlorophyll-a	Secchi	Aquatic life use	Aquatic recreation use
Hjalmer	38-0758-00	87	--	Shallow Lake	NLF	--	NA	NA	NA	IF	IF	IF	NA	IF
Bassett	69-0041-00	410	20	Deep Lake	NLF	I	NA	NA	NA	MTS	IF	MTS	NA	FS
Wolf	69-0143-00	512	12	Shallow Lake	NLF	--	NA	NA	NA	MTS	IF	MTS	NA	FS

Abbreviations for Ecoregion: **DA** = Driftless Area, **NCHF** = North Central Hardwood Forest, **NGP** = Northern Glaciated Plains, **NLF** = Northern Lakes and Forests, **NMW** = Northern Minnesota Wetlands, **RRV** = Red River Valley, **WCBP** = Western Corn Belt Plains
Abbreviations for Secchi Trend: **D** = decreasing/declining trend, **I** = increasing/improving trend, **NT** = no detectable trend, **--** = not enough data
Abbreviations for Indicator Evaluations: **--** = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2016 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.

Summary

Wetlands dominate the West Branch Cloquet Subwatershed. Five tributary reaches were assessed for aquatic life including three coldwater reaches (Nelson, Breda, and Berry Creek). Both fish and macroinvertebrate indicators suggest supporting conditions for most of the reaches that were sampled. The lone exception was Petrel Creek where the Fish Index of Biological Integrity (FIBI) score was below the applicable threshold. The fish sample from Petrel Creek was dominated by wetland indicative taxa such as northern pike and yellow perch, which are tolerant of low dissolved oxygen conditions. The impairment is likely due to natural wetland influences. Habitat conditions were good at all stations. As a whole, this subwatershed, like many others in the Cloquet system, have minimal human disturbance and overall good biological communities.

The water chemistry station was located at the Cloquet River canoe carry down access on Bear Lake Trail. This location is on the main-stem of the Cloquet River about four river miles below the confluence with the West Branch. Much of this watershed is composed of public forest, wetland, and lakes within the Cloquet Valley State Forest and Superior National Forest. Although there were insufficient chemistry samples alone to make an assessment of aquatic life, the conventional parameters here indicated high water quality. Phosphorus and sediment levels were consistently low. This reach had several minor pH exceedances (below the 6.5 standard), likely due to natural conditions. Minor exceedances of the pH standards are common, and have been documented in many other low gradient wetland streams in the vicinity.

Low pH can occur when wetland material decomposes, producing weak acids. *E. coli* bacteria concentrations were consistently low in this watershed, and indicated full support for aquatic recreation.

Two lakes in this watershed, Bassett and Wolf, had sufficient data available for an assessment of aquatic recreation, and both were assessed as fully supporting. Bassett Lake is a popular recreational lake located in the headwaters; this is a high quality lake with TP, Chl-a, and Secchi datasets meeting standards. Bassett has a long term Secchi record, with annual data back to 1994; transparency is improving at a rate of about 1.1 feet (0.4 m) per decade. Wolf Lake is an impoundment of Petrel Creek. This waterbody is very shallow (mean depth of 1.5 m or 5 feet) and is dominated by wild rice from mid to late summer. These characteristics yield relatively high levels of phosphorus and low Chl-a concentrations (Figure 29), as productivity in this lake is dominated by aquatic plants versus suspended algae. Secchi transparency in Wolf Lake is very low, naturally limited by tannins in the water from the wetland landscape upstream.

Figure 27. Water quality summary of assessed lakes in the West Branch Cloquet Subwatershed.

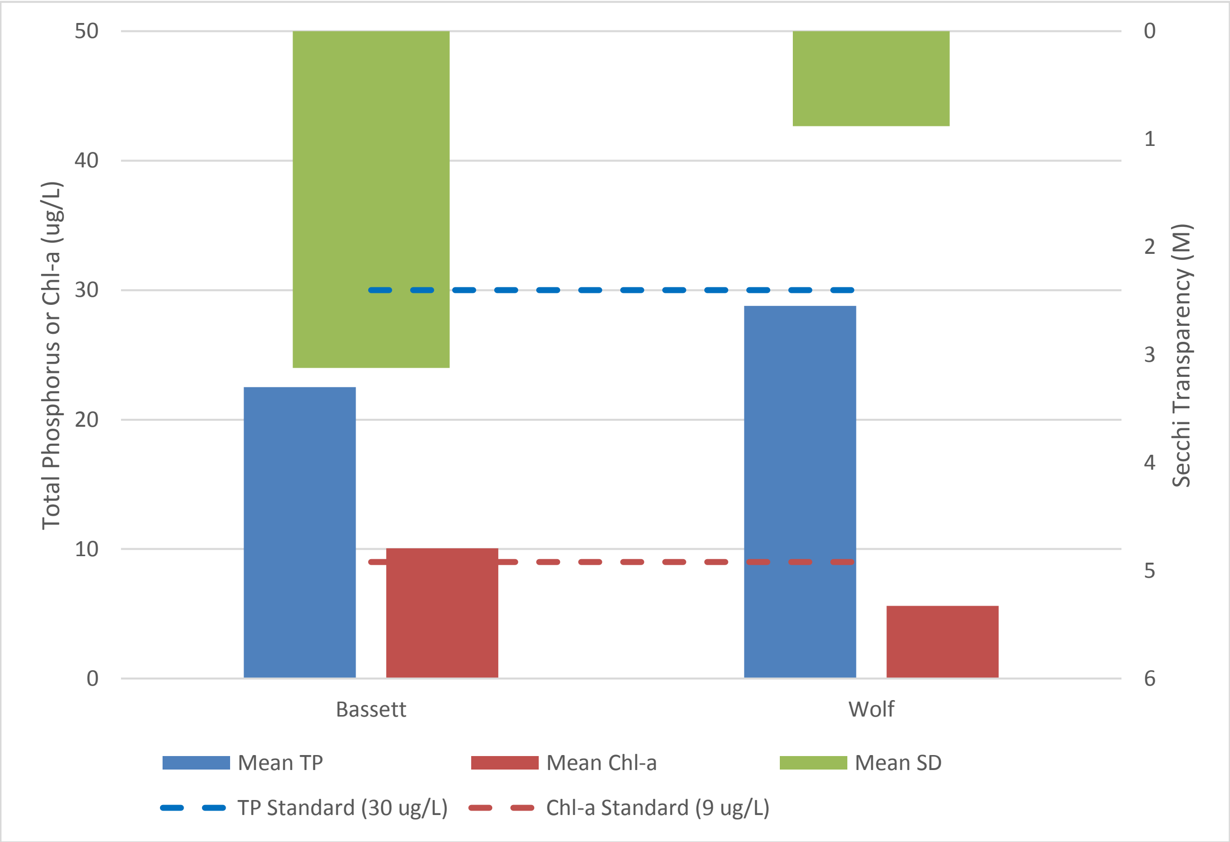
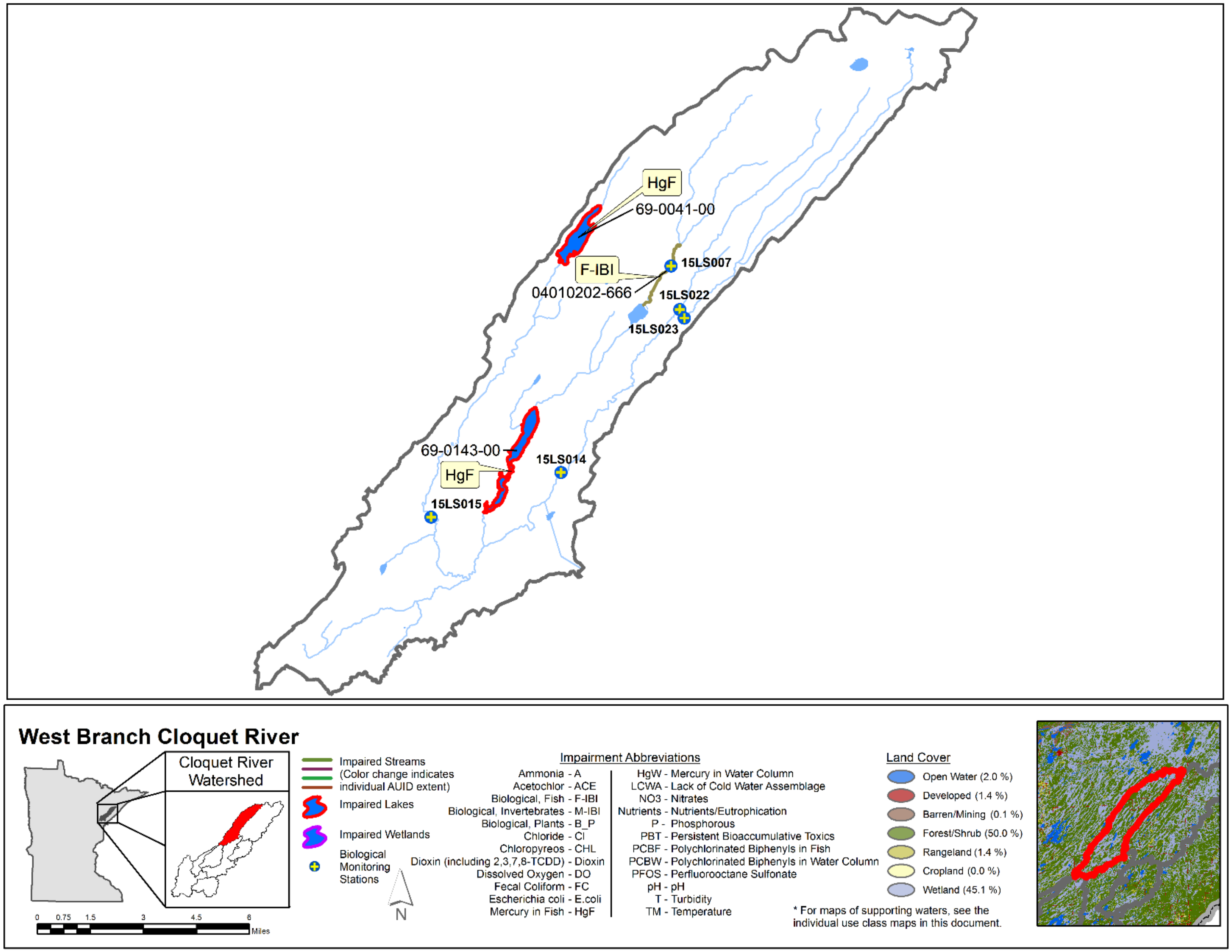


Figure 28. Currently listed impaired waters by parameter and land use characteristics in the West Branch Aggregated 12-HUC.



Little Cloquet Aggregated 12-HUC HUC 0401020204-02

The Little Cloquet Subwatershed is one of the smallest subwatersheds of the Cloquet River, draining approximately 60 square miles of land. It is almost entirely within St. Louis County, with the exception of the far eastern edge which is in Lake County. The Little Cloquet River, which is the primary reach within this subwatershed originates from Smith Lake. Smith Lake and its upstream counterpart, Pequaywan Lake, are impoundment lakes formed by dams on Coyote Creek, located in the headwater portions of this subwatershed. Mud Creek, is also a tributary of the Little Cloquet River within this subwatershed, and flows into it from the East.

Table 6. Aquatic life and recreation assessments on stream reaches: Little Cloquet Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach name***, *Reach description*	Biological station ID	Reach length (miles)	Use class	Aquatic life indicators: Fish IBI	Invert IBI	Dissolved oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	Aquatic life	Aquatic Rec. (Bacteria)
04010202-584 **Coyote Creek** **Unnamed Cr to Pequaywan Lk**	15LS016	1	WWe	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA
04010202-589 **Little Cloquet River** **Mud Cr to Unnamed Cr (Lieung Lk outlet)**	15LS004	3	WWg	MTS	MTS	IF	-	IF	-	IF	-	-	-	SUP	NA

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: = existing impairment, listed prior to 2016 reporting cycle; = new impairment; = full support of designated use; = insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 7. Lake assessments: Little Cloquet River Aggregated 12-HUC.

Lake name	DNR ID	Area (acres)	Max depth (ft)	Assessment method	Ecoregion	Secchi trend	Aquatic life indicators: Fish IBI	Aquatic life indicators: Chloride	Aquatic life indicators: Pesticides ***	Aquatic recreation indicators: Total phosphorus	Aquatic recreation indicators: Chlorophyll-a	Aquatic recreation indicators: Secchi	Aquatic life use	Aquatic recreation use
Pequaywan	69-0011-00	432	33	Deep Lake	NLF	D	NA	NA	NA	MTS	MTS	MTS	NA	FS
Ace	69-0013-00	27	--	Deep Lake	NLF	--	NA	NA	NA	--	--	MTS	NA	IF
Sand	69-0016-00	27	16	Shallow Lake, Stream Trout	NLF	--	NA	NA	NA	EX	EX	EX	NA	NS
White	69-0030-00	120	29	Deep Lake	NLF	I	NA	NA	NA	MTS	MTS	MTS	NA	FS
Smith	69-0111-00	181	51	Deep Lake	NLF	I	NA	NA	NA	IF	IF	MTS	NA	IF
Wet	69-1287-00	12	--	Deep Lake	NLF	--	NA	NA	NA	--	--	IF	NA	IF

Abbreviations for Ecoregion: **DA** = Driftless Area, **NCHF** = North Central Hardwood Forest, **NGP** = Northern Glaciated Plains, **NLF** = Northern Lakes and Forests, **NMW** = Northern Minnesota Wetlands, **RRV** = Red River Valley, **WCBP** = Western Corn Belt Plains

Abbreviations for Secchi Trend: **D** = decreasing/declining trend, **I** = increasing/improving trend, **NT** = no detectable trend, **--** = not enough data

Abbreviations for Indicator Evaluations: **--** = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)

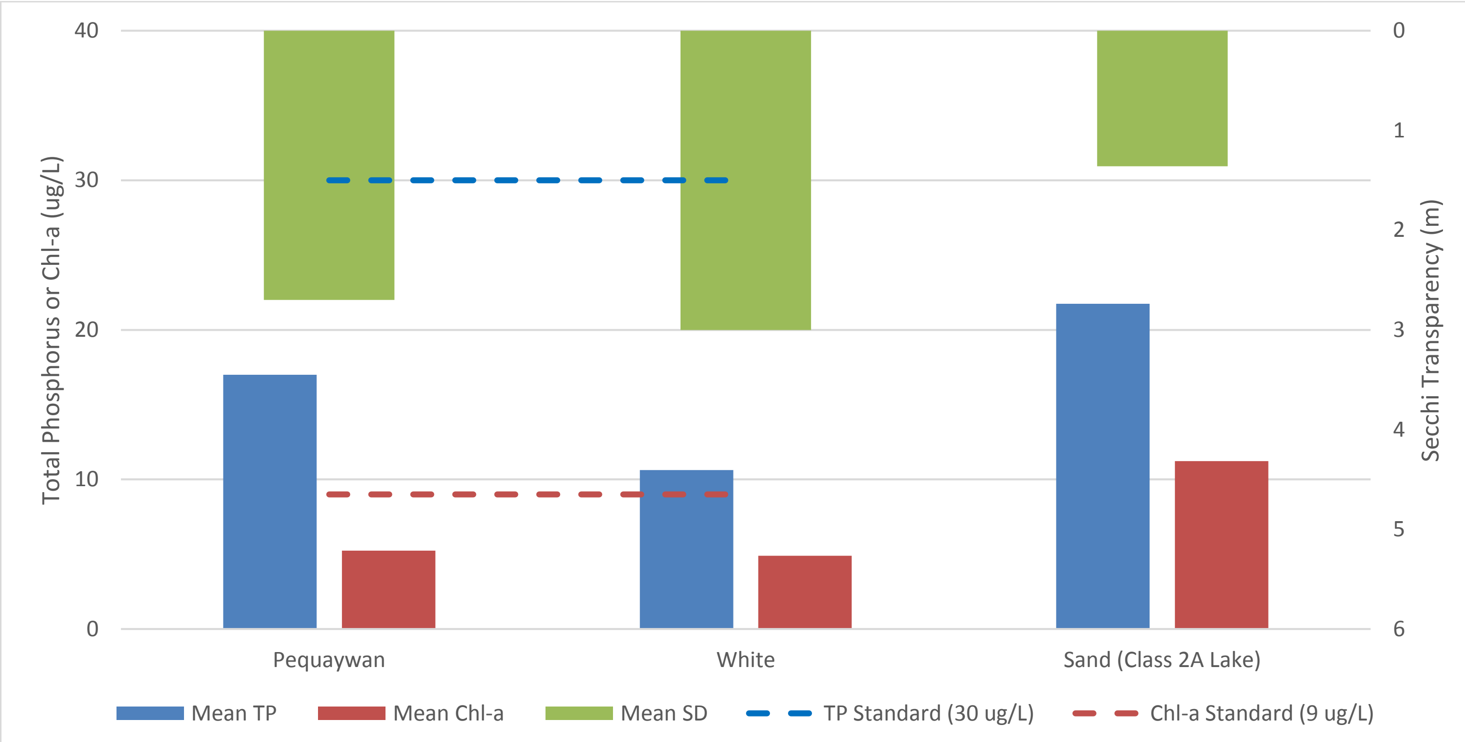
Key for Cell Shading: ☐ = existing impairment, listed prior to 2016 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐= insufficient information.

Summary

The fish and macroinvertebrate communities indicate that the Little Cloquet Subwatershed is in excellent biological condition. Two reaches were assessed for aquatic life. Coyote Creek produced the highest FIBI score in the entire Cloquet Watershed as well as a superb Macroinvertebrate Index of Biological Integrity (MIBI) score. The reach was designated as exceptional because of the good IBI scores for both assemblages. The FIBI score on the Little Cloquet River was above the exceptional threshold but the macroinvertebrate community scored just below the exceptional threshold. Because both assemblages must score above their respective exceptional thresholds for a reach to be officially designated as such, this reach will remain general use. Habitat conditions were very good at both stations. The excellent biology and habitat conditions in the Little Cloquet are likely related to the lack of development in the subwatershed.

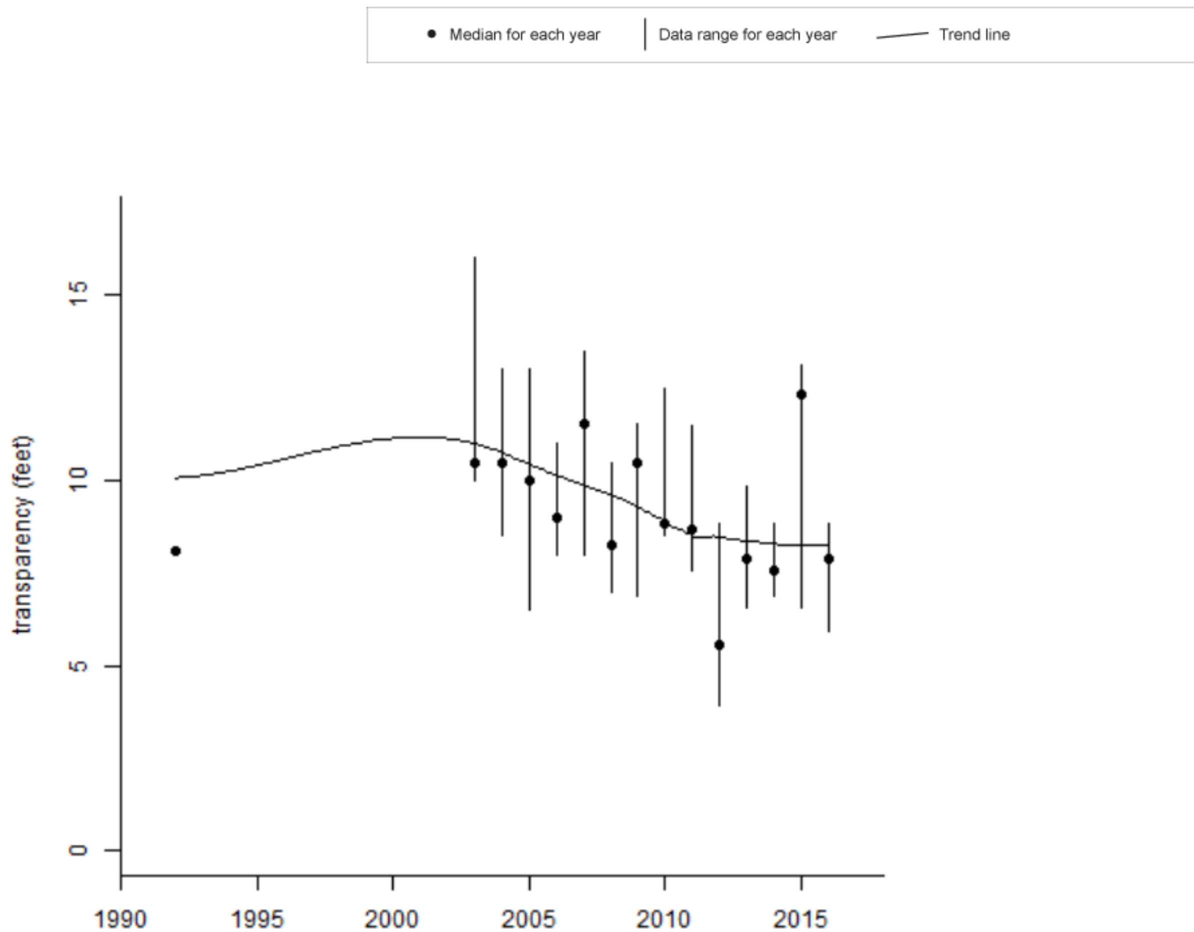
The Little Cloquet River water chemistry monitoring site was located on the Little Cloquet River at County Rd. 44 (Pequaywan Lake Road), about three river miles upstream of the confluence with the Cloquet River. This watershed drains several lakes, including Pequaywan, Smith, and King. Water quality at this location was excellent. Nutrients and sediment levels were low and consistently met standards. *E. coli* bacteria concentrations were also consistently low in this watershed, and indicated full support for aquatic recreation.

Figure 29. Water quality summary of assessed lakes in the Little Cloquet River Subwatershed.



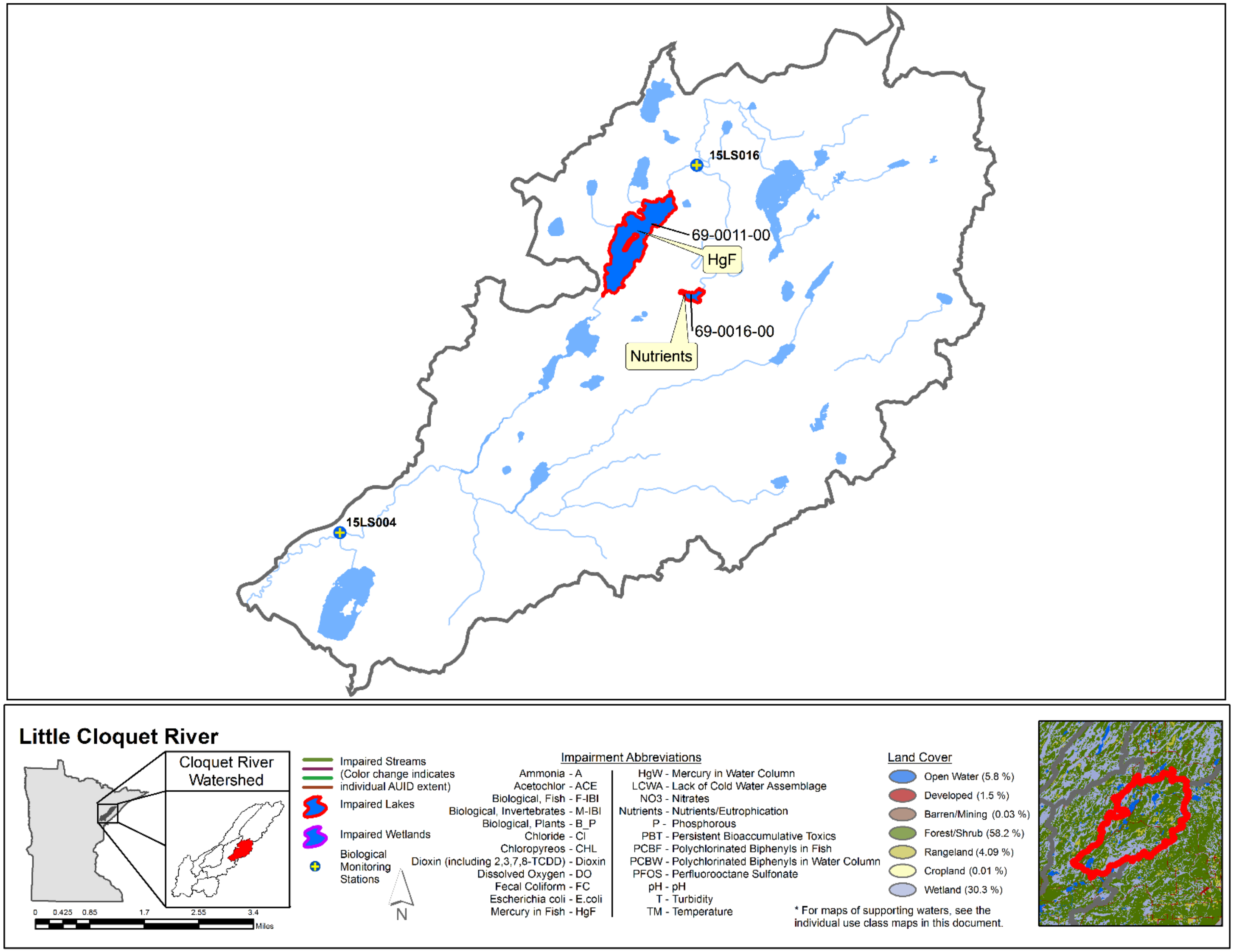
Three lakes in the watershed had sufficient data available for an assessment of aquatic recreation (Figure 29). Pequaywan is the largest lake in the subwatershed, covering 432 acres. Pequaywan and White Lakes are two of the most intensively developed lakes in the entire watershed; both lakes fully supported aquatic recreation, and are meeting standards for phosphorus, chlorophyll-a and Secchi transparency (Figure 29). Pequaywan has a long term Secchi dataset, with observations back to 2003; transparency is declining in this lake at a rate of about 1.9 feet (0.6 meters) per decade (Figure 30). This conclusion suggests that Pequaywan is vulnerable to a water quality decline; continued citizen Secchi transparency monitoring is strongly recommended. Secchi trends in White Lake indicate slightly improving transparency, although conclusions are affected by an eight year span of no data in the record.

