Root River Watershed Monitoring and Assessment Report

Minnesota Pollution Control Agency

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Acknowledgements

MPCA Watershed Report Development Team:

Michael Koschak, Mike Walerak, Pam Anderson, Dan Helwig, Bruce Monson, Dave Christopherson, David Duffey, Andrew Streitz

Contributors:

Citizen Stream Monitoring Program Volunteers
Minnesota Department of Natural Resources
Minnesota Department of Health
Minnesota Department of Agriculture
Fillmore County Soil and Water Conservation District

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Minnesota Pollution Control Agency

520 Lafayette Road North | Saint Paul, MN 55155-4194 | www.pca.state.mn.us | 651-296-6300
Toll free 800-657-3864 | TTY 651-282-5332

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Contents

Executive Summary

This assessment report is the first in a series of reports for watershed work being conducted in the Root River watershed. The results of surface water monitoring activities in the Root River watershed are reported here. Subsequent reports will explain stressor identification, total maximum daily loads, and restoration and protection plans for the watershed.

The Root River watershed (07040008) covers 1,064,961 acres in southeast Minnesota within the Lower Mississippi River Basin. Agriculture is the most prevalent land use in the watershed. The watershed's wealth of surface waters is a valuable resource for aquatic recreation and its health is essential to resident aquatic life. In 2008 the Minnesota Pollution Control Agency (MPCA) undertook an intensive watershed monitoring effort of the Root River watershed's surface waters. A total of 109 sites were sampled for biology at the outlets of variable sized sub-watersheds within the Root River watershed. These locations included the mouth of the Root River, the outlets of its major tributaries, and the outlets of headwater tributaries. As part of this effort, the MPCA also joined with the Fillmore County Soil and Water Conservation District who completed stream water chemistry sampling at the outlets of the Root River's 15 major subwatersheds during 2009. In 2011, a holistic approach was taken to assess all of the watershed's surface water bodies for aquatic life, recreation, and fish consumption use support, where data was available. A total of 142 stream reaches were sampled for fish, and 139 stream reaches were sampled for macroinvertebrates in the Root River watershed during the assessment window. Eighty-six streams were assessed for aquatic life support and eighteen were assessed for aquatic recreation in this effort. Not all streams were able to be assessed due to insufficient data, modified channel condition, or "limited resources waters" water quality designation.

Forty-three streams were found to be supporting of aquatic life use in the Root River watershed. Aquatic biological impairments were found scattered throughout the watershed where assessments were made (see Fig. 46 for a map of impaired sites). Forty-three new impairments of aquatic life have been added to the Root River watershed during the 2011 assessment cycle. Eighteen stream reaches were assessed for aquatic recreation, with none of these streams supporting. Aquatic consumption impairments span the entire length of the Root River as well as the South Fork Root River and Middle Branch Root River due to the presence of mercury in fish tissue. Channelized streams throughout the watershed are generally in good to fair condition for fish and poor condition for invertebrates. Habitat assessments generally showed conditions in the good to fair range. Water column impairments, most commonly high bacteria concentrations, are present throughout the watershed.

The Root River watershed is in relatively good condition when compared to other assessed watersheds in the state. However, more channel stability and erosion control measures need to be taken to help curb sediment problems and minimize the impacts of flooding events. Land use modifications and use practices, such as the high abundance of rangeland, may be contributing to the high number of aquatic recreation impairments and need to be addressed. Protection strategies and plans need to be considered for streams of the watershed with exceptionally good water quality.

I. Introduction

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

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

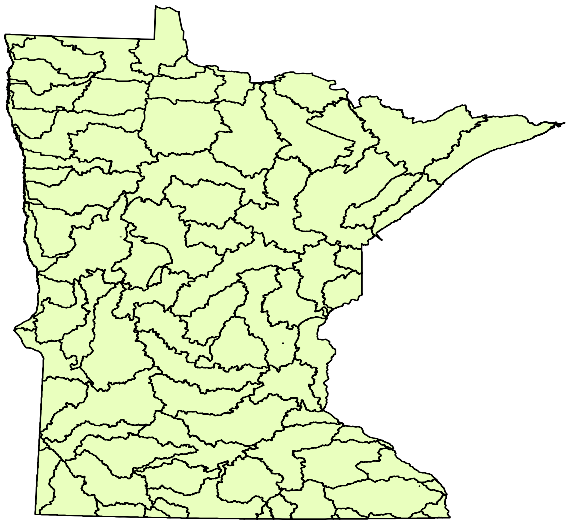
The passage of Minnesota's Clean Water Legacy Act (CWLA) of 2006 provided a policy framework and resources to state and local governments to accelerate efforts to monitor, assess, restore, and protect surface waters. Funding from the Clean Water Fund, created by the passage of the Clean Water, Land, and Legacy Amendment to the state constitution, allows a continuation of this work. In response, the MPCA has developed a watershed monitoring strategy which uses an effective and efficient integration of water monitoring programs to provide a more comprehensive assessment of water quality and expedite the restoration and protection process. This has permitted the MPCA to establish a goal to assess the condition of Minnesota's surface waters via a 10-year cycle, and provides an opportunity to more fully integrate MPCA water resource management efforts in cooperation with local government and stakeholders, to allow for coordinated development and implementation of water quality restoration and improvement projects.