Figure 30. Secchi transparency trends for Pequaywan Lake (69-0011-00).



Sand (Loaine) Lake is a designated stream trout lake east of Pequaywan Lake. This small, shallow, seepage lake is undeveloped, and has been regularly stocked with rainbow trout since the 1950's. Sand Lake is not meeting the Class 2A stream trout water quality standards for TP, Chl-a, or Secchi transparency. Because the lakeshore and watershed are dominated by public wetlands and forests, and the shoreline is in a natural state (minus the public water access), MPCA staff determined that these exceedances are due to natural conditions.

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



Boulder Lake Reservoir Aggregated 12-HUC — HUC 0401020203-01

The Boulder Lake Reservoir Subwatershed is located in West-central portion of the Cloquet Watershed. Draining an area of approximately 67 square miles, it is entirely within St. Louis County. Boulder Lake, which is the key feature within this subwatershed, is a reservoir resulting from a dam created on Boulder Creek for water storage for the generation of hydroelectric power further downstream on the St. Louis River. Upstream of this reservoir, Boulder Creek flows for roughly 12 miles. Humphrey Creek, one of the only tributaries of Boulder Creek, is a coldwater reach that flows for roughly four miles before its confluence with Boulder Creek. Unlike other upstream subwatersheds, Boulder Lake is unique in that its pour point isn't directly linked to the Cloquet River, but instead flows into Island Lake Reservoir, the next downstream watershed and man-made impoundment of the Cloquet River.

Table 8. Aquatic life and recreation assessments on stream reaches: Boulder Lake Reservoir Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach name***, *Reach description*	**Biological station ID**	**Reach length (miles)**	**Use class**	**Aquatic life indicators:** Fish IBI	Invert IBI	Dissolved oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic life**	**Aquatic Rec. (Bacteria)**
04010202-530 **Humphrey Creek** **Headwaters to Boulder Cr**	15LS025	3.67	CWe	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA
04010202-513 **Boulder Creek** **Humphrey Cr to Unnamed Cr**	97LS079	2.02	WWg	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2016 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐ = insufficient information.
Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional, **LRVW** = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 9. Lake assessments: Boulder Lake Reservoir Aggregated 12-HUC .

							Aquatic life indicators:			Aquatic recreation indicators:				
Lake name	**DNR ID**	**Area (acres)**	**Max depth (ft)**	**Assessment method**	**Ecoregion**	**Secchi Trend**	**Fish IBI**	**Chloride**	**Pesticides *****	**Total phosphorus**	**Chlorophyll-a**	**Secchi**	**Aquatic life use**	**Aquatic recreation use**
Boulder Lake Reservoir	69-0373-00	3,287	18	Shallow Lake	NLF	--	NA	NA	NA	MTS	IF	IF	NA	FS

Abbreviations for Ecoregion: **DA** = Driftless Area, **NCHF** = North Central Hardwood Forest, **NGP** = Northern Glaciated Plains, **NLF** = Northern Lakes and Forests, **NMW** = Northern Minnesota Wetlands, **RRV** = Red River Valley, **WCBP** = Western Corn Belt Plains
Abbreviations for Secchi Trend: **D** = decreasing/declining trend, **I** = increasing/improving trend, **NT** = no detectable trend, **--** = not enough data
Abbreviations for Indicator Evaluations: **--** = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)
Key for Cell Shading: = existing impairment, listed prior to 2016 reporting cycle; = new impairment; = full support of designated use; = insufficient information.

Summary

The Boulder Lake Subwatershed's main feature is the presence of Boulder Lake, a reservoir created by a man made impoundment on Boulder Creek. Two reaches were assessed for aquatic life, including one coldwater reach (Humphrey Creek). Fish and macroinvertebrate surveys found very robust communities with good taxa diversity at both stations, indicating support for aquatic life. Humphrey Creek in particular, produced brook trout, and several sensitive taxa of both fish and macroinvertebrates. Consequently the reach was classified as exceptional. This was unique in that approximately 50% of the biological monitoring stations length on Humphrey Creek was channelized (straightened). Very rarely are exceptional aquatic life communities associated with altered reaches. Boulder Creek also produced an exceptional macroinvertebrate community, and a good fish community. Habitat conditions were good on both reaches, however Minnesota Stream Habitat Assessment (MSHA) scores were slightly better at Boulder Creek.

This watershed includes the area draining Boulder Lake, and does not contain a water chemistry stream monitoring site, because only smaller streams enter into the lake. Boulder Lake is large and quite shallow (98% littoral); its water quality reflects the wetlands and flooded forest that were inundated when Minnesota Power created the reservoir in the early 1900's. Today this lake is a popular recreation destination for fishing, skiing, hiking, camping, and environmental education. Boulder is a productive mesotrophic lake with phosphorus concentrations meeting standards. Overall the lake fully supports aquatic recreation, although Chl-a values slightly exceeded the standard on average; mild algal blooms were documented (Chl-a concentrations > 20 µg/L) on a handful of sampling visits. These conditions can be common mid-summer in shallow lakes draining wetland dominated landscapes during periods of reduced inflows. Secchi transparency in Boulder Lake is naturally limited, due to wetland influence; average clarity was 1.5 m (5 feet), versus the 2.0 m standard.

Figure 32. Boulder Lake Water Quality Summary.

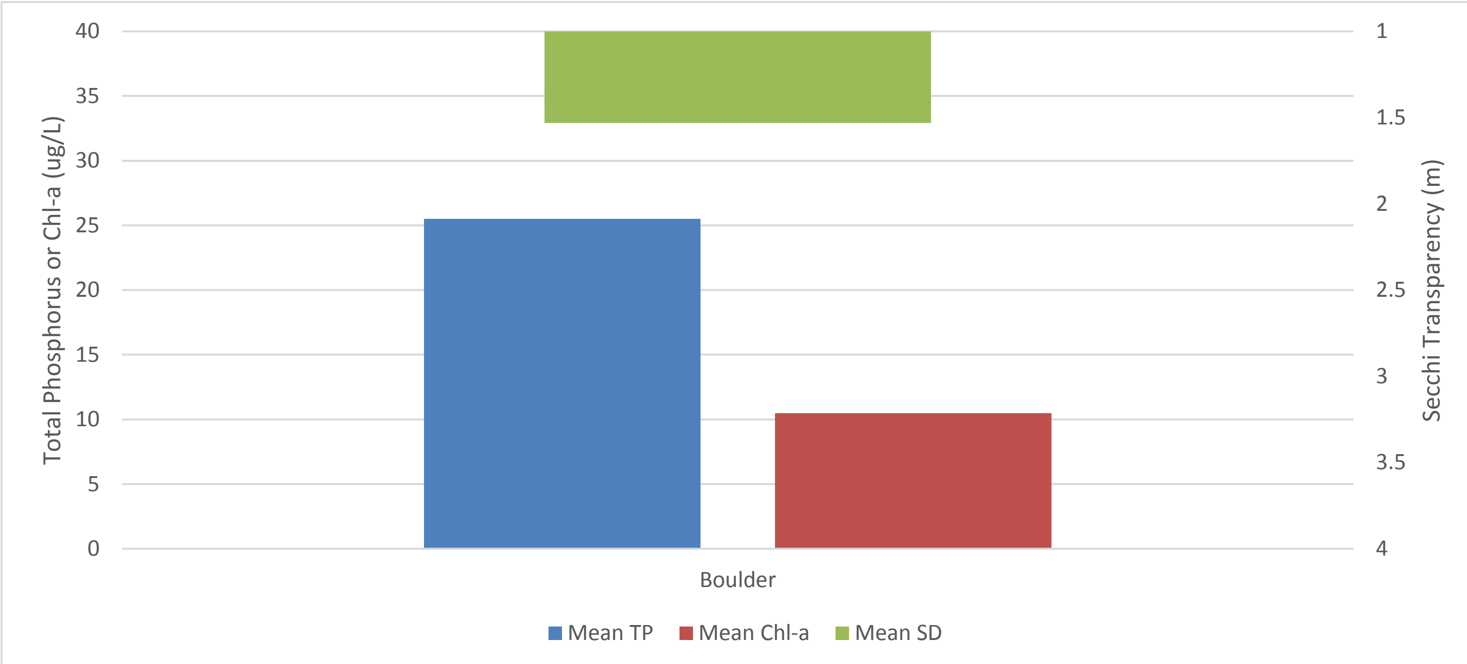
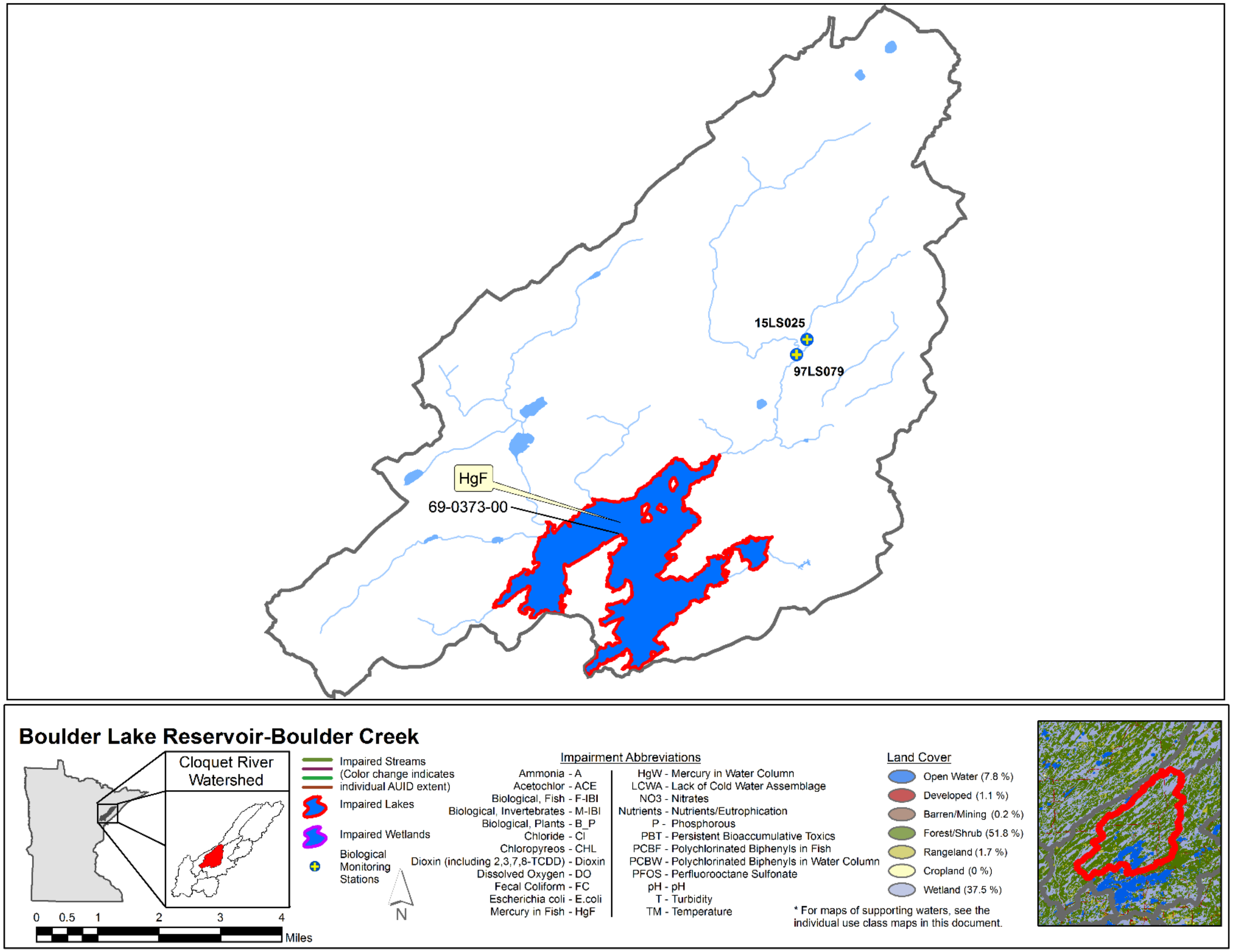


Figure 33. Currently listed impaired waters by parameter and land use characteristics in the Boulder Lake Aggregated 12-HUC.



Middle Cloquet Aggregated 12-HUC

HUC 0401020204-01

The Middle Cloquet Subwatershed is in the heart of the Cloquet River drainage. Spanning an area of roughly 117 square miles, it is one of the largest subwatersheds of the Cloquet River and is entirely within St. Louis County. Beginning near the confluence of the West Branch of the Cloquet River and ending at the outlet of Island Lake Reservoir, this subwatershed is primarily a "flow-through" of the main-stem Cloquet River, encompassing its middle portion. Probably the most distinguishing characteristic of this subwatershed is the presence of Island Lake, a reservoir which was created by the construction of a dam on the Cloquet River to store water for downstream hydroelectric power facilities. Island Lake Reservoir covers approximately 8,000 acres and serves as an attraction based on the excellent multi-species fishing opportunities it provides. Despite the reservoirs presence, still a relatively small amount of disturbance occurs throughout the subwatershed (<2%). The watershed receives flow from the West Branch of the Cloquet River, Little Cloquet River, and Boulder Lake.

Table 10. Aquatic life and recreation assessments on stream reaches: Middle Cloquet Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

				Aquatic life indicators:											
AUID ***Reach name*,** *Reach description*	**Biological station ID**	**Reach length (miles)**	**Use class**	Fish IBI	Invert IBI	Dissolved oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia $-NH_3$	Pesticides ***	Eutrophication	**Aquatic life**	**Aquatic Rec. (Bacteria)**
04010202-671 **Cloquet River** **West Branch Cloqet R to Island Lake Reservoir**	98LS044,15LS017	28.82	WWe	MTS	-	IF	IF	MTS	-	MTS	MTS	-	IF	SUP	SUP

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

Table 11. Lake assessments: Middle Cloquet River Aggregated 12-HUC.

Lake name	DNR ID	Area (acres)	Max depth (ft)	Assessment method	Ecoregion	Secchi Trend	Aquatic life indicators: Fish IBI	Aquatic life indicators: Chloride	Aquatic life indicators: Pesticides ***	Aquatic recreation indicators: Total phosphorus	Aquatic recreation indicators: Chlorophyll-a	Aquatic recreation indicators: Secchi	Aquatic life use	Aquatic recreation use
Big Bear	69-0113-00	132	15	Shallow Lake	NLF	--	NA	NA	NA	MTS	MTS	IF	NA	FS
Briar	69-0128-00	71	19	Deep Lake, Stream Trout	NLF	D	NA	NA	NA			IF	NA	IF
Spring	69-0129-00	91	25	Deep Lake	NLF	NT	NA	NA	NA	MTS	MTS	MTS	NA	FS
Little Alden	69-0130-00	93	29	Deep Lake	NLF	--	NA	NA	NA	MTS	MTS	MTS	NA	FS
Alden	69-0131-00	188	29	Deep Lake	NLF	D	NA	NA	NA	MTS	MTS	IF	NA	FS
Schultz	69-0230-00	209	48	Deep Lake	NLF	D	NA	NA	NA			MTS	NA	IF
Jacobs	69-0231-00	81	9	Shallow Lake	NLF	--	NA	NA	NA			IF	NA	IF
Sunshine	69-0235-00	79	37	Deep Lake	NLF	NT	NA	NA	NA	MTS	MTS	MTS	NA	FS
Thompson	69-0241-00	199	8.5	Shallow Lake	NLF	D	NA	NA	NA			IF	NA	IF
Island Lake Reservoir (W. Basin)	69-0372-01	5993	50	Deep Lake	NLF	NT	NA	NA	NA	MTS	MTS	IF	NA	FS
Island Lake Reservoir (E. Basin)	69-0372-02	1508	94	Deep Lake	NLF	D	NA	NA	NA	MTS	MTS	MTS	NA	FS
Flowage	69-0394-00	110	15	Shallow Lake	NLF	I	NA	NA	NA	MTS	MTS	MTS	NA	FS
Clearwater	69-0397-00	14	25.5	Deep Lake, Stream Trout	NLF	I	NA	NA	NA	MTS	MTS	MTS	NA	FS

Abbreviations for Ecoregion: DA = Driftless Area, NCHF = North Central Hardwood Forest, NGP = Northern Glaciated Plains, NLF = Northern Lakes and Forests, NMW = Northern Minnesota Wetlands, RRV = Red River Valley, WCBP = Western Corn Belt Plains

Abbreviations for Secchi Trend: D = decreasing/declining trend, I = increasing/improving trend, NT = no detectable trend, -- = not enough data

Abbreviations for Indicator Evaluations: -- = No Data, **MTS** = Meets Standard; **EX** = Exceeds Standard; **IF** = Insufficient Information

Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **FS** = Full Support (Meets Criteria); **NS** = Not Support (Impaired, exceeds standard)

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

Summary

The Middle Cloquet Subwatershed is in the center of the Cloquet River system. The Cloquet River main-stem is the primary reach within this subwatershed, and the only one that was assessed for aquatic life. Fish communities collected on the two associated stations exceeded the exceptional FIBI threshold; a unique quality only associated with the uppermost minimally disturbed reaches of the Cloquet upstream of Island Lake Reservoir. Due to the presence of Island Lake, the amount of open water in this subwatershed is almost double that of others. Macroinvertebrates were not collected because the water depth prohibited sampling. Habitat conditions were good at both stations, with no notable difference in MSHA scores.

The water chemistry monitoring site for the Middle Cloquet River was located on Taft Road (County Road 48) about 1.2 river miles below the outlet of Island Lake Reservoir. As expected, water quality (i.e. nutrient) conditions here are similar to those in Island Lake (see below). Although there was not enough water chemistry data to assess for aquatic life, water quality was excellent in general at this location- nutrient and sediment levels were low, and oxygen levels consistently met the standard. *E. coli* bacteria concentrations were also consistently low in this watershed, and indicated full support for aquatic recreation.

A total of eight lakes in the watershed had assessment-level data (Figure 34). Seven of these lakes (Big Bear, Spring, Little Alden, Alden, Sunshine, Island, and Flowage) are Class 2B warm or cool water lakes, and fully supported aquatic recreation. All these lakes met TP and Chl-a standards. A few lakes in the Middle Cloquet had naturally low Secchi transparency (below the 2.0 m standard) due to tanning staining from upstream wetlands, especially those lakes connected to the Cloquet River (Alden, Little Alden). Sunshine Lake, a small seepage lake was a bit of an outlier, with very low P concentrations, and high transparency (Figure 37); likely due to groundwater influence.

Island Lake Reservoir is the largest (~ 8,000 acres) and most popular lake in the subwatershed. This waterbody is divided by Highway 4 into east and west basins, with the Cloquet River flowing through the center. Both basins had similar TP concentrations, while the east basin had lower Chl-a concentrations (3.2 v. 7.8 µg/L), perhaps due to its greater depth and shorter residence time. Clearwater Lake, a small, shallow stream trout lake south of Island, met the eutrophication standard and fully supported aquatic recreation.

Sufficient long-term Secchi datasets are available to determine trends on seven lakes in the watershed (Table 18). Two lakes, Flowage and Clearwater, have improving transparency, while Briar, Alden, Schultz, Thompson, and the east basin of Island have declining transparency. Most declines are relatively minor (<1 foot per decade) and are likely a function of variability in climate and water levels, versus an increase in trophic status.

Figure 34. Water quality summary of assessed lakes in the Middle Cloquet River Subwatershed.

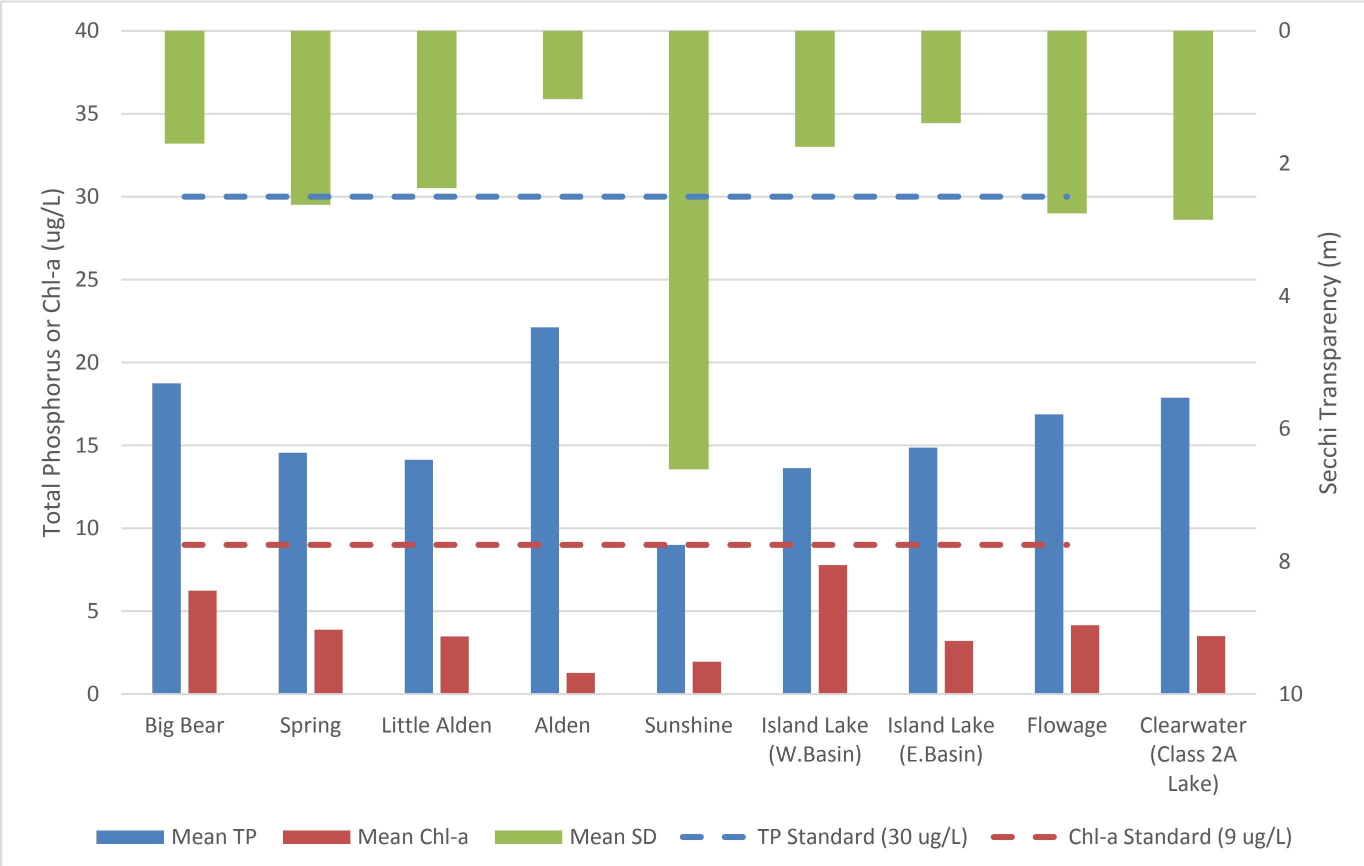
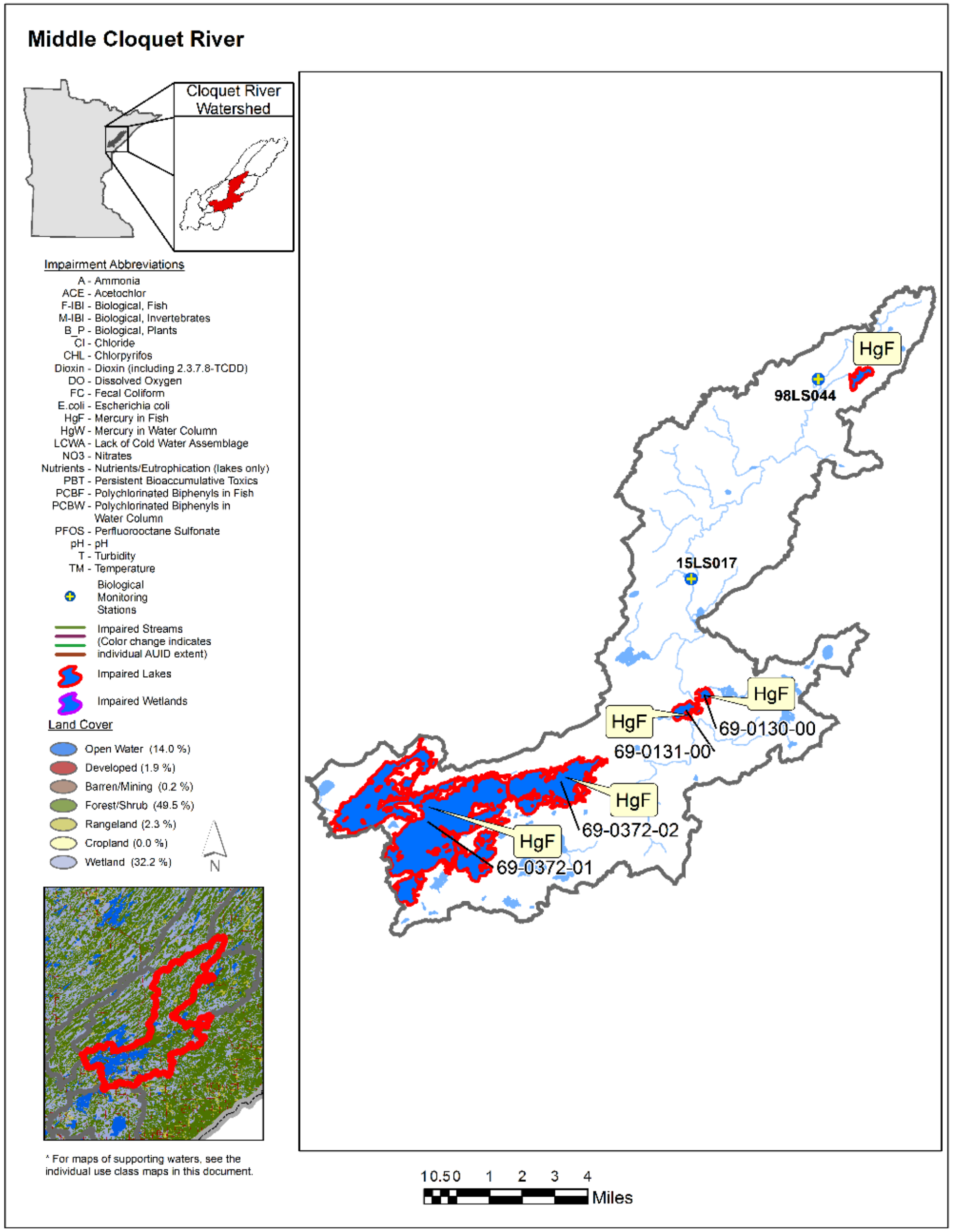


Figure 35. Currently listed impaired waters by parameter and land use characteristics in the Middle Cloquet Aggregated 12-HUC.



Fish Lake Reservoir Aggregated 12-HUC — HUC 0401020205-01

The Fish Lake Subwatershed is in the far southeastern corner of the Cloquet River Watershed. Draining an area of roughly 75 square miles, it is one of the smaller contributing subwatersheds to the Cloquet River. Its primary stream reach, the Beaver River, begins at the outlet of Wild Rice Lake (approximately 2,400 acres) and flows to the north and then northwest. After flowing about five and a half miles, the Beaver River flows into Fish Lake, an approximately 2,900 acre reservoir created by a dam which was built as a water storage reservoir on the Beaver River. The reservoir is well known as an excellent fishery and, like Island Lake, serves as a recreational draw to the area. Fish Lake Flowage also receives water from Caribou (540 acres) and Long Lakes through small reaches connecting them on its southwest corner. Downstream of this dam, the Beaver River continues for about two and a half miles before entering into the Cloquet River.

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

AUID *Reach name*, *Reach description*	Biological station ID	Reach length (miles)	Use class	Aquatic life indicators: Fish IBI	Invert IBI	Dissolved oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic life**	**Aquatic Rec. (Bacteria)**
04010202-503 **Beaver River** **Cloquet R to Fish Lake Reservoir**	15LS020	2.52	WWg	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA

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

Table 13. Lake assessments: Fish Lake Reservoir Aggregated 12-HUC.

Lake name	DNR ID	Area (acres)	Max depth (ft)	Assessment method	Ecoregion	Secchi Trend	Aquatic life indicators: Fish IBI	Chloride	Pesticides ***	Aquatic recreation indicators: Total Phosphorus	Chlorophyll-a	Secchi	Aquatic life use	Aquatic recreation Use
Mirror	69-0234-00	19	27	Shallow Lake, Stream Trout	NLF	--	NA	NA	NA	MTS	MTS	MTS	NA	FS
Wild Rice	69-0371-00	2,304	10	Shallow Lake	NLF	NT	NA	NA	NA	IF	IF	IF	NA	IF
Caribou	69-0489-00	535	21	Shallow Lake	NLF	I	NA	NA	NA	MTS	MTS	MTS	NA	FS
Fish Lake Reservoir (Main Basin)	69-0491-01	2,857	36	Shallow Lake	NLF	NT	NA	NA	NA	MTS	IF	IF	NA	IF

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

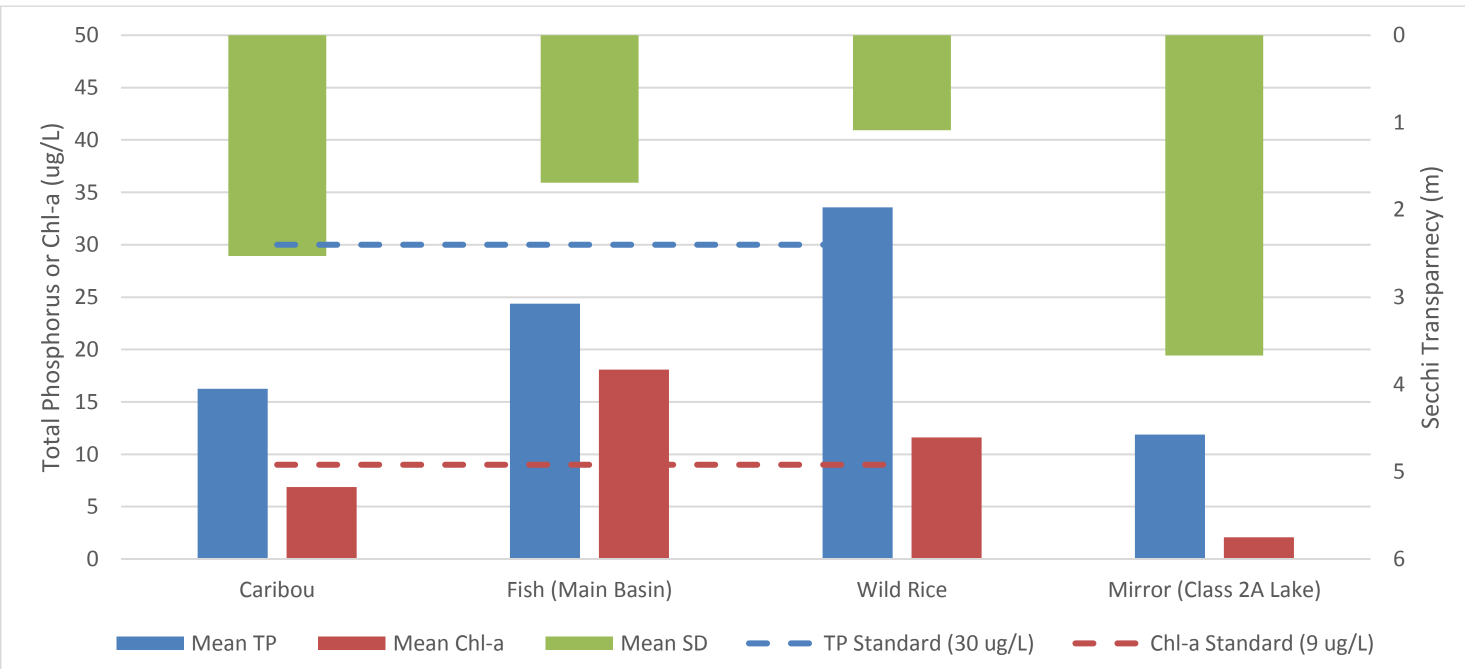
Summary

Fish Lake subwatershed has the highest percentage of development of all of the subwatersheds in the Cloquet system. Most of this development is on the shorelines of Fish Lake Reservoir and Wild Rice Lake. The Beaver River upstream of Fish Lake was the only reach assessed for aquatic life in this subwatershed. Several sensitive and or late maturing fish species such as mottled sculpin, longnose dace, burbot and rock bass were identified. Similarly, the macroinvertebrate included a good diversity of caddisflies. Both assemblages indicated support for aquatic life. Habitat was also excellent, with a MSHA score of 70.

This lake-dominated watershed did not have a water chemistry stream monitoring station. Four lakes in this watershed had assessment-level data (Table 13). Three are Class 2B cool or warm water lakes, while Mirror Lake (69-0234) is a designated stream trout lake. Caribou Lake is a shallow, popular recreational lake just north of Duluth. Most of the lakeshore is developed with homes or seasonal cabins. Caribou met standards for TP, Chl-a, and Secchi transparency and fully supported aquatic recreation. Clarity has increased on the lake since the late 1970's. Over the last ~ 15 years, transparency has been relatively stable near 2.5 meters.

The main basin of Fish Lake Reservoir was monitored by MPCA staff in 2015-2016. The MPCA and Minnesota Power have historically monitored the lake as a requirement of Minnesota Powers hydropower license. Fish Lake is the largest water body in the sub-watershed, covering over 2,800 acres, and is a very popular recreational and fishing destination. Fish Lake is productive. Its water quality is influenced by the shallow lake, wetland, and forested landscape that was inundated to create the reservoir in the early 1900's. Overall, the reservoir fully supported aquatic recreation. Phosphorus concentrations in the lake met the standard overall, summer average concentrations varied from 13 µg/L in 2015 to 31 µg/L in 2016. The difference in nutrient concentrations from 2015 to 2016 was likely caused by variability in runoff; 2015 was a much drier summer (http://files.dnr.state.mn.us/natural_resources/climate/current_conditions/hydrologic_conditions_august_2015.pdf). In reservoirs, years with below normal runoff are often associated with lower nutrient and algae levels. Chlorophyll-a concentrations in Fish Lake exceeded the standard, although the two-year average value was influenced by an outlier concentration (41 µg/L) from August of 2016. Similar to TP concentrations, algal productivity was much greater in 2016. All four summer samples exceeded the 9 µg/L standard, some at concentrations indicative of nuisance algal blooms (> 20 µg/L). Secchi transparency varied considerably over the monitoring period, from 0.5 m to 4.4 m. The transparency in the reservoir is typically highest in spring/early summer and reaches a minimum late summer when lake productivity and water temperatures are at their maximum.

Figure 36. Water quality summary of assessed lakes in the Fish Lake Reservoir Subwatershed.

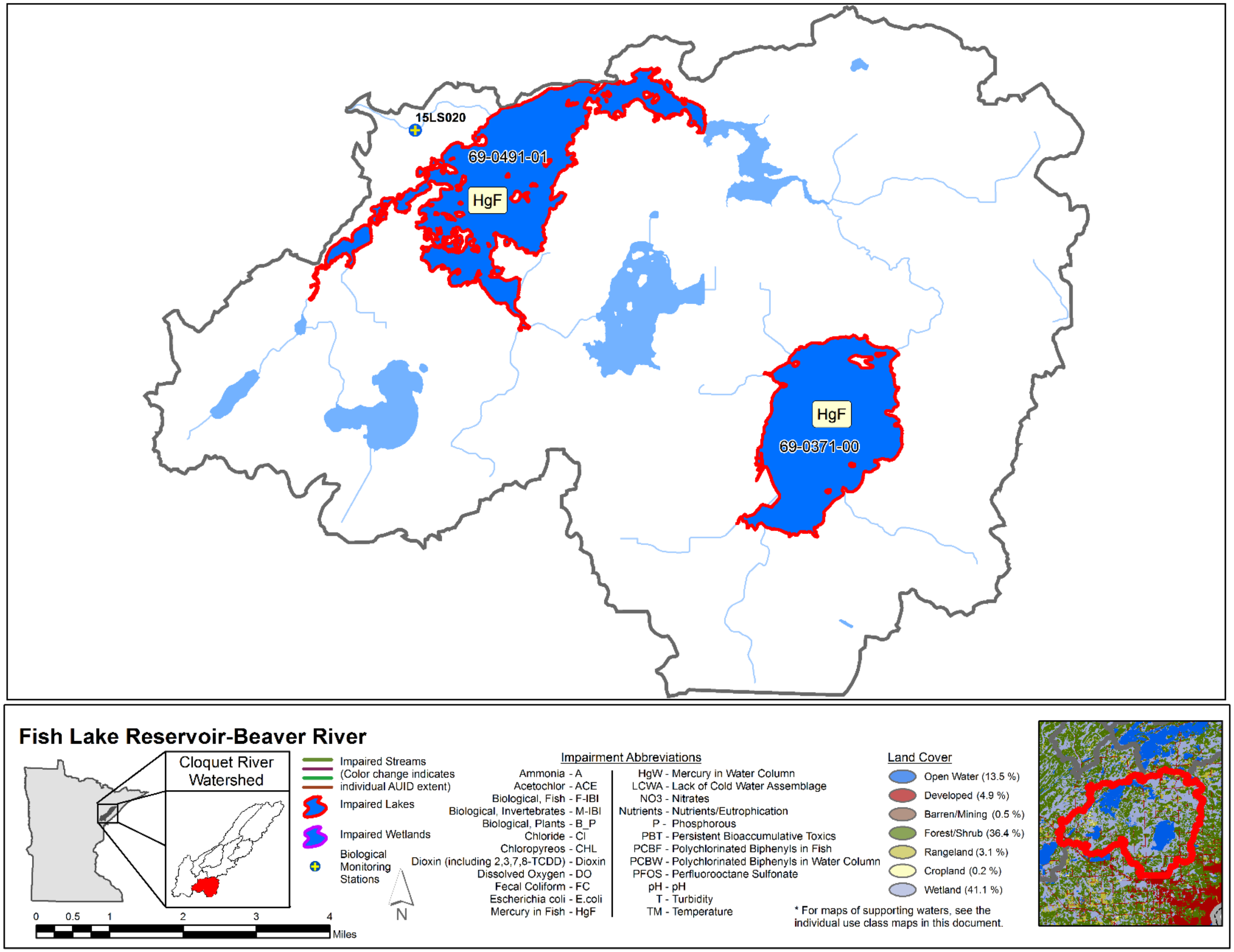


Wild Rice Lake is the other large, water-storage reservoir in this sub-watershed; this lake flows into Fish Lake via the Beaver River. Wild Rice is a very shallow lake surrounded by wetlands; most of the reservoir is less than two meters deep. Despite having a robust cool and warm water sport fishery, this waterbody has experienced winterkills in the past.

Wild Rice Lake had variable water quality; with average concentrations exceeding the water quality standards (Figure 36). The lake is not being assigned an impairment at this time, as the error around the average phosphorus concentration includes the water quality standard and the Secchi data is biased by tanning staining. Small increases in phosphorus would lead to a future impairment. Secchi has been relatively stable in the lake since monitoring began in 1990.

Mirror Lake is the final lake in the subwatershed with assessment level data. Mirror is currently managed for brown trout, although the lake has recently been stocked with walleye. Mirror is a high quality lake that fully supports aquatic recreation; all three eutrophication parameters met standards protective of stream trout lakes.

Figure 37. Currently listed impaired waters by parameter and land use characteristics in the Fish Lake Reservoir Aggregated 12-HUC.



Us-Kab-Wan-Ka Aggregated 12-HUC

HUC 0401020206-02

The Us Kab Wan Ka Subwatershed is located in the Southwest corner of the Cloquet River Watershed. Draining an area of roughly 40 square miles, it is the smallest contributing subwatershed to the Cloquet River and entirely within St. Louis County. The Us Kab Wan Ka River, its major reach, originates from Rush Lake, an approximately 250 acre basin located in the far northeast corner of the subwatershed within the Cloquet Valley State Forest. The River flows approximately 20 miles in a most southerly direction prior to its confluence with the Cloquet River. The Rivers name in the Ojibwe language is *askibwaanikaa-ziibi* which translates to “River full of Jerusalem artichokes”. The Us Kab Wan Ka is a coldwater stream which has a history of sustaining healthy populations of both Brook and Brown Trout, and continues to be managed for these species.

Table 14. Aquatic life and recreation assessments on stream reaches: Us-Kab-Wan-Ka Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach name*,** *Reach description*	Biological station ID	Reach length (miles)	Use class	Aquatic life indicators: Fish IBI	Invert IBI	Dissolved oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic life**	**Aquatic Rec. (Bacteria)**
04010202-510 **Us Kab Wan Ka River** **Headwaters (Rush Lk 69-0374-00) to Cloquet R**	97LS026,15LS002	19.72	CWg	MTS	MTS	IF	IF	MTS	-	MTS	MTS	-	IF	SUP	SUP

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

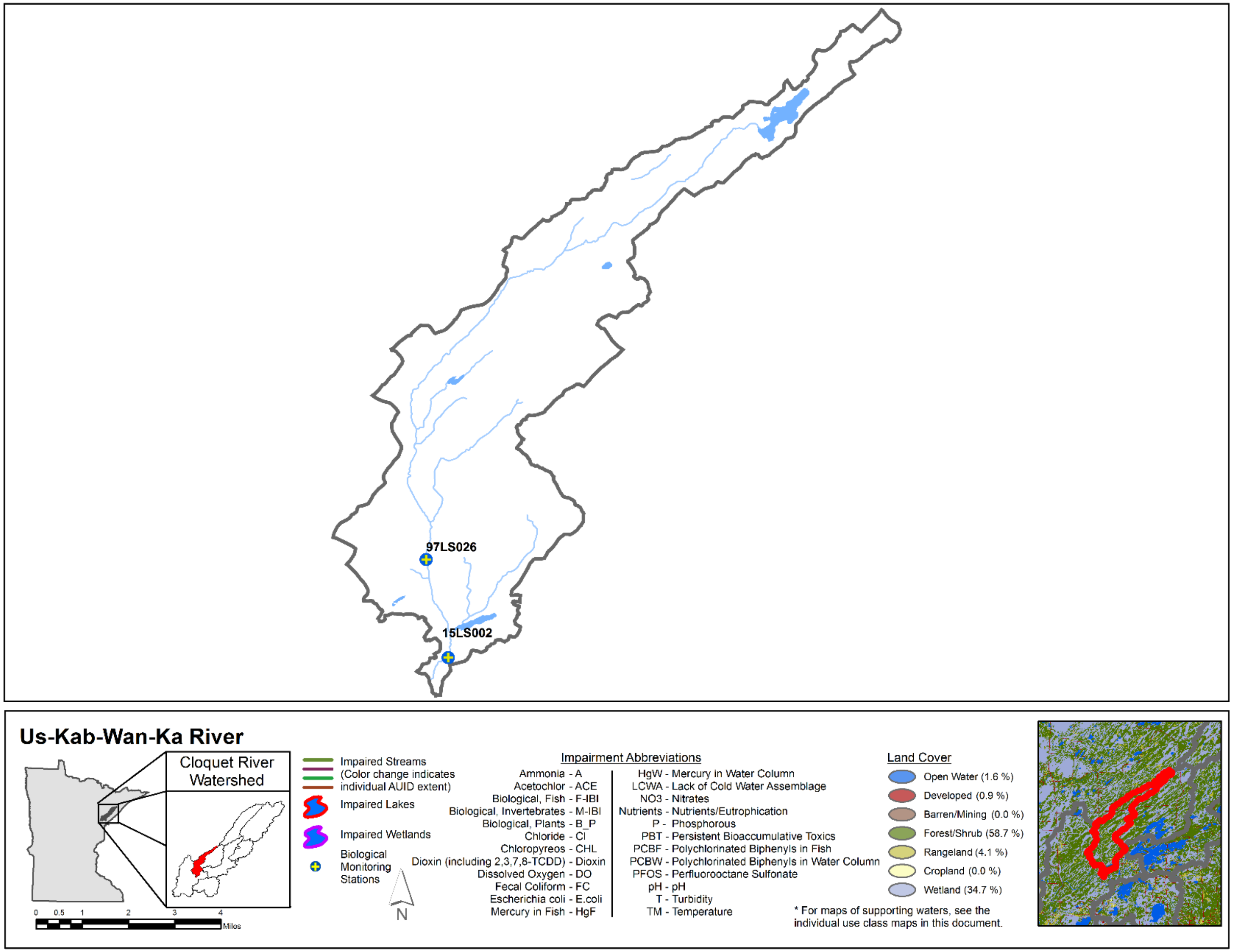
Summary

Biological communities collected within the Us Kab Wan Ka Subwatershed indicate support for aquatic life. The Us Kab Wan Ka River is a coldwater reach that supports trout and other aquatic communities that depend on cold water temperatures. The river has long been managed for these communities through both management and stocking efforts. Fish and macroinvertebrates were sampled at two monitoring stations on the Us Kab Wan Ka River. The fish community included good numbers of sensitive and coldwater indicative species such as mottled sculpin, longnose dace, and burbot. Brook and Brown Trout were also collected at the upstream station. The FIBI score was better at the upstream station than at the downstream station, however both stations indicated support for aquatic life. The macroinvertebrate IBI scores were similarly good. Habitat conditions were very good to excellent at both stations as indicated by the MSHA surveys.

The water chemistry monitoring site for this watershed was located at Lost Lake Road about one mile south of the community of Taft. Much of the Us-Kab-Wan-Ka River drains public forests and wetlands in the remote portion of the Cloquet Valley State Forest. Overall, the water chemistry data suggests that water quality is excellent in the Us-Kab-Wan-Ka River. Nutrient and sediment levels were low, and oxygen levels regularly met the cold water standard (7 mg/L). *E. coli* bacteria concentrations were also consistently low in this watershed, and indicated full support for aquatic recreation.

This watershed contains very few lakes, the largest being Rush Lake, which forms the headwaters of the River. Rush Lake does not have a public access and therefore was not monitored or assessed.

Figure 38. Currently listed impaired waters by parameter and land use characteristics in the Us Kab Wan Ka Aggregated 12-HUC.



Lower Cloquet Aggregated 12-HUC

HUC 0401020206-01

The Lower Cloquet River Subwatershed is the most downstream contributor to the Cloquet River from downstream of Island Lake to its confluence with the St. Louis River. Draining an area of roughly 144 square miles, it is one of the largest subwatersheds and is entirely within St. Louis County. Similar to the Middle and Upper Cloquet Subwatersheds, it is primarily a “flow through” subwatershed containing the lower portion of the Cloquet River which runs through its center. Tributaries to the Cloquet River which make up this subwatershed include Chicken Creek, Hellwig Creek, Chalberg Creek, Cemetary Creek, and Beartrap Creek. All of these streams are designated as coldwater reaches for either a portion if not all their length, and average between five and ten miles long.

Table 15. Aquatic life and recreation assessments on stream reaches: Lower Cloquet Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach name,*** *Reach description*	**Biological station ID**	**Reach length (miles)**	**Use class**	**Aquatic life indicators:** Fish IBI	Invert IBI	Dissolved oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication	**Aquatic life**	**Aquatic Rec. (Bacteria)**
04010202-504 **Cloquet River** **Island Lake Reservoir to Beaver R**	15LS003	7.54	WWg	MTS	IF	IF	IF	MTS	-	MTS	MTS	-	IF	IF	SUP
04010202-662 **Sullivan Creek** **Headwaters to Cloquet R**	15LS026	4.27	WWg	EXS	-	IF	IF	IF	-	IF	IF	-	-	IF	NA
04010202-672 **Hellwig Creek** **Unnamed Cr to Unnamed Cr (T52 R17 S15 (East line?)**	98LS019		WWg	EXP	EXP	IF	IF	IF	-	IF	IF	-	-	IMP	NA
04010202-533 **Chalberg Creek** **Beaver Lk (69-0507-00) to Cloquet R**	15LS021	5.47	CWg	MTS	IF	IF	IF	IF	-	IF	IF	-	-	SUP	NA
04010202-532 **Cemetary Creek** **T51 R17W S4, north line to Cloquet R**	15LS031	2.59	CWg	MTS	MTS	IF	IF	IF	-	IF	IF	-	-	SUP	NA

04010202-521 **Beartrap Creek** **T51 R17W S25, south line to Cloquet R**	01LS006	7.09	CWg	EXP	EXP	IF	IF	IF	-	IF	IF	-	-	IMP	NA
04010202-501 **Cloquet River** **Us-kab-wan-ka R to St Louis R**	15LS001	17.9	WWg	MTS	MTS	IF	MTS	MTS	MTS	MTS	MTS	-	MTS	SUP	SUP

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

Table 16. Lake assessments: Lower Cloquet Aggregated 12-HUC.

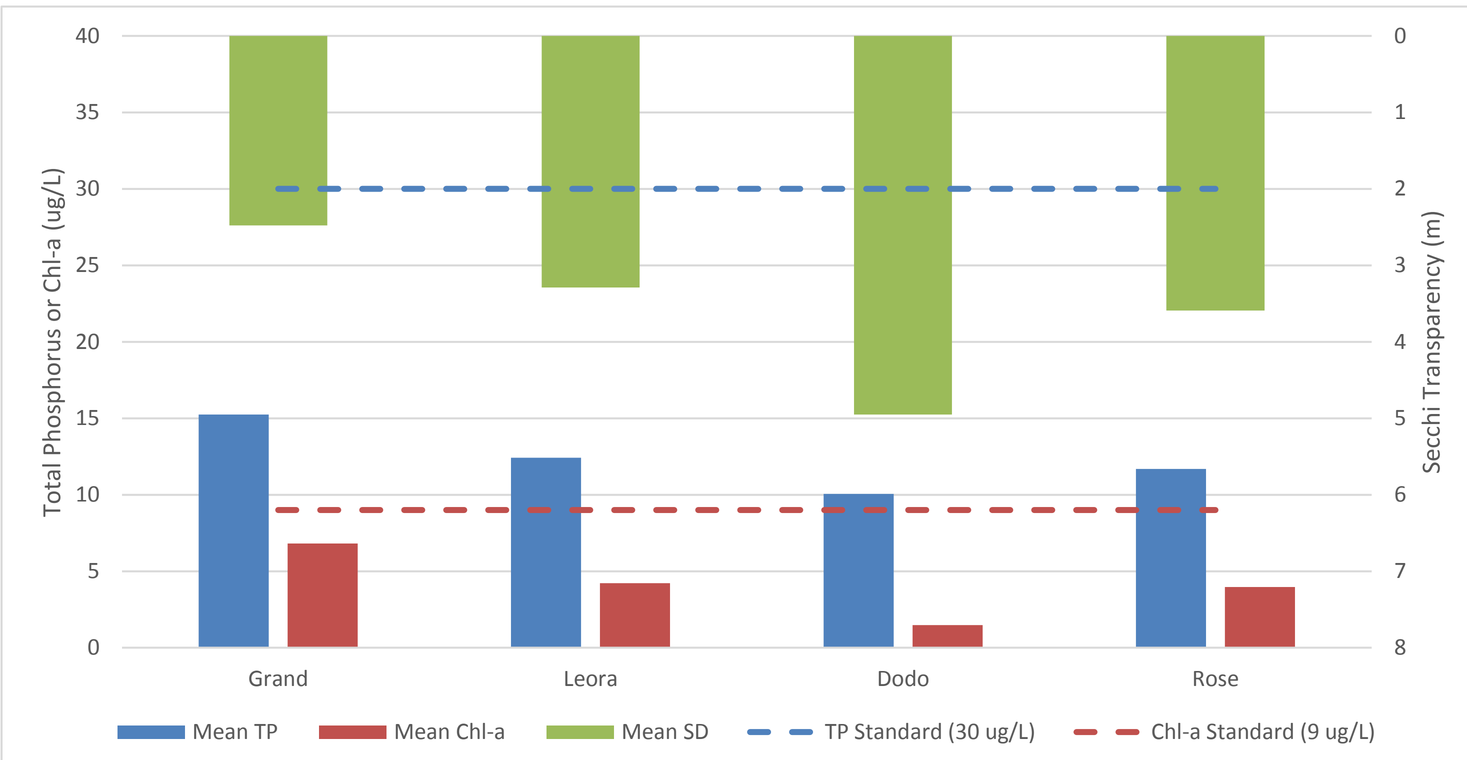
							Aquatic life indicators:			Aquatic recreation indicators:				
Lake name	DNR ID	Area (acres)	Max depth (ft)	Assessment method	Ecoregion	Secchi Trend	Fish IBI	Chloride	Pesticides ***	Total phosphorus	Chlorophyll-a	Secchi	Aquatic life use	Aquatic recreation use
Grand	69-0511-00	1,668	24	Shallow Lake	NLF	D	NA	NA	NA	MTS	MTS	MTS	NA	FS
Little Grand	69-0513-00	174	58	Deep Lake	NLF	--	NA	NA	NA	IF		MTS	NA	IF
Side (Bowman)	69-0519-00	42	18	Shallow Lake	NLF	NT	NA	NA	NA	IF		IF	NA	IF
Leora	69-0521-00	257	35	Deep Lake	NLF	I	NA	NA	NA	MTS	MTS	MTS	NA	FS
Winkle	69-0522-00	34	14	Shallow Lake	NLF	--	NA	NA	NA	IF	IF	IF	NA	IF
Dodo	69-0523-00	88	53	Deep Lake	NLF	I	NA	NA	NA	MTS	MTS	MTS	NA	FS
Rose	69-0525-00	57	31	Deep Lake	NLF	D	NA	NA	NA	MTS	MTS	MTS	NA	FS

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

Summary

The Lower Cloquet Subwatershed is the most downstream subwatershed of the Cloquet drainage, and the only subwatershed where there were aquatic life impairments not attributed to natural background conditions. Major reaches include the main-stem of the Cloquet River, and several tributary reaches including some that are designated coldwater (e.g. Beartrap Creek, Cemetary Creek, Hellwig Creek, and Chalberg Creek). Seven reaches were assessed for aquatic life. On the Cloquet River mainstem, fish and macroinvertebrates indicators suggested support for aquatic life but, unlike its upstream segments, this lower reach was not designated as Exceptional. Fish and macroinvertebrates were impaired on Hellwig Creek and Beartrap Creek. No coldwater fish were found on Hellwig Creek, contradicting its coldwater designation. A review of water temperature collected at the biological monitoring site suggested that the stream would be more suitably designated as warmwater. The segment of Hellwig Creek that was sampled is a low gradient, wetland type stream with little groundwater influence. It was assessed using low gradient criteria.

Figure 39. Water quality summary of assessed lakes in the Lower Cloquet Subwatershed.

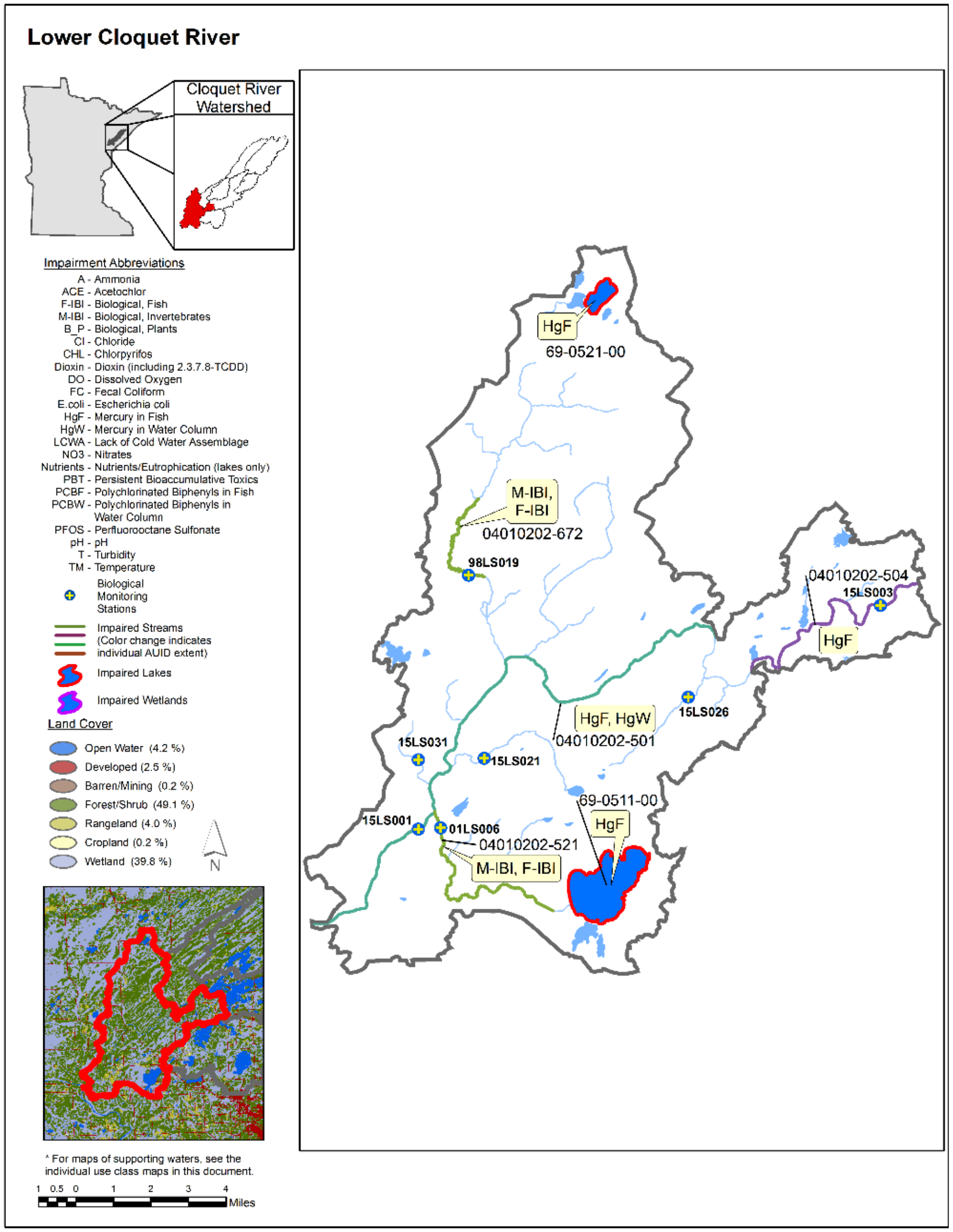


The water chemistry site for this watershed was located on County Road 7. There is also a WPLMN load monitoring site on the same stream segment, located half a mile downstream of the water chemistry site on County Road 694 - so a robust dataset was available to assess for aquatic life based on water chemistry.

This reach of the Cloquet River had excellent water quality. Phosphorus and chlorophyll-a concentrations were consistently low. In this high gradient river segment, oxygen regularly attained the 7 mg/L standard that protect the river's cold water fisheries. None of the 44 dissolved oxygen samples collected over seven years were below the standard. Phosphorus concentrations averaged 28 µg/L; slightly higher than upstream reaches. The higher phosphorus concentrations were expected because of the watershed's forest and wetlands, and the influence of upstream tributaries and reservoirs. *E. coli* bacteria concentrations were also consistently low in this watershed, and indicated full support for aquatic recreation.

Four lakes had assessment level data in this watershed: Grand Lake north of Duluth; and Rose, Dodo, and Leora lakes that form the headwaters of Hellwig Creek. Grand Lake is the largest natural lake in the watershed, and is relatively shallow, with 91% of its basin classified as littoral. This moderately developed lake has experienced winterkill in the past; the last time was in 2013-2014. Grand fully supported aquatic recreation; all three parameters met eutrophication standards (Figure 39. Water quality summary of assessed lakes in the Lower Cloquet Subwatershed. Secchi transparency is slightly declining in Grand Lake, falling by 1.6 feet per decade from the late 1990's to 2016. Leora, Dodo, and Rose Lakes, located east of Canyon are high quality waters. All of these mesotrophic lakes fully supported aquatic recreation. P concentrations were less than 15 µg/L and chlorophyll-a concentrations were less than 5 µg/L. Trends in Secchi transparency vary among the three lakes; clarity is improving on Leora and Dodo, and slightly declining on Rose. Continued citizen monitoring on these lakes is highly recommended.

Figure 40. Currently listed impaired waters by parameter and land use characteristics in the Lower Cloquet Aggregated 12-HUC.



Watershed-wide results and discussion

Assessment results and data summaries are included below for the entire HUC-8 watershed unit of the Cloquet River, grouped by sample type. Summaries are provided for lakes, streams, and rivers in the watershed for the following: aquatic life and recreation uses, aquatic consumption results, load monitoring data results, transparency trends, and remote sensed lake transparency. Waters identified as priorities for protection or restoration work were also identified. Additionally, groundwater and wetland monitoring results are included where applicable.

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

Stream water quality

Twenty-eight of the 169 stream reaches were assessed (Table 17). Of the assessed streams, 23 streams fully supported aquatic life and five streams fully supported aquatic recreation. No reaches were classified as limited resource waters.

Throughout the watershed, three reaches do not support aquatic life. All reaches with sufficient data support aquatic recreation.

Table 17. Assessment summary for stream water quality in the Cloquet River Watershed.

				Supporting		Non-supporting			
Watershed	**Area (acres)**	**# Total WIDs**	**# Assessed WIDs**	**# Aquatic life**	**# Aquatic recreation**	**# Aquatic life**	**# Aquatic recreation**	**Insufficient data**	**# Delistings**
Cloquet River **HUC 8**	**507,569**	**169**	**28**	**23**	**5**	**3**	**0**	**2**	**0**
Upper Cloquet	116,851	35	9	9	1	0	0	0	0
West Branch Cloquet	67,654	23	5	4	NA	1	NA	0	0
Little Cloquet	38,336	23	2	2	NA	0	NA	0	0
Boulder Lake	43,123	11	2	2	NA	0	NA	0	0
Middle Cloquet	74,880	12	1	1	1	0	0	0	0
Fish Lake Reservoir	48,467	9	1	1	NA	0	NA	0	0
Us Kab Wan Ka	25,874	13	1	1	1	0	0	0	0
Lower Cloquet	92,307	43	7	3	2	2	0	2	0

Lake water quality

A total of 28 lakes within the watershed had sufficient data to assess for aquatic recreation. Twenty-seven lakes fully supported aquatic recreation, and therefore met the MPCA's phosphorus or chlorophyll-a water quality standards in Minnesota's Northern Lakes and Forests Ecoregion. Sand (Loaine) Lake did not meet standards protective of its stream trout fishery; however an MPCA review of the lake's environmental setting determined these exceedances were due to natural conditions. The lakeshore is undeveloped and the watershed is dominated by forest. The Cloquet River reservoir lakes vary in quality; Island Lake had the lowest concentrations of phosphorus (P) and chlorophyll-a (Chl-a). Most of the reservoir lakes have naturally low Secchi transparency due to wetlands and the influence of the Cloquet River. Fish, Boulder, and Wild Rice lakes are productive and classified as mesotrophic; their water quality is influenced by the riverine, wetland, and forest landscapes that were inundated when the reservoirs were created in the early 1900's. Long-term trends in Secchi transparency vary among the lakes. A total of 23 lakes had sufficient data to determine temporal trends. Nine lakes have improving trends, while eight lakes have declining trends. Those lakes with declining trends, and relatively high amounts of lake-shore development, are potentially vulnerable to water quality declines. These lakes include Briar, Schultz, Pequaywan, Grand, and Rose.

Table 18. Assessment summary for lake water chemistry in the Cloquet River Watershed.

			Supporting		Non-supporting			
Watershed	**Area (acres)**	**Lakes >10 acres**	**# Aquatic life**	**# Aquatic recreation**	**# Aquatic life**	**# Aquatic recreation**	**Insufficient data**	**# Delistings**
Cloquet River **HUC 8**	**507,569**	**44**	**NA**	**28**	**NA**	**1**	**14**	**0**
Upper Cloquet	116,851	10	NA	6	NA	0	3	0
West Branch Cloquet	67,654	3	NA	2	NA	0	1	0
Little Cloquet	38,336	6	NA	2	NA	1	3	0
Boulder Lake	43,123	1	NA	1	NA	0	0	0
Middle Cloquet	74,880	13	NA	9	NA	0	4	0
Fish Lake Reservoir	48,467	4	NA	4	NA	0	0	0
Us Kab Wan Ka	25,874	0	NA	NA	NA	NA	NA	0
Lower Cloquet	92,307	7	NA	4	NA	0	3	0

Fish contaminant results

Mercury and polychlorinated biphenyls (PCBs) have been analyzed in fish tissue samples collected from the Cloquet River and 20 lakes in the Cloquet River Watershed. Fish from the Cloquet River in 2015 were collected by the MPCA biomonitoring staff. The other fish were collected by DNR fisheries staff from 1982 to 2016. Perfluorochemicals were measured in representative fish from Wild Rice (69-0491) and Fish Lake Flowage (69-0371).

The Cloquet River and 16 of the 20 tested lakes are on the 2018 Impaired Waters Inventory (IWI) for mercury in fish tissue (Table 19). Of the 16 lakes on the IWI, 10 qualified for inclusion in the Minnesota Statewide Mercury TMDL.

PCBs were tested in representative species from 11 lakes. All but one of the PCB concentrations were less than the reporting limits. The one measurable PCB concentration was 0.02 mg/kg in a walleye from Island Lake Reservoir (69-0374), collected in 1989.

Perfluorochemicals were measured in Wild Rice (69-0491) and Fish Lake Flowage (69-0371). All results of perfluorooctane sulfonate (PFOS) were above the reporting limits (~5 µg/kg), but below the threshold for listing as impaired (200 µg/kg). The fish were collected in 2008 and 2009. The relatively high PFOS concentrations for this non-urban area warrants follow-up collections and analysis.

Table 19. Fish contaminants: summary of fish length, mercury, PCB's, and PFOS by waterway-species-year.

							Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (µg/kg)			
DOWID/RIVER	Waterway/Location	Species	Year	Anat-omy[1]	Total fish	Number samples	Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
CLOQUET R.**	AT CSAH 7, IN BURNETT	Shorthead redhorse	2015	FILSK	5	5	14.8	13.1	16.8	0.178	0.113	0.290	2	0.025	0.025	Y				
		Smallmouth bass	2015	FILSK	5	5	10.9	9.9	14.1	0.183	0.093	0.437	2	0.025	0.025	Y				
	AT INDEPENDENCE	Redhorse, unknown sp.	2013	FILSK	3	3	16.8	15.9	17.6	0.330	0.240	0.508								
		Smallmouth bass	2013	FILSK	8	8	10.6	6.9	13.8	0.255	0.069	0.497								
	AT ISLAND LAKE DAM	Bluegill sunfish	2013	FILSK	5	5	7.2	6.5	7.7	0.172	0.130	0.221								
		Rock bass	2013	FILSK	1	1	5.4	5.4	5.4	0.225	0.225	0.225								
		Shorthead redhorse	2013	FILSK	1	1	16.5	16.5	16.5	0.702	0.702	0.702								
	BETWEEN HWYS 8 & 7	Shorthead redhorse	2013	FILSK	4	4	15.5	13.8	17.0	0.166	0.077	0.286								
		Smallmouth bass	2013	FILSK	22	22	11.1	9.3	14.1	0.194	0.110	0.394								
		Walleye	2013	FILSK	1	1	17.3	17.3	17.3	0.320	0.320	0.320								
38053800	KATHERINE*	Northern pike	1993	FILSK	20	3	17.7	14.4	21.6	0.273	0.210	0.400	1	0.01	0.01	Y				
		Yellow perch	1993	FILSK	9	1	7.0	7.0	7.0	0.100	0.100	0.100								
38053900	CLOQUET**	Northern pike	1994	FILSK	22	6	20.6	12.2	28.4	0.367	0.240	0.450								
			2000	FILSK	5	5	18.0	15.3	20.5	0.348	0.270	0.450								
			2010	FILSK	8	8	17.8	15.1	21.4	0.409	0.281	0.626								
			2015	FILSK	8	8	21.7	16.5	35.0	0.610	0.185	1.605								

DOWID/RIVER	Waterway/Location	Species	Year	Anat-omy[1]	Total fish	Number samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (µg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
		Walleye	1994	FILSK	12	4	18.9	15.1	23.4	0.550	0.320	0.960	2	0.01	0.01	Y				
			2000	FILSK	6	6	16.2	12.7	19.5	0.363	0.180	0.690								
			2003	FILSK	5	5	17.2	13.1	21.7	0.479	0.177	0.904								
			2010	FILSK	8	8	19.5	18.5	20.8	0.467	0.353	0.524								
			2015	FILSK	3	3	22.0	20.1	25.0	1.111	0.779	1.425								
		White sucker	1994	FILSK	5	1	19.2	19.2	19.2	0.140	0.140	0.140								
			2000	FILSK	8	1	18.1	18.1	18.1	0.190	0.190	0.190								
			2010	FILSK	5	1	17.4	17.4	17.4	0.134	0.134	0.134								
			2015	FILSK	5	1	18.1	18.1	18.1	0.131	0.131	0.131								
		Yellow perch	1994	FILSK	9	1	10.7	10.7	10.7	0.074	0.074	0.074								
			2000	FILSK	8	1	10.0	10.0	10.0	0.170	0.170	0.170								
			2003	FILSK	5	1	10.3	10.3	10.3	0.278	0.278	0.278								
			2010	FILSK	10	2	10.2	9.4	10.9	0.175	0.143	0.206								
			2015	FILSK	10	1	10.5	10.5	10.5	0.154	0.154	0.154								
38054000	SINK	Northern pike	2015	FILSK	8	8	18.8	16.1	23.3	0.449	0.308	0.782								
		Yellow perch	2015	FILSK	10	1	10.6	10.6	10.6	0.262	0.262	0.262								
38065100	KANE	Northern pike	1982	FILSK	2	1	22.5	22.5	22.5	0.520	0.520	0.520								
				WHORG	2	1	22.5	22.5	22.5											
			1985	FILSK	4	1	19.6	19.6	19.6	0.400	0.400	0.400								
				WHORG	4	1	19.6	19.6	19.6											
		Walleye	1982	FILSK	5	1	17.2	17.2	17.2	0.160	0.160	0.160								
				WHORG	5	1	17.2	17.2	17.2											
			1985	FILSK	5	1	17.7	17.7	17.7	0.680	0.680	0.680								
				WHORG	5	1	17.7	17.7	17.7											
69001100	PEQUAYWAN*	Walleye	1991	FILSK	12	3	18.1	13.9	23.1	0.397	0.180	0.560	2	0.01	0.01	Y				
69003600	SALO*	Bluegill sunfish	1989	FILSK	5	1	6.0	6.0	6.0	0.120	0.120	0.120								
		Black crappie	1998	FILSK	10	1	9.2	9.2	9.2	0.150	0.150	0.150								
			2014	FILSK	1	1	6.5	6.5	6.5	0.246	0.246	0.246								
		Northern pike	1998	FILSK	7	7	20.8	17.8	25.9	0.431	0.360	0.500								
			2014	FILSK	8	8	21.9	17.6	31.2	0.727	0.614	0.910								
		Smallmouth bass	1989	FILSK	3	2	13.0	9.8	16.2	0.450	0.130	0.770								
			1998	FILSK	4	4	14.0	11.6	15.5	0.498	0.290	0.910								

DOWID/RIVER	Waterway/Location	Species	Year	Anat-omy[1]	Total fish	Number samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (µg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
		Walleye	2014	FILSK	2	2	18.8	16.4	21.1	1.003	0.953	1.053								
		White sucker	1998	FILSK	5	1	17.8	17.8	17.8	0.082	0.082	0.082								
			2014	FILSK	3	1	15.9	15.9	15.9	0.094	0.094	0.094								
		Yellow perch	2014	FILSK	10	1	7.8	7.8	7.8	0.309	0.309	0.309								
69004100	BASSETT*	Bluegill sunfish	1993	FILSK	10	1	6.7	6.7	6.7	0.140	0.140	0.140								
		Largemouth bass	2011	FILSK	2	2	14.1	13.5	14.6	0.247	0.223	0.271								
		Northern pike	1983	FILSK	1	1	17.6	17.6	17.6	0.200	0.200	0.200								
			1993	FILSK	13	3	21.2	17.4	25.4	0.280	0.200	0.350	1	0.01	0.01	Y				
			2011	FILSK	8	8	19.8	15.8	22.1	0.178	0.116	0.243								
			2016	FILSK	8	8	22.2	17.2	29.7	0.493	0.155	0.733								
		Walleye	1983	FILSK	7	2	14.4	12.9	15.9	0.355	0.250	0.460								
			1993	FILSK	15	4	18.5	14.2	23.7	0.408	0.260	0.550	1	0.011	0.011	Y				
			2011	FILSK	8	8	14.5	11.8	19.1	0.154	0.090	0.373								
			2016	FILSK	8	8	19.4	13.2	26.5	0.547	0.250	1.048								
		White sucker	1993	FILSK	8	2	20.7	19.0	22.3	0.145	0.120	0.170	1	0.01	0.01	Y				
			2011	FILSK	5	1	19.7	19.7	19.7	0.138	0.138	0.138								
			2016	FILSK	5	1	18.2	18.2	18.2	0.158	0.158	0.158								
		Yellow perch	2011	FILSK	10	2	8.5	7.7	9.2	0.066	0.065	0.066								
			2016	FILSK	10	1	7.6	7.6	7.6	0.236	0.236	0.236								
69011300	BIG BEAR**	Northern pike	2001	FILSK	6	6	25.2	17.4	45.5	0.533	0.309	1.053	1	0.01	0.01	Y				
		White sucker	2001	FILSK	4	1	20.1	20.1	20.1	0.145	0.145	0.145								
		Yellow perch	2001	FILSK	9	1	10.1	10.1	10.1	0.258	0.258	0.258								
69012800	BRIAR	Yellow perch	1989	FILSK	5	1	11.1	11.1	11.1	0.130	0.130	0.130								
69013000	LITTLE ALDEN*	Bluegill sunfish	2001	FILSK	9	1	7.2	7.2	7.2	0.107	0.107	0.107								
		Walleye	2001	FILSK	6	6	14.5	11.9	17.1	0.337	0.211	0.465								
		White sucker	2001	FILSK	3	1	17.2	17.2	17.2	0.196	0.196	0.196								
69013100	ALDEN**	Black crappie	2001	FILSK	9	1	7.7	7.7	7.7	0.260	0.260	0.260								
		Shorthead redhorse	2001	FILSK	4	1	17.0	17.0	17.0	0.283	0.283	0.283								
		Walleye	2001	FILSK	6	6	14.2	12.2	18.6	0.597	0.467	0.760								
69014300	WOLF**	Black crappie	1994	FILSK	8	1	10.9	10.9	10.9	0.250	0.250	0.250								
			2001	FILSK	4	1	10.9	10.9	10.9	0.223	0.223	0.223								
		Northern pike	1994	FILSK	15	4	18.0	12.5	23.1	0.388	0.320	0.500								

DOWID/RIVER	Waterway/Location	Species	Year	Anat-omy[1]	Total fish	Number samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (µg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
		Walleye	1991	FILSK	7	7	11.9	8.2	22.3	0.289	0.130	0.750								
			1994	FILSK	19	5	18.6	13.1	25.1	0.710	0.380	1.400	1	0.01	0.01	Y				
			2001	FILSK	6	6	17.8	13.3	26.5	0.641	0.265	1.412								
			2009	FILSK	12	12	12.7	10.0	17.1	0.371	0.250	0.791								
		White sucker	1994	FILSK	8	1	20.0	20.0	20.0	0.310	0.310	0.310								
			2001	FILSK	5	1	17.6	17.6	17.6	0.215	0.215	0.215								
69037100	WILD RICE*	Bluegill sunfish	2008	FILSK	5	5	7.5	7.1	8.3								5	61.82	88.6	
			2009	FILSK	6	2	7.5	7.4	7.6	0.060	0.060	0.060					1	68.8	68.8	
		Black crappie	2008	FILSK	5	5	8.9	5.9	11.4								5	164	213	
			2009	FILSK	6	2	9.1	9.1	9.1	0.053	0.053	0.053					1	94.8	94.8	
		Northern pike	1995	FILSK	30	30	21.8	13.8	35.6	0.183	0.060	0.710	1	0.01	0.01	Y				
			2000	FILSK	30	30	22.1	17.5	36.2	0.168	0.027	0.550								
			2004	FILSK	26	26	23.8	13.9	40.0	0.179	0.075	0.598								
			2008	FILSK	5	5	18.7	17.3	23.2								5	120.7	146	
			2009	FILSK	29	29	22.0	17.2	26.8	0.167	0.092	0.350					5	30.5	71.2	
			2014	FILSK	15	15	24.7	19.8	41.2	0.243	0.114	0.865								
		Walleye	1991	FILSK	25	25	13.2	9.4	28.0	0.107	0.040	0.560								
			1995	FILSK	38	38	16.8	11.0	23.3	0.199	0.050	0.590	1	0.01	0.01	Y				
			2000	FILSK	31	31	17.1	10.1	29.7	0.225	0.076	0.710								
			2004	FILSK	27	27	16.6	10.9	24.8	0.175	0.052	0.378								
			2008	FILSK	5	5	16.4	13.0	19.7								5	131.7	163	
			2009	FILSK	29	29	16.6	12.2	22.4	0.134	0.062	0.364					5	125.3	185	
			2014	FILSK	8	8	17.9	12.9	25.0	0.233	0.094	0.384								
		White sucker	1995	FILSK	5	1	18.8	18.8	18.8	0.095	0.095	0.095	1	0.01	0.01	Y				
		Yellow perch	1995	FILSK	10	1	10.0	10.0	10.0	0.077	0.077	0.077								
69037200	ISLAND LAKE RES.**	Bluegill sunfish	2006	FILSK	10	10	8.4	7.9	9.0	0.208	0.114	0.289								
		Black crappie	2006	FILSK	10	10	8.4	4.6	11.3	0.157	0.064	0.303								
		Northern pike	1983	FILSK	3	1	16.1	16.1	16.1	0.730	0.730	0.730								
			1989	FILSK	8	2	20.8	19.5	22.1	0.425	0.360	0.490								
			1994	FILSK	40	40	18.1	11.2	27.7	0.400	0.150	1.000								
			1998	FILSK	22	22	21.0	16.3	25.8	0.518	0.190	1.230								
			2003	FILSK	30	30	18.5	14.2	23.2	0.367	0.177	0.667								

DOWID/RIVER	Waterway/Location	Species	Year	Anatomy[1]	Total fish	Number samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (µg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
			2006	FILSK	24	24	21.0	11.1	29.7	0.398	0.114	1.190								
			2012	FILSK	12	12	21.0	16.9	28.6	0.377	0.237	0.589								
		Rock bass	2006	FILSK	10	10	7.7	5.0	10.5	0.293	0.123	0.581								
		Pumpkinseed sunfish	2006	FILSK	7	7	7.0	6.5	7.7	0.136	0.118	0.159								
		Smallmouth bass	2006	FILSK	10	10	11.7	6.9	16.2	0.271	0.124	0.646								
		Walleye	1983	FILSK	12	2	15.5	12.3	18.6	0.780	0.630	0.930								
			1989	FILSK	11	3	16.4	12.7	20.6	0.933	0.440	1.540	1	0.02	0.02					
			1991	FILSK	13	13	15.4	9.8	25.9	0.493	0.170	1.020								
			1994	FILSK	51	45	17.1	10.4	25.9	0.752	0.220	2.110	2	0.01	0.01	Y				
			1998	FILSK	43	43	14.6	6.9	25.7	0.494	0.110	1.130								
			2003	FILSK	31	31	13.7	11.1	18.1	0.480	0.237	1.047								
			2006	FILSK	34	34	13.0	6.8	21.3	0.431	0.182	0.877								
		White sucker	1994	FILSK	8	1	18.5	18.5	18.5	0.205	0.205	0.205								
		Yellow perch	1994	FILSK	10	1	9.0	9.0	9.0	0.520	0.520	0.520								
			2006	FILSK	10	10	8.5	6.3	11.7	0.347	0.193	0.842								
				WHORG	14	5	7.2	6.4	8.1	0.283	0.207	0.402								
69037300	BOULDER*	Black bullhead	1993	FILET	10	1	8.9	8.9	8.9	0.200	0.200	0.200								
		Northern pike	1993	FILSK	28	12	22.5	18.2	37.5	0.424	0.320	0.530	1	0.01	0.01	Y				
			1997	FILSK	21	21	19.6	13.3	29.2	0.328	0.120	0.570	1	0.01	0.01	Y				
			2008	FILSK	30	30	21.3	13.2	29.3	0.263	0.145	0.556								
			2013	FILSK	15	15	20.9	14.6	26.2	0.460	0.276	0.593								
		Walleye	1991	FILSK	13	13	13.9	11.5	19.0	0.280	0.180	0.580								
			1993	FILSK	49	25	15.7	8.7	28.6	0.446	0.100	1.400	1	0.01	0.01	Y				
			1997	FILSK	19	19	15.2	8.5	28.0	0.404	0.100	1.100	1	0.01	0.01	Y				
			2008	FILSK	28	28	12.9	10.0	17.5	0.165	0.121	0.304								
		Yellow perch	1993	FILSK	10	1	8.9	8.9	8.9	0.140	0.140	0.140								
69048900	CARIBOU*	Black crappie	2015	FILSK	10	1	8.6	8.6	8.6	0.090	0.090	0.090								
		Largemouth bass	2015	FILSK	8	8	14.3	11.5	16.6	0.254	0.127	0.451								
		Northern pike	1986	FILSK	7	2	21.7	21.7	21.7											
			1987	FILSK	6	3	20.5	18.4	21.9	0.117	0.100	0.140	3	0.01	0.01	Y				
				WHORG	3	1	23.4	23.4	23.4											
			2007	FILSK	6	6	18.0	13.7	23.3	0.155	0.087	0.398								

DOWID/RIVER	Waterway/Location	Species	Year	Anat-omy[1]	Total fish	Number samples	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (µg/kg)			
							Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	Max	< RL
			2015	FILSK	8	8	23.8	19.4	26.6	0.180	0.144	0.241								
		Walleye	1987	FILSK	10	2	13.1	12.6	13.6	0.205	0.190	0.220	2	0.01	0.01	Y				
			2015	FILSK	7	7	19.9	17.1	22.5	0.310	0.227	0.419								
		White sucker	1987	FILSK	2	1	10.1	10.1	10.1	0.020	0.020	0.020	1	0.01	0.01	Y				
			2015	FILSK	4	1	15.6	15.6	15.6	0.019	0.019	0.019								
69049100	FISH LAKE FLOWAGE*	Bluegill sunfish	2008	FILSK	5	5	7.7	6.7	8.3								5	42.62	57.3	
		Black crappie	1993	FILSK	9	1	10.2	10.2	10.2	0.140	0.140	0.140								
			2008	FILSK	5	5	9.5	7.3	10.2								5	86.76	103	
			2010	FILSK	5	5	9.2	6.9	10.2								5	102.36	164	
		Largemouth bass	2008	FILSK	5	5	13.9	12.6	14.6								5	88.24	124	
			2010	FILSK	4	4	12.5	10.8	13.6								4	179	206	
		Northern pike	1983	FILSK	10	2	19.6	16.5	22.6	0.230	0.190	0.270	1	0.02	0.02	Y				
			1987	FILSK	35	8	22.8	18.3	31.2	0.331	0.140	0.730	3	0.0167	0.02	Y				
			1993	FILSK	10	10	17.8	14.7	22.5	0.140	0.080	0.250								
			1999	FILSK	28	28	18.4	14.9	23.0	0.115	0.009	0.186								
			2005	FILSK	21	21	22.1	16.0	29.2	0.144	0.091	0.241								
			2008	FILSK	5	5	18.7	16.9	20.1								5	47.1	82.7	
			2010	FILSK	24	24	19.4	16.3	28.2	0.139	0.064	0.403								
		Walleye	1983	FILSK	20	4	17.6	13.8	20.8	0.345	0.170	0.540	1	0.02	0.02	Y				
			1987	FILSK	10	2	15.1	13.6	16.5	0.210	0.190	0.230	2	0.02	0.02	Y				
			1991	FILSK	9	9	13.9	9.1	20.0	0.197	0.070	0.450								
			1993	FILSK	51	34	14.2	8.1	22.9	0.205	0.040	0.580	1	0.01	0.01	Y				
			1999	FILSK	32	32	16.4	11.1	25.2	0.210	0.079	0.690								
			2005	FILSK	27	27	17.0	10.6	24.2	0.238	0.085	0.605								
			2008	FILSK	5	5	14.1	12.2	17.5								5	87.14	116	
			2010	FILSK	24	24	16.5	10.6	27.3	0.147	0.071	0.598								
		White sucker	1987	FILSK	5	1	18.6	18.6	18.6	0.210	0.210	0.210								
				WHORG	5	1	18.0	18.0	18.0				1	0.05	0.05	Y				
			1993	FILSK	8	1	20.2	20.2	20.2	0.140	0.140	0.140	1	0.01	0.01	Y				
69051100	GRAND**	Black bullhead	2010	FILET	3	1	11.5	11.5	11.5	0.119	0.119	0.119								
		Black crappie	2010	FILSK	10	2	9.9	9.0	10.8	0.095	0.061	0.128								
		Largemouth bass	2010	FILSK	7	7	14.7	13.6	15.6	0.324	0.273	0.407								

DOWID/RIVER	Waterway/Location	Species	Year	Anat-omy[1]	Total fish	Number samples	Length (in) Mean	Length (in) Min	Length (in) Max	Mercury (mg/kg) Mean	Mercury (mg/kg) Min	Mercury (mg/kg) Max	PCBs (mg/kg) N	PCBs (mg/kg) Mean	PCBs (mg/kg) Max	PCBs (mg/kg) < RL	PFOS (µg/kg) N	PFOS (µg/kg) Mean	PFOS (µg/kg) Max	PFOS (µg/kg) < RL
		Northern pike	2010	FILSK	8	8	20.2	16.5	27.1	0.196	0.110	0.261								
		Walleye	2010	FILSK	7	7	21.0	19.0	23.5	0.640	0.446	0.920								
69052100	LEORA*	Black crappie	1998	FILSK	9	1	10.0	10.0	10.0	0.050	0.050	0.050								
			2011	FILSK	2	1	11.6	11.6	11.6	0.131	0.131	0.131								
		Largemouth bass	2011	FILSK	1	1	12.1	12.1	12.1	0.129	0.129	0.129								
		Northern pike	1998	FILSK	10	10	20.4	16.5	24.8	0.213	0.130	0.280								
			2011	FILSK	8	8	19.1	15.1	29.4	0.208	0.180	0.318								
		Walleye	1998	FILSK	7	7	15.5	12.7	23.1	0.145	0.096	0.290								
			2011	FILSK	7	7	19.0	11.8	24.8	0.331	0.147	0.577								
		White sucker	1998	FILSK	5	1	18.2	18.2	18.2	0.021	0.021	0.021								
			2011	FILSK	2	1	13.9	13.9	13.9	0.015	0.015	0.015								
69095100	UNNAMED	Rainbow trout	1986	FILSK	4	1	17.5	17.5	17.5	0.230	0.230	0.230								

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

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

1 Anatomy codes: FILSK – edible fillet, skin-on; FILET—edible fillet, skin-off; BIOPSY or PLUG—dorsal muscle piece, without skin; WHORG—whole organism; NOHV-organism without head or viscera; PLUSK-dorsal muscle with skin;

Pollutant load monitoring

The WPLMN has two sites within the Cloquet River Watershed as shown in Table 20.

Table 20. WPLMN Stream Monitoring Sites for the Cloquet River Watershed

Site type	Stream name	USGS ID	DNR/MPCA ID	EQuIS ID
Major Watershed	Cloquet River nr Burnett, CR694	NA	H04048001	S005-147
Subwatershed	Cloquet River nr Brimson, CSAH 44	NA	H04012001	S007-610

Statewide average annual FWMCs of TSS, TP, and NO_3+NO_2-N for Minnesota's major watersheds, with the Cloquet River Watershed highlighted, are presented below. Water runoff, a significant factor in pollutant loading, is also shown. Water runoff is the portion of annual precipitation that makes it to a river or stream; thus it can be expressed in inches.

As a general rule, elevated levels of TSS and NO_3+NO_2-N are regarded as "non-point" source derived pollutants originating from many small diffuse sources such as urban or agricultural runoff. Excess TP can be attributed to both non-point as well as point sources such as industrial or 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.

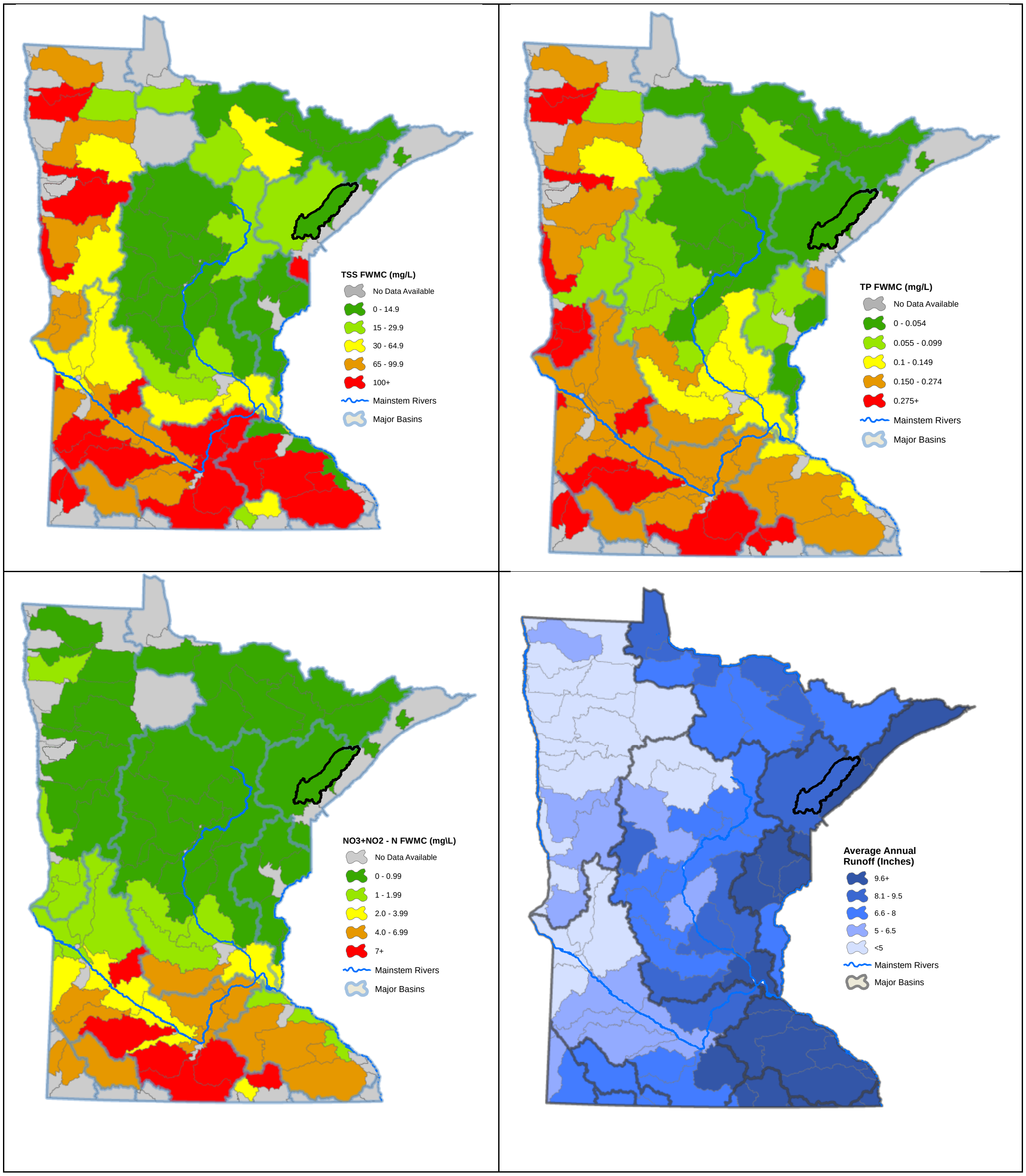
Excessive TSS, TP, and NO_3+NO_2-N in surface waters impacts fish and other aquatic life, as well as fishing, swimming and other recreational uses. High levels of NO_3+NO_2-N is a concern for drinking water.

NO_3+NO_2-N concentrations measured from the Cloquet River were comparable to those from other similar size watersheds in the Lake Superior Basin. There were 189 samples were collected between 2009 and 2015 with a mean concentration of 0.101 mg/L. Flow weighted mean NO_3+NO_2-N concentrations ranged between 0.06 and 0.17 mg/L, all very low values from a statewide perspective.

Total suspended solids levels measured from the Cloquet River were similarly low compared to other watershed outlet sites in the Lake Superior Basin and across the state. The mean TSS concentration of the 192 samples collected between 2009 and 2015 was 3.9 mg/L, with 1% of those samples exceeding the state water quality TSS standard of 15 mg/L for the Northern River Nutrient Region (NRNR).

Total phosphorus concentrations measured from the Cloquet River were also generally low to very low. Of the 151 TP samples collected over the seven year monitoring period, only two samples collected during the summer months of June, July and August exceeded the TP water quality standard of 0.05 mg/L for the NRNR. The mean TP concentration of the samples was 0.024 mg/L. The FWMCs were all below the NRNR standard.

Figure 41. 2007-2015 Average annual TSS, TP, and NO3-NO2-N FWMCs, and runoff by major watershed.

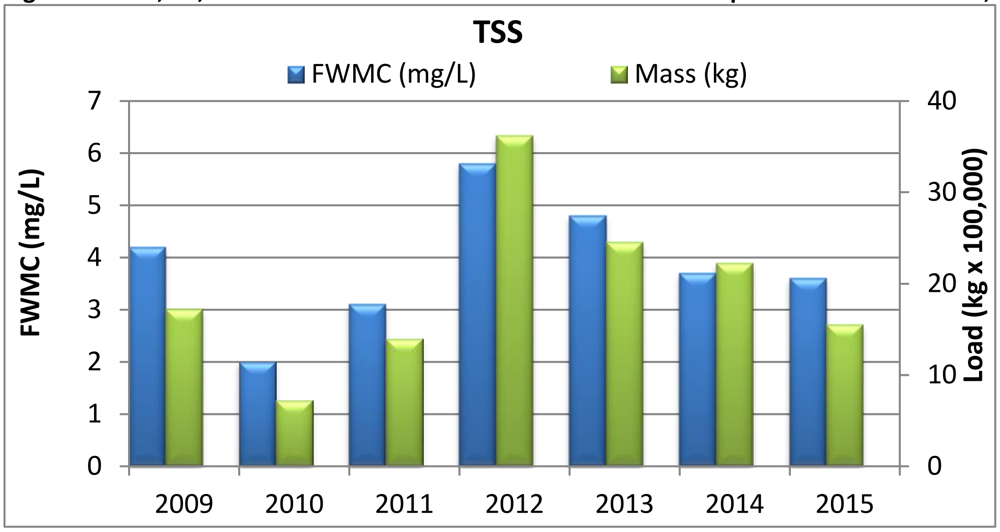


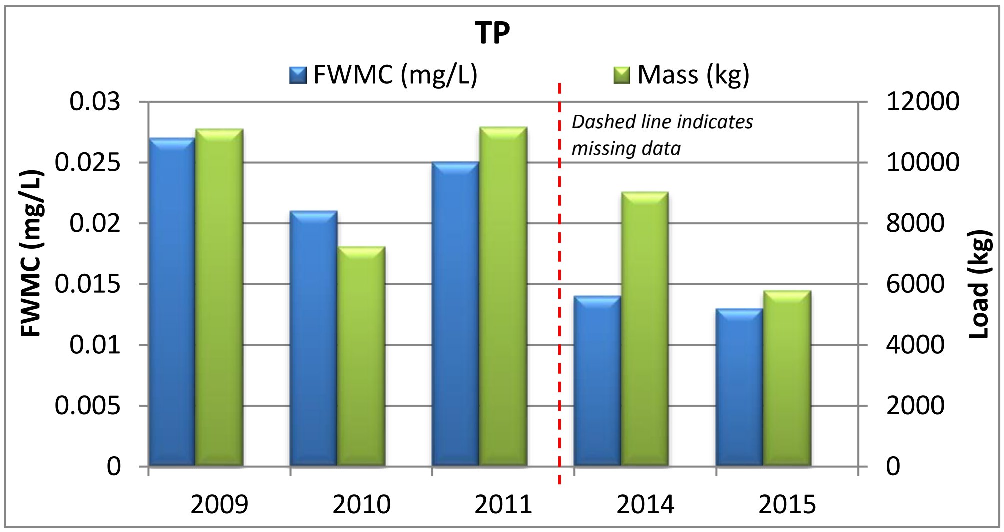
When compared with other major watersheds throughout the state, Figure 41 shows the average annual TSS, TP, and NO_3+NO_2-N FWMCs to be several times lower for the Cloquet River Watershed than watersheds in western and southern Minnesota. In general, the Cloquet River Watershed is one of Minnesota's more pristine watersheds.

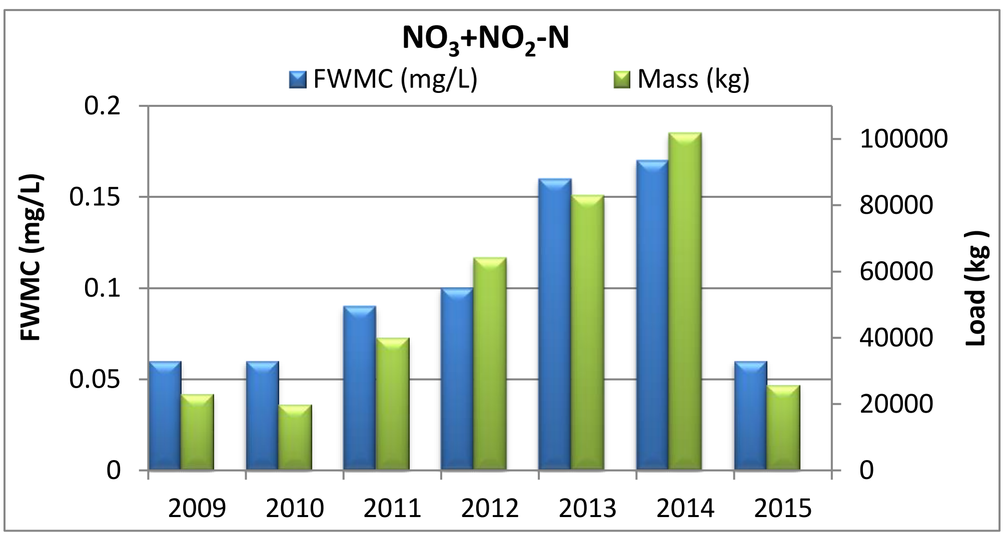
More information, including results for subwatershed stations, can be found at the WPLMN website.

Substantial year-to-year variability in water quality occurs for most rivers and streams, including the Cloquet River. Results for individual years are shown in the charts (Figure 42) that follow.

Figure 42. TSS, TP, and NO3+NO2-N FWMCs and loads for the Cloquet River near Burnett, MN.







Groundwater monitoring

Stream flow

Streamflow data from the USGSs real-time streamflow gaging stations for the Cloquet River was analyzed for annual mean discharge and summer monthly mean discharge (July and August). Figure 43 is a display of the annual mean streamflow for the Cloquet River near Burnett, Minnesota from 2010 to 2017. The data appears to be increasing over time, but with a minor statistical trend ($p<0.1$). Figure 44 displays July and August mean flows, which also appear to be increasing in July and August, but neither at a statistically significant rate. By way of comparison at a state level, summer month flows have declined at a statistically significant rate at a majority of streams selected randomly for a study of statewide trends (Streitz, 2011). For additional streamflow data throughout Minnesota, please visit the USGS website: http://waterdata.usgs.gov/mn/nwis/rt or the DNR website: http://www.dnr.state.mn.us/waters/csg/index.html.

Figure 43. Annual mean streamflow for the Cloquet River near Burnett, MN (2010-2017) (Source: DNR, 2017c).

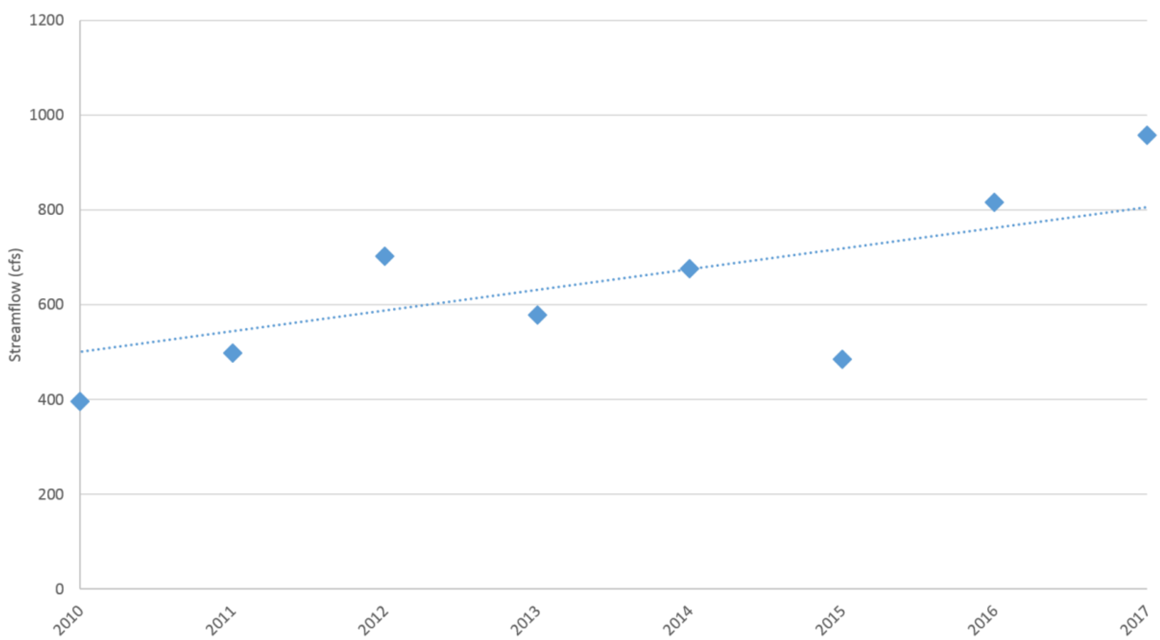
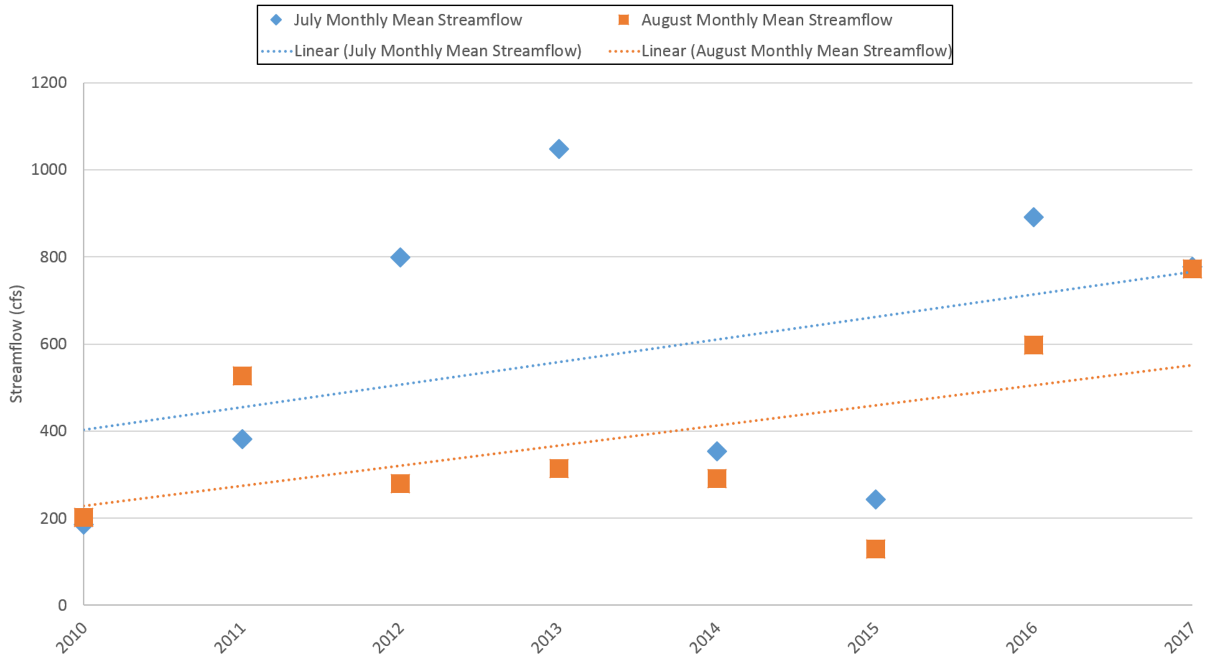


Figure 44. Monthly mean streamflow for the Cloquet River near Burnett, MN (2010-2017) (Source: DNR, 2017c).



Groundwater protection should be considered both for quantity and quality. Quantity is based on the amount of water withdrawn versus the amount of water being recharged to the aquifer. Groundwater withdrawals in the watershed have increased at a statistically significant rate ($p<0.01$) from 1996 to 2015, despite there only being one active high capacity permittee in 2015. Surface water withdrawals have also increased during this time period ($p<0.1$). The average potential groundwater recharge for this watershed is twice the statewide average, indicating that groundwater is being adequately replenished.

The Cloquet River Watershed has a limited amount of groundwater quality data available. Baseline water quality data indicated that the Northeast region has groundwater quality that is considered good, despite some exceedances to drinking water criteria. MDH determined that this area also had some exceedances of the arsenic MCL. Arsenic is primarily naturally occurring and can be linked to presence of a clay layer and low dissolved oxygen levels, often associated with the Des Moines glacial lobe till, which is abundant in this region. The pollution sensitivity of near-surface materials throughout the watershed is primarily low to moderate, but there is an area with high pollution sensitivity in the south and central regions of the watershed (refer to Figure 15). This area correlates with sand and gravel quaternary geology and may experience a possible risk of contamination due to high infiltration rates.

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

Wetland Condition

Wetland vegetation quality is generally high in Minnesota (MPCA 2015). This is driven by the large share of wetlands located in Minnesota's northern forest ecoregion where development and resulting wetland quality impacts are much less widespread compared to the rest of the state. Wetlands that are in exceptional or good condition have had few (if any) measurable changes in their expected native species composition or abundance distribution. Wetland vegetation quality is largely degraded outside of northern Minnesota, where non-native plant species (most notably Reed canary grass and Narrow leaf or Hybrid cattail) have replaced native wetland plant communities over the majority of the remaining wetlands (MPCA 2015).

As the entire Cloquet River Watershed lies within Minnesota's northern forest ecoregion, wetland vegetation quality in the watershed is expected to be high overall. An estimated 84% of the wetlands in the ecoregion are in good-exceptional vegetation condition (MPCA 2015). Wetland quality impacts in the watershed are likely localized. Primary impacts to wetland vegetation quality include hydrology alterations associated with road building, peat subsidence and community changes adjacent to drainage ditches, and logging impacts in coniferous swamps.

Figure 45. Stream Tiered Aquatic Life Use Designations in the Cloquet River Watershed.

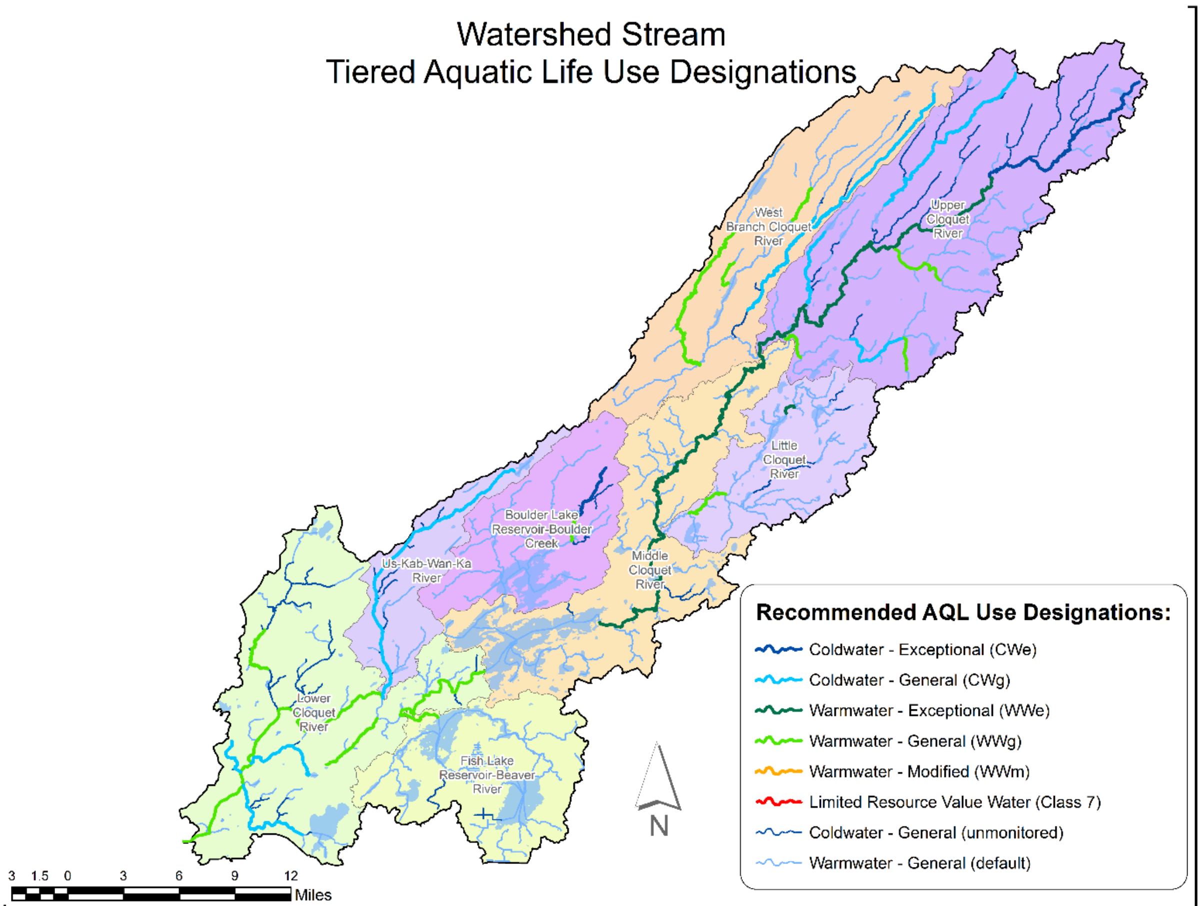


Figure 46. Fully supporting waters by designated use in the Cloquet River Watershed.

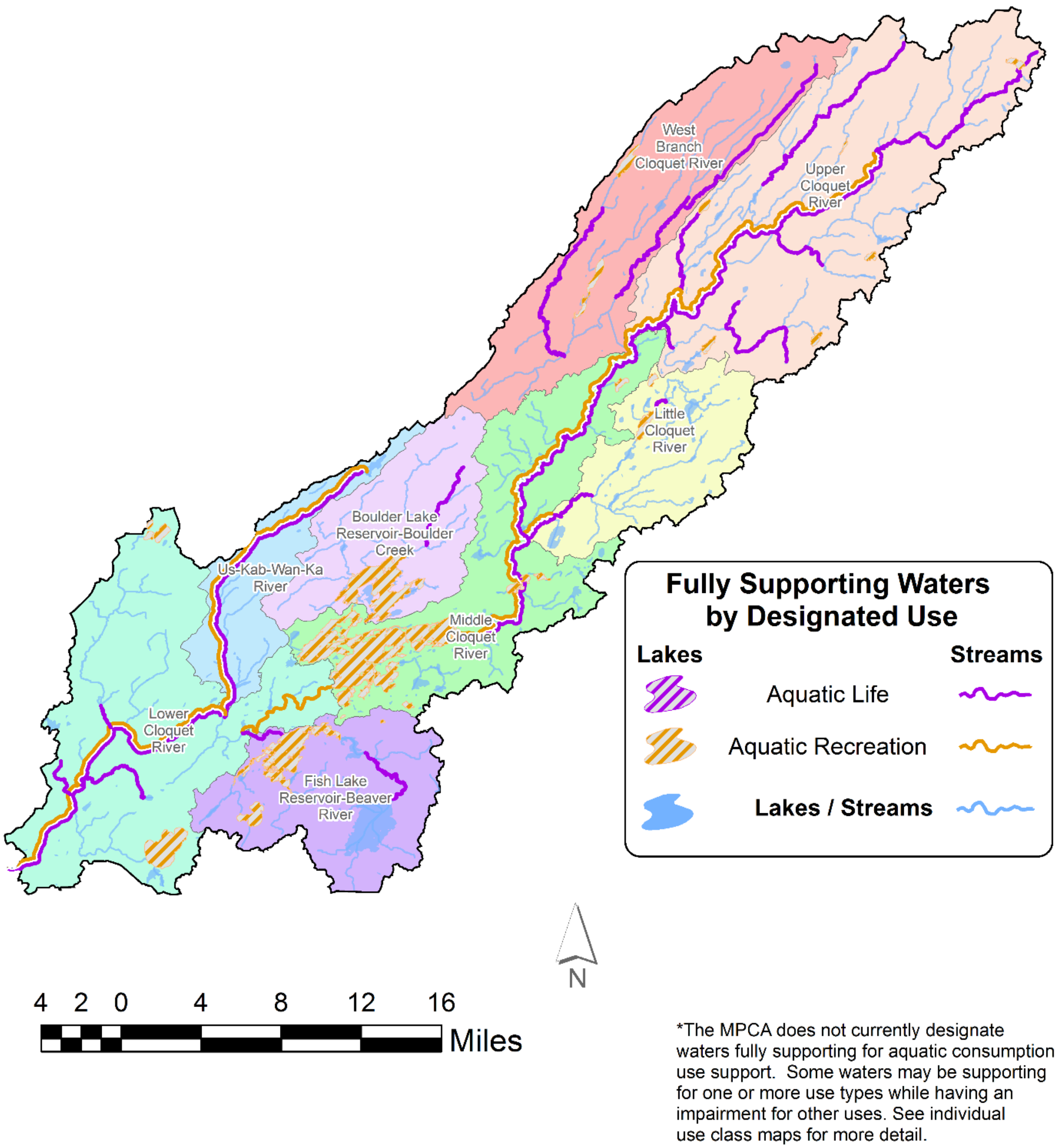


Figure 47. Impaired waters by designated use in the Cloquet River Watershed. Map depicts results of AY2017 assessment cycle only.

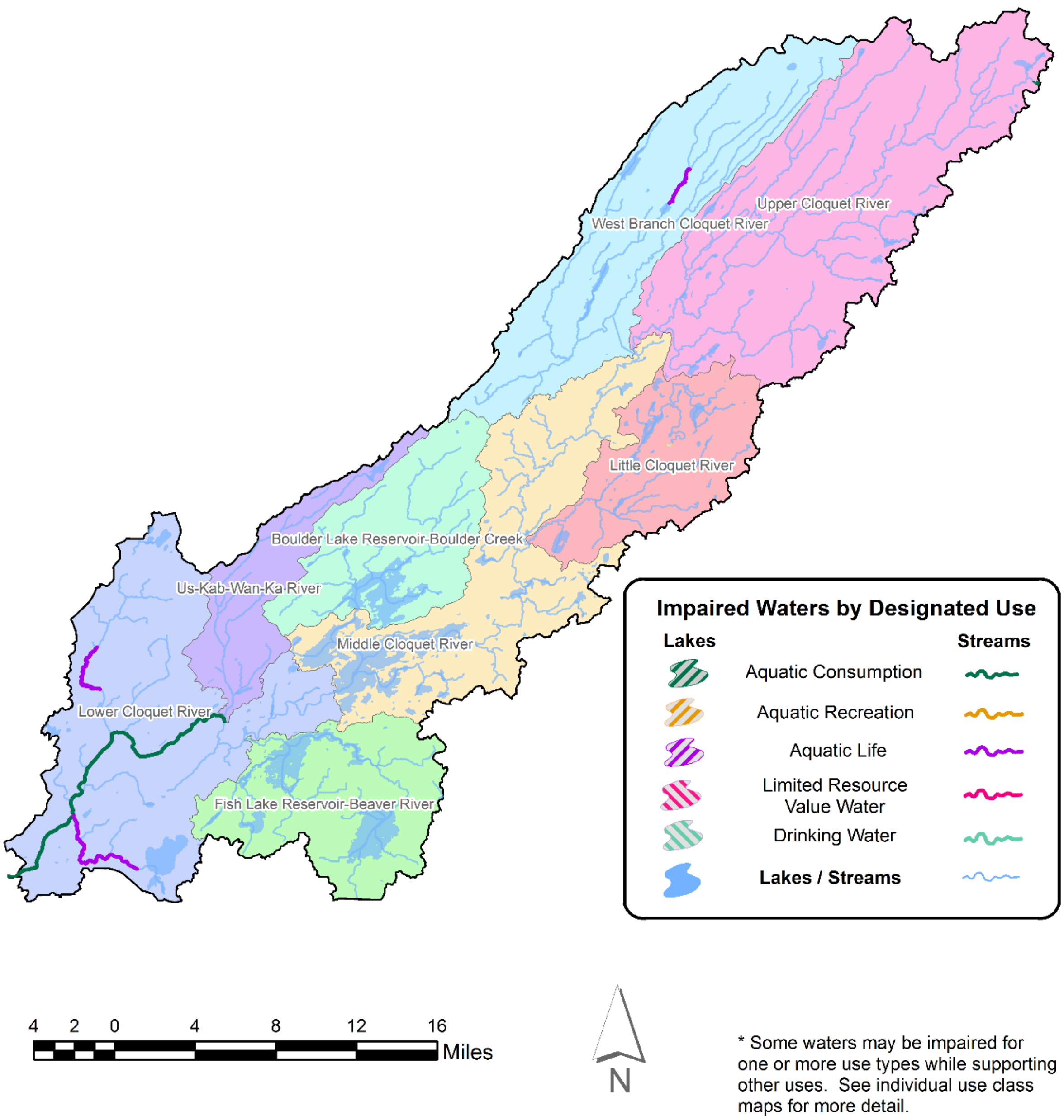


Figure 48. Aquatic consumption use support in the Cloquet River Watershed.

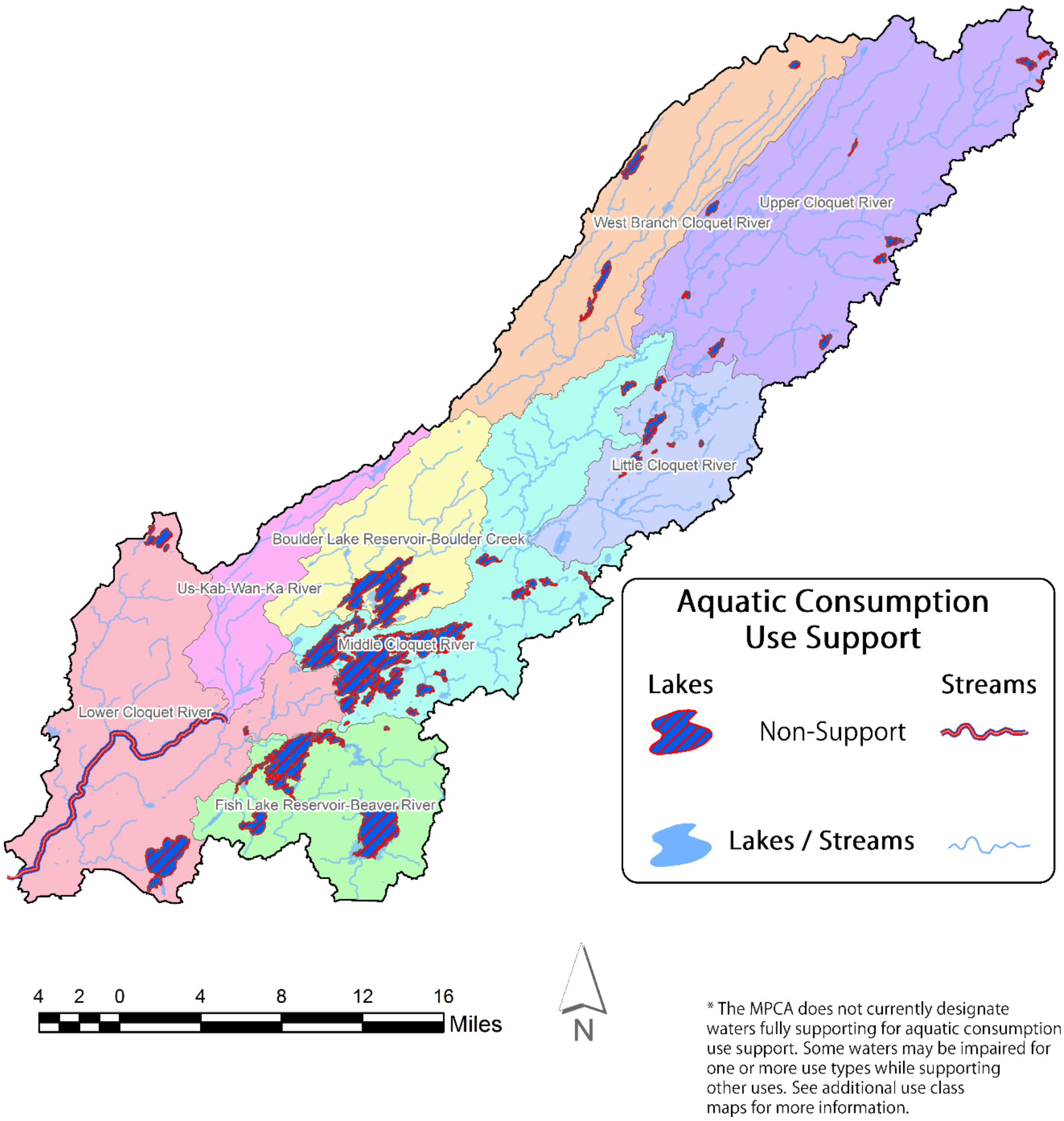


Figure 49. Aquatic life use support in the Cloquet River Watershed.

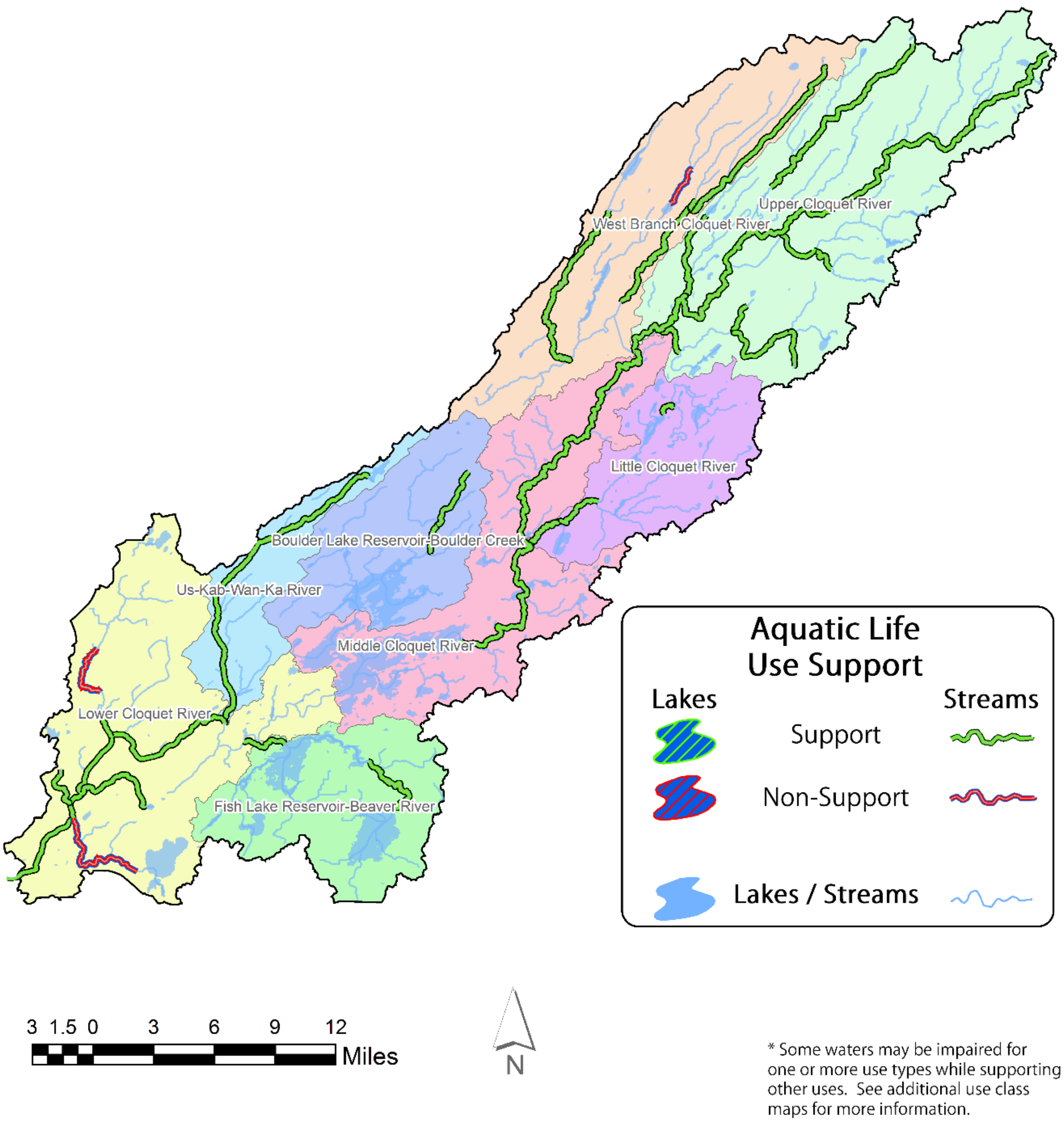
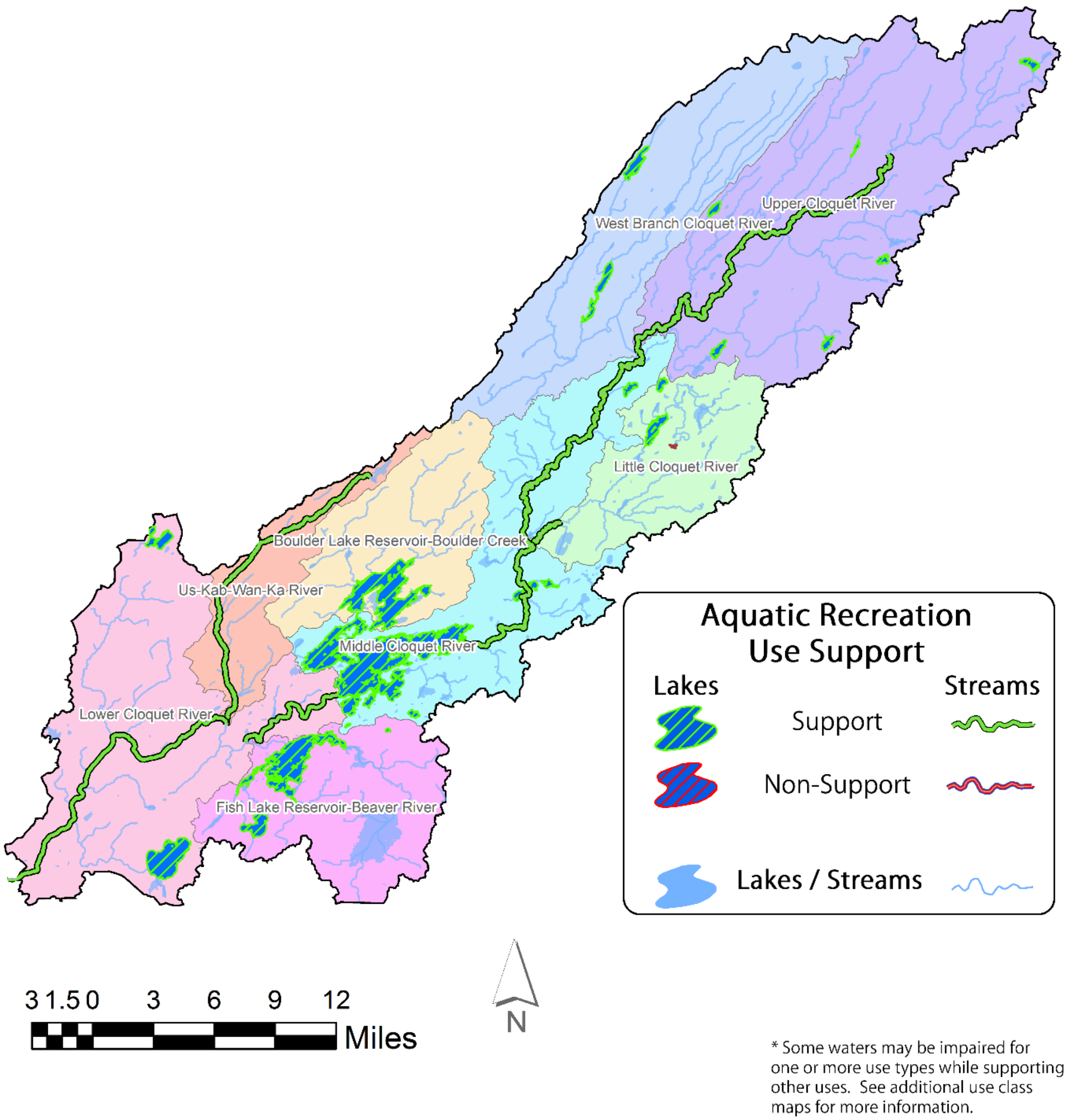


Figure 50. Aquatic recreation use support in the Cloquet River Watershed.



Transparency trends for the Cloquet River Watershed

MPCA completes annual trend analysis on lakes and streams across the state based on long-term transparency measurements. The data collection for this work relies heavily on volunteers across the state and also incorporates any agency and partner data submitted to EQuIS.

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

Citizen volunteer monitoring occurs at 3 streams and 23 lakes in the watershed. There are insufficient data from the stream sites and 6 of the lake sites to determine long term trends in stream transparency.

Table 21. Water Clarity Trends.

Cloquet Watershed HUC 04010202	Streams	Lakes
Number of sites w/increasing trend	0	9
Number of sites w/decreasing trend	0	8
Number of sites w/no trend	3	6

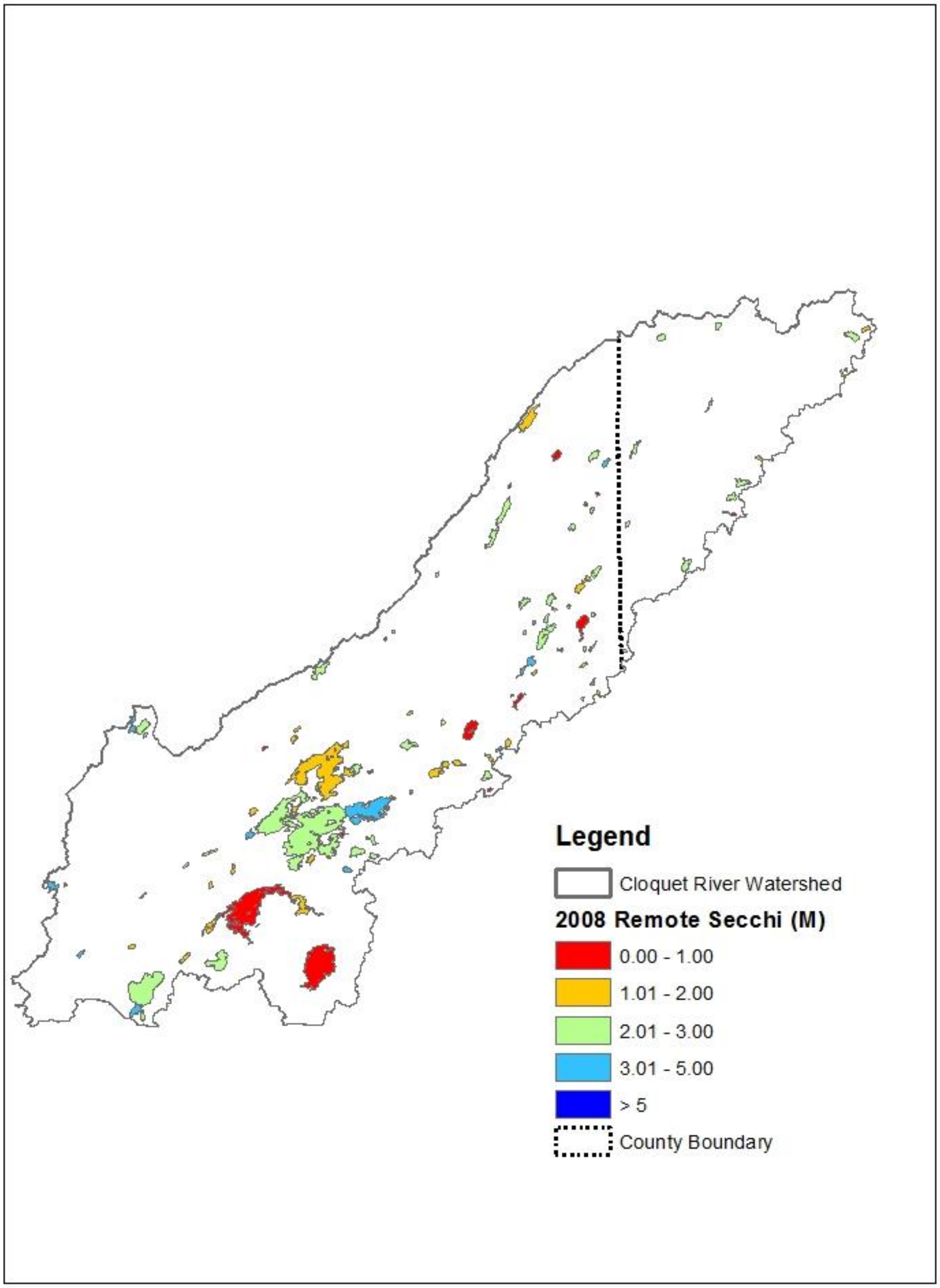
In June 2014, the MPCA published its final trend analysis of river monitoring data located statewide based on the historical Milestones Network. The network is a collection of 80 monitoring locations on rivers and streams across the state with good, long-term water quality data. The period of record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

Remote sensing for lakes in the Cloquet River Watershed

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

Remotely-sensed Secchi in the Cloquet River Watershed varied from less than one meter to approximately four meters (Figure 51), and compared favorably to monitored transparency in most lakes across the state. Remotely-sensed transparency was lowest in the shallow reservoir lakes (such as Fish and Wild Rice) and shallow wetland-dominated, undeveloped lakes in the headwaters (such as King and Lieuna).

Figure 51. Remotely sensed Secchi transparency on lakes in the Cloquet River Watershed.



Priority waters for protection and restoration in the Cloquet River Watershed

The MPCA and DNR have been developing methods to help identify waters that are high priority for protection and restoration activities. Protecting lakes and streams from degradation requires consideration of how human activities impact the lands draining to the water. In addition, helping to determine the risk for degradation allows for prioritization to occur; so limited resources can be directed to waters that would benefit most from implementation efforts.

The results of the analysis are provided to watershed project teams for use during Watershed Restoration and Protection Strategies (WRAPS) and One Watershed One Plan (1W1P) or other local water plan development efforts. The results of the analysis are considered a preliminary sorting of possible protection priorities and should be followed by a discussion and evaluation with other resource agencies, project partners and stakeholders. Other factors that are typically considered during the protection prioritization process include: whether a water has an active lake or river association, is publically accessible, presence of wild rice, presence of invasive, rare or endangered species, as well as land use information and/or threats from proposed development. Opportunities to gain or enhance multiple natural resource benefits ("benefit stacking") is another consideration during the final protection analysis. At present, the prioritization methodology has been developed for lakes based on recreation use and is summarized below (MPCA 2017). Stream protection and prioritization method development is nearing completion.

Waterbodies identified during the assessment process as vulnerable to impairment are also included in the summary below. The results for selected indicators and the risk priority ranking for each lake are shown in Appendix 6.

Special consideration for protection should be given to streams that have been designated as Exceptional based on superb fish and macroinvertebrate communities. Within the Cloquet River Watershed, there were three reaches that met these criteria. They include: Coyote Creek (Unnamed Creek to Pequaywan Lake, 04010202-584), Humphry Creek (Headwaters to Boulder Creek, 04010202-530), and the Cloquet River (Headwaters to Island Lake Reservoir, 04010202-669, 670, and 671). Every effort should be made to protect the biological integrity of stream designated as Exceptional so that they remain in good condition for years to come.

The DNR and MPCA have developed criteria for protection of high-quality unimpaired waters at the greatest risk of water quality decline. The methods estimate a probability of loss of transparency due to an increase in phosphorus reaching the lake. Each lake with sufficient data has a unique phosphorus load reduction target or goal, identified as the 25th percentile of monitored summer-mean concentration (this value is different, and more stringent, than the lake's applicable phosphorus standard). These data are compared to the percentage of the lake-shed with disturbed land-use. In the Cloquet River Watershed, disturbed land-use is most often urbanization, such as lake shore development and road density. In the Cloquet River Watershed, the highest quality, most at-risk lakes include White, Rose, Island, Grand, and Wild Rice (Table 22). Rose Lake is a very strong candidate for protection, because has very high quality, a high percentage of lake-shore development, and a declining trend in Secchi transparency.

Table 22. Lake phosphorous sensitivity and protection priority ranking of lakes within the Cloquet River Watershed.

DNR ID	Lake name	% Disturbed land use	Mean TP (ug/L)	Presence of trend	Load reduction goal (pounds/year)	Priority class
69003000	White	5%	9.3	No evidence of trend	1	A
69052500	Rose	11%	13.1	Decreasing trend	1	A
69037200	Island Lake Rsvr	8%	14.0	No evidence of trend	32	A
69051100	Grand	5%	15.1	No evidence of trend	29	A
69037100	Wild Rice	8%	41.3	No evidence of trend	161	A
69023500	Sunshine	5%	9.1	No evidence of trend	2	B
38065100	Kane	5%	16.4	No evidence of trend	2	B
69052200	Winkle	10%	27.0	Insufficient data	1	B
69039400	Flowage	7%	16.9	Decreasing trend	3	B
69052100	Leora	3%	18.3	Increasing trend	10	B
69048900	Caribou	4%	16.5	No evidence of trend	12	B
69004100	Bassett	4%	22.8	Increasing trend	21	B
69023400	Mirror	5%	14.0	Insufficient data	1	C
69001800	Schaeffer	1%	13.6	Insufficient data	2	C
69039700	Clearwater	9%	20.2	No evidence of trend	1	C
38053800	Katherine	1%	15.0		2	C
69002800	Little Stone	0%	14.8	Insufficient data	4	C
69039900	Deepwater	9%	29.0		1	C
69001600	Sand	1%	22.5	Insufficient data	3	C
69011300	Big Bear	0%	19.0	Insufficient data	5	C
69052300	Dodo	4%	14.0	Decreasing trend	8	C
69003600	Salo	4%	19.3	Insufficient data	8	C
38053900	Cloquet	2%	20.3	Insufficient data	8	C
69012900	Spring	2%	16.0	No evidence of trend	11	C
69013000	Little Alden	3%	15.0	Insufficient data	13	C
38075100	Thomas	3%	24.5	Insufficient data	13	C
69011100	Smith	2%	9.8	No evidence of trend	32	C
38075500	Sullivan	4%	38.5	Insufficient data	16	C
69001100	Pequaywan	2%	16.0	No evidence of trend	47	C
69002300	Indian	3%	32.3	Insufficient data	50	C
69014300	Wolf	1%	27.0	Insufficient data	102	C
69037300	Boulder	1%	25.4	Insufficient data	265	C
69049100	Fish Lk Flowage	5%	25.1	No evidence of trend	286	C
69013100	Alden	1%	20.8	No evidence of trend	539	C

Summaries and recommendations

The Cloquet River Watershed as a whole has minimal human disturbance compared to other watersheds in Minnesota. Fish and macroinvertebrate communities sampled during the Intensive Watershed Monitoring efforts are indicative of a watershed with minimal human disturbance. The most upstream reach of the Cloquet River main-stem was found to have Exceptional biological communities, including coldwater species. The next two downstream reaches on the Cloquet also had Exceptional aquatic communities. The excellent biology in these reaches goes hand in hand with the overall pristine characteristics and excellent habitat conditions within the watershed.

The Cloquet River Watershed has many stream reaches that support coldwater communities of fish and macroinvertebrates that provide unique opportunities for anglers and recreationalists. Protection of these resources can only be attained by protecting the riparian zones of streams and lakes throughout the watershed. For coldwater reaches, in addition to riparian protection, beaver management is critical. Beaver impoundments slow water and allow sunlight to penetrate and warm it, often times to a level which exceeds the thermal tolerance for coldwater species such as trout. Coldwater streams typically maintain their cold temperature through cold groundwater sources. These groundwater sources need to be identified, protected and preserved in order for these streams to sustain coldwater aquatic assemblages.

Water quality in the stream and rivers in the watershed was excellent. Nutrient and sediment levels were low and oxygen concentrations were supportive of a cold water biological community. Bacteria levels were low throughout the watershed; recreational use was supported across the watershed.

The Cloquet River Watershed is home to a variety of lakes, from large shallow reservoirs, which have the ability to produce mild nuisance algal blooms to smaller high quality lakes with intact, predominantly forested watersheds. Clarity in this watershed is naturally limited; waters are often tannin stained. Overall, recreational opportunities are good for lakes in the watershed, and algal blooms are not often present.

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Appendix 1 – Water chemistry definitions

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

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

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

Orthophosphate (OP) - is a water soluble form of phosphorus that is readily available to algae (bioavailable). While OPs 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.

Total Kjeldahl 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.

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

Appendix 2.1 – Intensive watershed monitoring water chemistry stations in the Cloquet River Watershed

EQuIS ID	Biological station ID	WID	Waterbody name	Location	Aggregated 12-digit HUC
S008-455	15LS005	04010202-507	Cloquet River	At North Loop Road, 1 mi. W of Rollins.	Upper Cloquet River
S008-456	98LS044	04010202-507	Cloquet River	At carry-in canoe access on Bear Lake Trail, 5.5 mi. SW of Rollins.	West Branch Cloquet River
S005-548	15LS004	04010202-590	Little Cloquet River	At CSAH 44 (Pequayan Lake Road) Road, 10 mi. NE of Lake Island.	Little Cloquet River
S008-457	15LS002	04010202-510	Us Kab Wan Ka River	At Lost Lake Road, 1 mi. S of Taft	Us Kab Wan Ka River
S003-968	15LS001	04010202-501	Cloquet River	At CSAH 7, in Burnett.	Lower Cloquet River
S008-458	15LS003	04010202-504	Cloquet River	Downstream of CSAH 48 (Taft Road), 2 mi. NW of Fredenberg.	Middle Cloquet River

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

WID	Biological station ID	Waterbody name	Biological station location	County	Aggregated 12-digit HUC
04010202-669	15LS006	Cloquet River	Upstream of CSAH 15, in Jordan	Lake	Upper Cloquet
04010202-670	14LS007	Cloquet River	Upstream of CR 403, 7 mi. NE of Rollins.	St. Louis	Upper Cloquet
04010202-670	97LS016	Cloquet River	Downstream of CR 403, 4 mi. E of Breda	St. Louis	Upper Cloquet
04010202-670	15LS011	Cloquet River	Upstream of CSAH 44 (Brimson Rd), in Rollins	St. Louis	Upper Cloquet
04010202-670	15LS005	Cloquet River	Downstream of North Loop Rd, 1 mi. W of Rollins	St. Louis	Upper Cloquet
04010202—558	92LS049	Murphy Creek	Downstream of CSAH 15, 3 mi. NW of Jordan	Lake	Upper Cloquet
04010202-660	15LS008	Little Langley River	Upstream of FR 122 (Langeley River Rd), 2.5 mi. W of McNaiir	Lake	Upper Cloquet
04010202-659	15EM089	Langley River	Adjacent to FR 122, 19 mi. N of Two Harbors	Lake	Upper Cloquet
04010202-548	15LS010	Indian Creek	Downstream of CR 547 (Brimson Rd), 1.5 mi. N of Rollins	St. Louis	Upper Cloquet
04010202-663	15LS032	Pine Creek	Downstream of Wickholm Rd, 16 mi. N of Two Harbors	Lake	Upper Cloquet
04010202-657	15LS012	Pine Creek	Upstream of CSAH 14, 1 mi. W of Wales	Lake	Upper Cloquet
04010202-657	10EM029	Pine Creek	N of Wickholm Rd, 16 mi. N of Two Harbors	Lake	Upper Cloquet
04010202-575	15LS013	Pine Creek	Upstream of CSAH 44 (Pequaywan Lake Rd), 1 mi. W of Rollins	St. Louis	Upper Cloquet
04010202-666	15LS007	Petrel Creek	Downstream of CSAH 44 (Fairbanks Rd), 2 mi. SW of Bassett	St. Louis	West Branch Cloquet
04010202-528	15LS022	Nelson Creek	Downstream of CSAH 44, 4.5 mi. N of Brimson	St. Louis	West Branch Cloquet
04010202-524	15LS023	Breda Creek	Upstream of CSAH 44, 4 mi. N of Brimson	St. Louis	West Branch Cloquet
04010202-571	15LS015	Cloquet River, West Branch	Upstream of CR 547 (Brimson Rd), 4 mi. W of Brimson	St. Louis	West Branch Cloquet
04010202-515	15LS014	Berry Creek	Upstream of CR 547 (Brimson Rd), 1.5 mi. W of Brimson	St. Louis	West Branch Cloquet
04010202-584	15LS016	Coyote Creek	Upstream of CSAH 44 (Pequaywan Lake Rd), 4 mi. SW of Rollins	St. Louis	Little Cloquet
04010202-589	15LS004	Little Cloquet River	Upstream of CSAH 44 (Pequaywan Lake Rd), 10 mi. NE of Lake Island	St. Louis	Little Cloquet

WID	Biological station ID	Waterbody name	Biological station location	County	Aggregated 12-digit HUC
04010202-530	15LS025	Humphrey Creek	Upstream of private drive off of CSAH 4 (Vermilion Tr), 6 mi. N of Lake Island	St. Louis	Boulder Lake Reservoir
04010202-513	97LS079	Boulder Creek	Upstream of CR 49 (Three Lakes Rd), 5 mi. N of Lake Island	St. Louis	Boulder Lake Reservoir
04010202-671	98LS044	Cloquet River	Adjacent to Bear Lake Tr, 5.5 mi. SW of Rollins	St. Louis	Middle Cloquet
04010202-671	15LS017	Cloquet River	Upstream at E end of Carrol Tr, 10 mi. SW of Rollins	St. Louis	Middle Cloquet
04010202-503	15LS020	Beaver River	Adjacent to Eagle View Dr, 3 mi. SE of Taft.	St. Louis	Fish Lake
04010202-510	97LS026	Us Kab Wan Ka	Adjacent to CR 223 (Munger Shaw Rd), 1 mi. N of Taft	St. Louis	Us Kab Wan Ka
04010202-510	15LS002	Us Kab Wan Ka	Upstream of Lost Lake Rd, 1 mi. S of Taft	St. Louis	Us Kab Wan Ka
04010202-504	15LS003	Cloquet River	Downstream of CSAH 48 (Taft Rd), 2 mi NW of Fredenberg	St. Louis	Lower Cloquet
04010202-662	15LS026	Sullivan Creek	Upstream of Beckman Rd, 2.5 mi. N of Bartlett	St. Louis	Lower Cloquet
04010202-672	98LS019	Hellwig Creek	Downstream of CR 734 (Shipley Rd), 2.5 mi. N of Independence	St. Louis	Lower Cloquet
04010202-533	15LS021	Chalberg Creek	Downstream of CSAH 33, 2.5 mi. S of Independence	St. Louis	Lower Cloquet
04010202-532	15LS031	Cemetary Creek	Upstream of CSAH 8, 2 mi. E of Culver	St. Louis	Lower Cloquet
04010202-521	01LS006	Beartrap Creek	Upstream of CSAH 7 (Industrial Rd), 2 mi. E of Burnett	St. Louis	Lower Cloquet
04010202-501	15LS001	Cloquet River	Downstream of CSAH 7, in Burnett	St. Louis	Lower Cloquet

Appendix 3.1 – Minnesota statewide IBI thresholds and confidence limits

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

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

National Hydrography Dataset (NHD) Assessment Segment WID	Biological station ID	Stream segment name	Drainage area Mi^2	Fish class	Threshold	FIBI	Visit date
HUC 12: 0401020201-01 (Upper Cloquet)							
04010202-548	15LS010	Indian Creek	13.72	11	35	57.58	28-Jul-15
04010202-558	92LS049	Murphy Creek	13.84	11	35	56.65	09-Jul-15
04010202-575	15LS013	Pine Creek	32.22	7	42	52.18	15-Jul-15
04010202-657	10EM029	Pine Creek	13.87	11	35	29.96	20-Aug-15
04010202-657	10EM029	Pine Creek	13.87	11	35	45.56	12-Aug-10
04010202-657	15LS012	Pine Creek	16.33	11	35	53.54	15-Jul-15
04010202-660	15LS008	Little Langley River	7.41	6	42	71.48	20-Jul-15
04010202-669	15LS006	Cloquet River	36.25	11	35	68.87	30-Jun-15
04010202-670	97LS016	Cloquet River	116.84	5	47	84.70	28-Jul-16
04010202-670	97LS016	Cloquet River	116.84	5	47	87.65	21-Jul-15
04010202-670	97LS016	Cloquet River	116.84	5	47	92.61	09-Jul-14
04010202-670	15LS011	Cloquet River	127.36	5	47	73.25	20-Jul-15
04010202-670	15LS005	Cloquet River	144.69	5	47	76.20	07-Jul-15
HUC 12: 0401020202-01 (West Branch Cloquet)							
04010202-515	15LS014	Berry Creek	26.59	11	35	46.11	15-Jul-15
04010202-524	15LS023	Breda Creek	12.18	11	35	43.67	20-Jul-15
04010202-528	15LS022	Nelson Creek (Berry Creek Tributary)	8.44	11	35	34.99	23-Jun-15
04010202-571	15LS015	Cloquet River, West Branch	20.64	6	42	75.51	19-Aug-15
04010202-666	15LS007	Petrel Creek	16.99	7	42	34.35	26-Jul-16
HUC 12: 0401020204-02 (Little Cloquet)							
15LS016	15LS016	Coyote Creek	12.84	6	42	89.77	15-Jul-15
15LS004	15LS004	Little Cloquet River	55.60	5	47	77.91	31-Aug-15
HUC 12: 0401020203-01 (Boulder Lake)							
04010202-513	97LS079	Boulder Creek	21.01	6	42	54.74	15-Jul-15
04010202-530	15LS025	Humphrey Creek	5.07	11	35	66.48	22-Jun-15
04010202-530	15LS025	Humphrey Creek	5.07	11	35	68.79	09-Jul-15

National Hydrography Dataset (NHD) Assessment Segment WID	Biological station ID	Stream segment name	Drainage area Mi^2	Fish class	Threshold	FIBI	Visit date
HUC 12: 0401020204-01 (Middle Cloquet)							
04010202-671	98LS044	Cloquet River	294.21	5	47	82.33	22-Jul-15
04010202-671	98LS044	Cloquet River	294.21	5	47	83.39	07-Jul-15
04010202-671	15LS017	Cloquet River	326.73	5	47	75.33	07-Jul-15
HUC 12: 0401020205-01 (Fish Lake)							
04010202-503	15LS020	Beaver River	75.30	5	47	59.47	01-Jul-15
HUC 12: 0401020206-02 (Us Kab Wan Ka)							
04010202-510	97LS026	Us-Kab-Wan-Ka River	28.06	11	35	50.11	02-Jul-15
04010202-510	15LS002	Us-Kab-Wan-Ka River	40.10	11	35	37.95	02-Jul-15
HUC 12: 0401020206-01 (Lower Cloquet)							
04010202-501	15LS001	Cloquet River	783.45	4	38	74.87	02-Jul-15
04010202-504	15LS003	Cloquet River	536.16	4	38	57.11	01-Jul-15
04010202-521	01LS006	Beartrap Creek	20.67	11	35	32.95	27-Jul-16
04010202-532	15LS031	Unnamed creek (Cemetery Creek)	4.86	11	35	43.89	01-Jul-15
04010202-533	15LS021	Chalberg Creek (Chellberg Creek)	7.64	11	35	38.77	01-Jul-15
04010202-662	15LS026	Sullivan Creek	5.27	7	42	29.26	06-Jul-15
04010202-672	98LS019	Hellwig Creek	29.25	7	42	12.77	01-Jul-15
04010202-672	98LS019	Hellwig Creek	29.25	7	42	43.07	27-Jul-16

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

National Hydrography Dataset (NHD) Assessment Segment WID	Biological station ID	Stream segment name	Drainage area Mi^2	Invert class	Threshold	MIBI	Visit date
HUC 12: 0401020201-01 (Upper Cloquet)							
04010202-657	10EM029	Pine Creek	13.87	8	32	33.70	20-Aug-15
04010202-669	15LS006	Cloquet River	36.25	8	32	66.20	25-Aug-15
04010202-670	14LS007	Cloquet River	116.78	3	53	79.14	11-Aug-14
04010202-670	15LS011	Cloquet River	127.36	3	53	91.38	26-Aug-15
04010202-670	97LS016	Cloquet River	116.84	3	53	94.03	25-Aug-15
04010202-657	10EM029	Pine Creek	13.87	8	32	36.10	25-Aug-10
04010202-575	15LS013	Pine Creek	32.22	4	51	88.56	26-Aug-15
04010202-558	92LS049	Murphy Creek	13.84	8	32	58.75	25-Aug-15
04010202-657	15LS012	Pine Creek	16.33	8	32	45.10	26-Aug-15
04010202-660	15LS008	Little Langley River	7.41	3	53	78.05	25-Aug-15
04010202-663	15LS032	Pine Creek	3.87	4	51	83.50	11-Aug-15
04010202-659	15EM089	Langley River	28.92	3	53	74.00	11-Aug-15
04010202-548	15LS010	Indian Creek	13.72	8	32	49.09	25-Aug-15
HUC 12: 0401020202-01 (West Branch Cloquet)							
04010202-515	15LS014	Berry Creek	26.59	8	32	47.49	26-Aug-15
04010202-524	15LS023	Breda Creek	12.18	8	32	45.00	19-Aug-15
04010202-571	15LS015	Cloquet River, West Branch	20.64	3	53	77.85	19-Aug-15
04010202-528	15LS022	Nelson Creek	8.44	8	32	59.54	14-Sep-16
04010202-528	15LS022	Nelson Creek	8.44	8	32	21.21	19-Aug-15
HUC 12: 0401020204-02 (Little Cloquet)							
04010202-589	15LS004	Little Cloquet River	55.60	3	53	76.34	31-Aug-15
04010202-584	15LS016	Coyote Creek	12.84	3	53	82.41	26-Aug-15
HUC 12: 0401020203-01 (Boulder Lake)							
04010202-513	97LS079	Boulder Creek	21.01	3	53	80.06	20-Sep-16
04010202-513	97LS079	Boulder Creek	21.01	3	53	65.00	19-Aug-15
04010202-530	15LS025	Humphrey Creek	5.07	8	32	20.70	19-Aug-15
04010202-530	15LS025	Humphrey Creek	5.07	8	32	70.58	20-Sep-16

National Hydrography Dataset (NHD) Assessment Segment WID	Biological station ID	Stream segment name	Drainage area Mi^2	Invert class	Threshold	MIBI	Visit date
HUC 12: 0401020204-01 (Middle Cloquet)							
No Assessable Macroinvertebrate Data							
HUC 12: 0401020205-01 (Fish Lake)							
04010202-503	15LS020	Beaver River	75.30	3	53	47.12	26-Aug-15
04010202-503	15LS020	Beaver River	75.30	3	53	51.46	26-Aug-15
HUC 12: 0401020206-02 (Us Kab Wan Ka)							
04010202-510	97LS026	Us-Kab-Wan-Ka River	28.06	8	32	51.68	25-Aug-15
04010202-510	15LS002	Us-Kab-Wan-Ka River	40.10	8	32	28.46	26-Aug-15
04010202-510	15LS002	Us-Kab-Wan-Ka River	40.10	8	32	56.20	21-Sep-16
HUC 12: 0401020206-01 (Lower Cloquet)							
04010202-521	01LS006	Beartrap Creek	20.67	8	32	27.44	21-Sep-16
04010202-504	15LS003	Cloquet River	536.16	1	49	38.20	26-Aug-15
04010202-504	15LS003	Cloquet River	536.16	1	49	29.40	26-Aug-15
04010202-501	15LS001	Cloquet River	783.45	1	49	72.56	16-Sep-15
04010202-532	15LS031	Cemetery Creek	4.86	8	32	26.99	25-Aug-15
04010202-672	98LS019	Hellwig Creek	29.25	4	51	34.20	25-Aug-15
04010202-532	15LS031	Cemetery Creek	4.86	8	32	29.37	06-Sep-16
04010202-533	15LS021	Chalberg Creek	7.64	8	32	0.00	25-Aug-15

Appendix 4.1 – Fish species found during biological monitoring surveys

Common name	Quantity of stations where present	Quantity of individuals collected
Black Bullhead	2	3
Black Crappie	1	1
Blacknose Dace	14	270
Blacknose Shiner	4	4
Bluegill	3	4
Brook Stickleback	7	190
Brook Trout	5	19
Brown Trout	1	1
Burbot	22	349
Central Mudminnow	21	210
Channel Catfish	1	3
Common Shiner	13	280
Creek Chub	22	469
Fathead Minnow	1	3
Finescale Dace	2	3
Golden Shiner	2	9
Hornyhead Chub	2	121
Iowa Darter	3	16
Johnny Darter	23	326
Largemouth Bass	4	17
Logperch	6	60
Longnose Dace	15	529
Mottled Sculpin	22	456
Northern Pike	14	54
Northern Redbelly Dace	6	72
Pearl Dace	7	306
Rock Bass	5	13
Shorthead Redhorse	5	35
Smallmouth Bass	4	34
Spottail Shiner	1	38
Tadpole Madtom	3	25
Trout-Perch	1	1
Walleye	3	5
White Sucker	27	1312
Yellow Perch	13	195

Appendix 4.2 – Macroinvertebrate species found during biological monitoring surveys

Taxonomic name	Number of visits present	Quantity of individuals collected
Amphipoda		
Hyalella	28	505
Amphipoda	1	1
Architaenioglossa		
Viviparidae	1	1
Campeloma	1	1
Basommatophora		
Ferrissia	19	123
Lymnaeidae	5	15
Fossaria	4	8
Bulimnaea megasoma	2	2
Physidae	2	10
Physa	2	5
Aplexa elongata	1	1
Physella	27	555
Planorbidae	5	53
Gyraulus	15	146
Helisoma anceps	7	33
Planorbella	1	1
Coleoptera		
Dytiscidae	7	9
Liodessus	5	16
Neoporus	1	1
Elmidae	4	6
Stenelmis	16	98
Dubiraphia	23	98
Optioservus	22	265
Ancyronyx variegatus	2	4
Macronychus glabratus	17	89
Gyrinus	4	6
Dineutus	2	2
Haliplus	2	3
Peltodytes	2	2
Hydraena	7	15
Hydrophilidae	1	1
Anacaena	3	10
Tropisternus	1	1
Helophorus	2	3
Hydrochus	1	1
Scirtidae	1	1
Agabus	1	1

Taxonomic name	Number of visits present	Quantity of individuals collected
Decapoda		
Cambaridae	2	2
Orconectes	12	24
Diptera		
Atherix	3	6
Ceratopogonidae	1	3
Atrichopogon	6	11
Ceratopogoninae	13	52
Chironomini	3	3
Chironomus	5	16
Cladopelma	4	7
Cryptochironomus	4	4
Cryptotendipes	1	2
Demicryptochironomus	3	5
Dicrotendipes	5	127
Endochironomus	1	6
Glyptotendipes	2	2
Microtendipes	30	299
Nilothauma	7	13
Pagastiella	1	2
Paralauterborniella nigrohalterale	1	1
Paratendipes	3	10
Phaenopsectra	10	28
Polypedilum	30	205
Stenochironomus	16	27
Stictochironomus	3	3
Tribelos	10	39
Xenochironomus xenolabis	3	4
Anopheles	2	2
Potthastia	3	3
Dixella	6	7
Empididae	2	3
Hemerodromia	18	63
Neoplasta	4	8
Ephydridae	3	3
Orthocladiinae	4	7
Brillia	8	12
Chaetocladius	2	2
Corynoneura	11	17
Cricotopus	25	152
Epoicocladius	1	1
Eukiefferiella	7	22
Heterotrissocladius	5	7
Hydrobaenus	1	1

Taxonomic name	Number of visits present	Quantity of individuals collected
Limnophyes	9	20
Nanocladius	6	30
Orthocladius	11	62
Paracricotopus	1	3
Parakiefferiella	10	26
Parametriocnemus	23	145
Paraphaenocladius	1	1
Psectrocladius	9	21
Rheocricotopus	12	25
Synorthocladius	3	4
Thienemanniella	9	14
Tvetenia	21	62
Xylotopus par	9	18
Orthocladius (Symposiocladius)	2	7
Simulium	27	388
Tabanidae	5	9
Thienemannimyia Gr.	30	244
Tanypodinae	7	7
Clinotanypus	1	2
Ablabesmyia	16	28
Conchapelopia	3	4
Labrundinia	9	17
Larsia	2	2
Pentaneura	4	22
Thienemannimyia	2	24
Zavrelimyia	12	32
Procladius	16	72
Limnophila	3	5
Tipula	5	8
Limoniinae	1	1
Antocha	5	8
Hexatoma	4	4
Pilaria	2	2
Pseudolimnophila	2	4
Cryptolabis	1	1
Erioptera	1	1
Dicranota	3	5
Neostempellina reissi	2	2
Tanytarsini	7	11
Cladotanytarsus	1	1
Micropsectra	23	185
Paratanytarsus	9	74
Rheotanytarsus	23	131
Stempellina	2	2

Taxonomic name	Number of visits present	Quantity of individuals collected
Stempellinella	22	63
Tanytarsus	24	194
Trissopelopia ogemawi	1	1
Ephemeroptera		
Baetisca	4	4
Anafroptilum	3	4
Labiobaetis propinquus	11	38
Iswaeon	11	87
Baetidae	10	32
Baetis	12	37
Baetis tricaudatus	1	2
Baetis brunneicolor	8	98
Baetis flavistriga	7	26
Callibaetis	1	1
Acerpenna pygmaea	5	24
Procloeon	5	8
Acerpenna	21	165
Plauditus	6	16
Acentrella turbida	1	1
Caenis diminuta	5	32
Caenis	3	13
Caenis hilaris	3	3
Caenis latipennis	1	3
Ephemera	5	10
Teloganopsis deficiens	2	11
Ephemerellidae	2	4
Ephemerella	11	170
Ephemerella subvaria	2	8
Eurylophella	22	253
Eurylophella temporalis	1	1
Serratella serrata	1	1
Maccaffertium vicarium	6	14
Heptageniidae	7	43
Leucrocuta	6	15
Stenacron	7	21
Maccaffertium	17	45
Isonychia	6	12
Leptophlebiidae	21	201
Leptophlebia	2	11
Paraleptophlebia	4	86
Tricorythodes	9	15
Haplotaxida		
Enchytraeus	1	3
Mesenchytraeus	3	4

Taxonomic name	Number of visits present	Quantity of individuals collected
Fridericia	2	2
Nais	7	16
Naidinae	1	3
Tubificinae	5	8
Aulodrilus	7	30
Naididae	2	3
Hemiptera		
Belostoma flumineum	5	7
Corixidae	7	105
Sigara	5	8
Hesperocorixa	2	2
Palmacorixa	1	1
Aquarius	1	1
Gerridae	1	1
Metrobates	1	1
Rhagovelia	3	22
Microvelia	1	1
Heterostropha		
Valvata	3	4
Isopoda		
Caecidotea	7	186
Lepidoptera		
Petrophila	2	3
Parapoynx	10	33
Lumbriculida		
Lumbriculus	1	1
Lumbriculidae	6	7
Megaloptera		
Corydalidae	1	1
Nigronia	13	36
Sialis	9	24
Neotaenioglossa		
Hydrobiidae	18	750
Odonata		
Aeshnidae	6	9
Aeshna	6	8
Aeshna umbrosa	4	7
Boyeria	4	6
Boyeria vinosa	18	43
Basiaeschna janata	2	2
Anisoptera	2	3
Calopterygidae	14	56
Calopteryx	13	89
Calopteryx maculata	1	2

Taxonomic name	Number of visits present	Quantity of individuals collected
Calopteryx aequabilis	9	47
Somatochlora	2	2
Somatochlora minor	2	2
Corduliidae	10	19
Coenagrionidae	6	14
Argia	2	11
Cordulegaster	4	4
Gomphidae	11	22
Gomphus	1	1
Hagenius brevistylus	3	5
Ophiogomphus	1	1
Ophiogomphus rupinsulensis	2	3
Macromia	1	6
Macromia illinoiensis	1	1
Plecoptera		
Capniidae	5	9
Perlodidae	1	1
Isoperla	7	23
Perlidae	3	7
Acroneuria	8	39
Acroneuria lycorias	12	27
Acroneuria abnormis	3	13
Paragnetina media	13	51
Pteronarcys	1	1
Taeniopteryx	4	41
Trichoptera		
Micrasema sprulesi	1	1
Brachycentrus numerosus	8	33
Micrasema	3	10
Micrasema rusticum	10	43
Phylocentropus	4	12
Glossosomatidae	3	5
Glossosoma	1	4
Glossosoma nigrior	1	6
Goera	2	8
Helicopsyche borealis	11	54
Hydropsyche placoda	1	1
Hydropsychidae	21	276
Cheumatopsyche	31	205
Hydropsyche	14	144
Hydropsyche betteni	10	92
Hydropsyche dicantha	2	3
Ceratopsyche	17	211
Ceratopsyche bronta	5	18

Taxonomic name	Number of visits present	Quantity of individuals collected
Ceratopsyche morosa	9	40
Ceratopsyche slossonae	4	28
Ceratopsyche sparna	6	9
Ceratopsyche alhedra	3	12
Hydroptilidae	4	14
Hydroptila	11	51
Oxyethira	19	56
Lepidostoma	17	95
Oecetis furva	2	6
Oecetis testacea	17	63
Leptoceridae	9	18
Triaenodes	11	25
Mystacides	6	15
Oecetis	3	5
Oecetis avara	10	30
Nectopsyche	3	5
Nectopsyche diarina	1	3
Ceraclea	10	35
Glyphopsyche irrorata	2	2
Limnephilidae	18	69
Hydatophylax argus	4	10
Limnephilus	4	16
Pycnopsyche	8	16
Nemotaulius hostilis	1	1
Molanna	4	14
Psilotreta indecisa	1	1
Philopotamidae	1	1
Chimarra	34	548
Dolophilodes distinctus	1	3
Phryganeidae	9	25
Ptilostomis	9	20
Polycentropodidae	13	38
Polycentropus	9	34
Cyrnellus fraternus	1	3
Neureclipsis	11	69
Nyctiophylax	7	17
Psychomyia flavida	10	23
Lype diversa	7	15
Rhyacophila invaria	1	9
Rhyacophila	1	1
Protoptila	2	6
Agarodes distinctus	2	11
Uenoidae	3	14
Trichoptera	2	6

Taxonomic name	Number of visits present	Quantity of individuals collected
Unclassified		
Nemata	3	4
Acari	32	217
Copepoda	1	2
Hirudinea	14	28
Nematomorpha	1	1
Trepaxonemata	5	20
Veneroida		
Pisidiidae	33	448

Appendix 5 – Minnesota Stream Habitat Assessment results

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

# Visits	Biological station ID	Reach name	Land use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish cover (0-17)	Channel morph. (0-36)	MSHA score (0-100)	MSHA rating
Habitat Results: *Upper Cloquet*									
2	92LS049	Murphy Creek	5	13	23.25	13	26	80.25	Good
2	15LS013	Pine Creek	5	12.5	17.5	12	14.5	61.5	Fair
1	14LS007	Cloquet River	5	10	20	12	28	75	Good
2	15LS012	Pine Creek	5	13	19.075	15	20	72.075	Good
2	15LS011	Cloquet River	5	10	17	11	23	66	Good
2	15LS010	Indian Creek	5	12	16	11.5	14.5	59	Fair
2	15LS008	Little Langley	5	11.5	19.05	14	23.5	73.05	Good
3	10EM029	Pine Creek	5	11	16.13333	13	21.3333	66.466	Good
2	15LS006	Cloquet River	5	12.5	23.2	12.5	27.5	80.7	Good
1	15LS005	Cloquet River	5	9	19	14	18	65	Fair
4	97LS016	Cloquet River	5	12.125	22.1125	13.25	29.5	81.987	Good
1	15LS032	Pine Creek	5	14	5.5	12	6	42.5	Poor
1	15EM089	Langley River	5	11	24	9	15	64	Fair
Averages:			5	11.6	18.6	12.4	20.5	68.2	Good
Habitat Results: *West Branch Cloquet*									
1	15LS007	Petrel Creek	5	12	7	14	11	49	Fair
2	15LS015	Cloquet River, West Branch	5	12	23.8	12	26	78.8	Good
3	15LS022	Nelson Creek	5	11.83333	15.06667	13.33	21.3333	66.566	Good
2	15LS023	Breda Creek	5	10.75	21.6	14	24.5	75.85	Good
2	15LS014	Berry Creek	5	11.25	14.15	13.5	15.5	59.4	Fair
Averages:			5	11.6	16.3	13.4	19.7	65.9	Fair
Habitat Results: *Little Cloquet*									
2	15LS004	Little Cloquet	5	9	22	15	19	70	Good
2	15LS016	Coyote Creek	5	11.5	17.8	14	23	71.3	Good
Averages:			5	10.25	19.9	14.5	21	70.65	Good

# Visits	Biological station ID	Reach name	Land use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish cover (0-17)	Channel morph. (0-36)	MSHA score (0-100)	MSHA rating
Habitat Results: *Boulder Lake Reservoir*									
3	97LS079	Boulder Creek	5	11.66667	11.66667	12.33	21.3333	62	Fair
4	15LS025	Humphrey Creek	4.8125	10.125	10.8625	12.5	18	56.3	Fair
Averages:			4.9	10.9	11.3	12.4	19.7	59.2	Fair
Habitat Results: *Middle Cloquet*									
1	15LS017	Cloquet River	5	9	19	15	17	65	Fair
2	98LS044	Cloquet River	5	11	20.575	10	20	66.575	Good
Averages:			5	10	19.8	12.5	18.5	65.8	Fair
Habitat Results: *Fish Lake Reservoir*									
2	15LS020	Beaver River	4.625	10.25	18.9	12	23	68.775	Good
Averages:			4.425	10.25	18.9	12	23	68.77	Good
Habitat Results: : *Us Kab Wan Ka*									
2	97LS026	Us-Kab-Wan-Ka	5	12.75	20.175	15.5	24.5	77.925	Good
3	15LS002	Us Kab Wan Ka	5	10.66667	19.33333	13.33	18.3333	66.666	Good
Averages:			5	11.7	19.8	14.4	21.4	72.3	Good
Habitat Results: *Lower Cloquet*									
2	01LS006	Beartrap Creek	5	10.75	9	13.5	13.5	51.75	Fair
2	15LS003	Cloquet River	4.25	10.5	18.8	11.5	18	63.05	Fair
3	15LS031	Cemetery Creek	5	13	18.35	14	18.3333	68.683	Good
1	15LS026	Sullivan Creek	5	11	2	12	7	37	Poor
3	98LS019	Hellwig Creek	5	11.33333	9.133333	16	13	54.466	Fair
2	15LS001	Cloquet River	4.375	11.5	21.9	5.5	17	60.275	Fair
2	15LS021	Chalberg Creek	5	12	16.7	15.5	17	66.2	Good
Average Habitat Results:			4.8	11.4	13.7	12.6	14.8	57.3	Fair

Qualitative habitat ratings

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

Appendix 6 – Lake protection and prioritization results

Lake ID	Lake name	Mean TP	Trend	% Disturbed land use	5% load reduction goal	Priority
69003000	White	9.3	No evidence of trend	5%	1	Highest
69052500	Rose	13.1	Decreasing trend	11%	1	Highest
69037200	Island Lake Reservoir	14.0	No evidence of trend	8%	32	Highest
69051100	Grand	15.1	No evidence of trend	5%	29	Highest
69037100	Wild Rice	41.3	No evidence of trend	8%	161	Highest
69023500	Sunshine	9.1	No evidence of trend	5%	2	Higher
38065100	Kane	16.4	No evidence of trend	5%	2	Higher
69052200	Winkle	27.0	Insufficient data	10%	1	Higher
69039400	Flowage	16.9	Decreasing trend	7%	3	Higher
69052100	Leora	18.3	Increasing trend	3%	10	Higher
69048900	Caribou	16.5	No evidence of trend	4%	12	Higher
69004100	Bassett	22.8	Increasing trend	4%	21	Higher
69023400	Mirror	14.0	Insufficient data	5%	1	High
69001800	Schaeffer	13.6	Insufficient data	1%	2	High
69039700	Clearwater	20.2	No evidence of trend	9%	1	High
38053800	Katherine	15.0		1%	2	High
69002800	Little Stone	14.8	Insufficient data	0%	4	High
69039900	Deepwater	29.0		9%	1	High
69001600	Sand	22.5	Insufficient data	1%	3	High
69011300	Big Bear	19.0	Insufficient data	0%	5	High
69052300	Dodo	14.0	Decreasing trend	4%	8	High
69003600	Salo	19.3	Insufficient data	4%	8	High
38053900	Cloquet	20.3	Insufficient data	2%	8	High

Lake ID	Lake name	Mean TP	Trend	% Disturbed land use	5% load reduction goal	Priority
69012900	Spring	16.0	No evidence of trend	2%	11	High
69013000	Little Alden	15.0	Insufficient data	3%	13	High
38075100	Thomas	24.5	Insufficient data	3%	13	High
69011100	Smith	9.8	No evidence of trend	2%	32	High
38075500	Sullivan	38.5	Insufficient data	4%	16	High
69001100	Pequaywan	16.0	No evidence of trend	2%	47	High
69002300	Indian	32.3	Insufficient data	3%	50	High
69014300	Wolf	27.0	Insufficient data	1%	102	High
69037300	Boulder	25.4	Insufficient data	1%	265	High
69049100	Fish Lake Flowage	25.1	No evidence of trend	5%	286	High
69013100	Alden	20.8	No evidence of trend	1%	539	High