The rationale behind the watershed approach is to intensively monitor the streams and lakes within a major watershed to determine the overall health of water resources, identify impaired waters, and to identify waters in need of additional protection efforts. This two year monitoring strategy was implemented in the Root River watershed beginning in the summer of 2008. This report provides a summary of all water quality assessment results and incorporates all data available for the assessment process including watershed monitoring, volunteer monitoring, and local government units. Consequently, there is an opportunity to begin to address most, if not all, impairments through a coordinated TMDL process at a watershed scale, rather than the reach-by-reach and parameter-by-parameter approach often historically employed. A watershed approach will more effectively address multiple impairments resulting from the cumulative effects of point and non-point sources of pollution, and further the CWA goal of protecting, restoring, and preserving the quality of Minnesota's water resources.

II. The Watershed Monitoring Approach

The watershed approach includes a 10-year rotation for assessing waters of the state on the level of Minnesota's 81 major watersheds (Fig. 1). The primary feature of the watershed approach is that it provides a unifying focus on the water resources within a watershed as the starting point for water quality assessment, planning, implementation, and results measures. The major benefit of this approach is the integration of monitoring resources to provide a more complete and systematic assessment of water quality at a geographic scale useful for the development and implementation of effective TMDLs and protection strategies. The following paragraphs provide details on each of the four principal monitoring components of the watershed approach. For additional information, see *Watershed Approach to Condition Monitoring and Assessment* (MPCA 2008) (http://www.pca.state.mn.us/publications/wq-s1-27.pdf).

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



Load monitoring network

The first component of this effort is the Major Watershed Load Monitoring Program (MWLMP), which involves permanent flow and water chemistry monitoring stations on Minnesota's major rivers, including the Red, Minnesota, Mississippi, and Rainy rivers, and the outlets of major tributaries (also referred to as outlets of each of the state's major watersheds). Major Watershed Load Monitoring program staff and program cooperators monitor water quality of these outlets and at various locations along Minnesota's major rivers. Initiated in 2007 and funded with appropriations from Minnesota's Clean Water Fund, the MWLMP's multi-agency monitoring approach combines site specific stream flow data from United States Geological Survey (USGS) and Minnesota Department of Natural Resources (MDNR) flow gauging stations. This partnership effort determines pollutant loads and trends which is a cornerstone of the watershed approach (MCES not pertinent for this watershed).

Water quality samples are collected year round at all MWLMP monitoring sites. Approximately 30-35 mid-stream grab samples are collected per site per year. Sample collection intensity is greatest during periods of moderate and high flow due to the importance these samples carry in pollutant load calculations. Sampling also occurs during low flow periods but at a lower frequency. Water quality and discharge data are combined in the "Flux32 Pollutant Load Model" to create concentration/flow regression equations to estimate pollutant concentrations and loads on days when samples are not collected. Primary outputs from Flux32 include pollutant loads and flow weighted mean concentrations (FWMC). A pollutant load is defined as the amount (mass) of a pollutant passing a stream location over a given unit of time. The FWMC is used to estimate the overall quality of water passing this point, computed by dividing the pollutant load by the total flow volume that passed the stream location over the same given unit of time. Annual pollutant loads are calculated for total suspended solids (TSS), total phosphorus (TP), dissolved orthophosphate (DOP), and nitrate plus nitrite-nitrogen (nitrate-N). Primary outputs from Flux32 include annual and daily pollutant loads and FWMC (pollutant load/total flow volume). When fully implemented, the MWLMP will monitor and compute pollutant loads at 81 stream sites across the State.

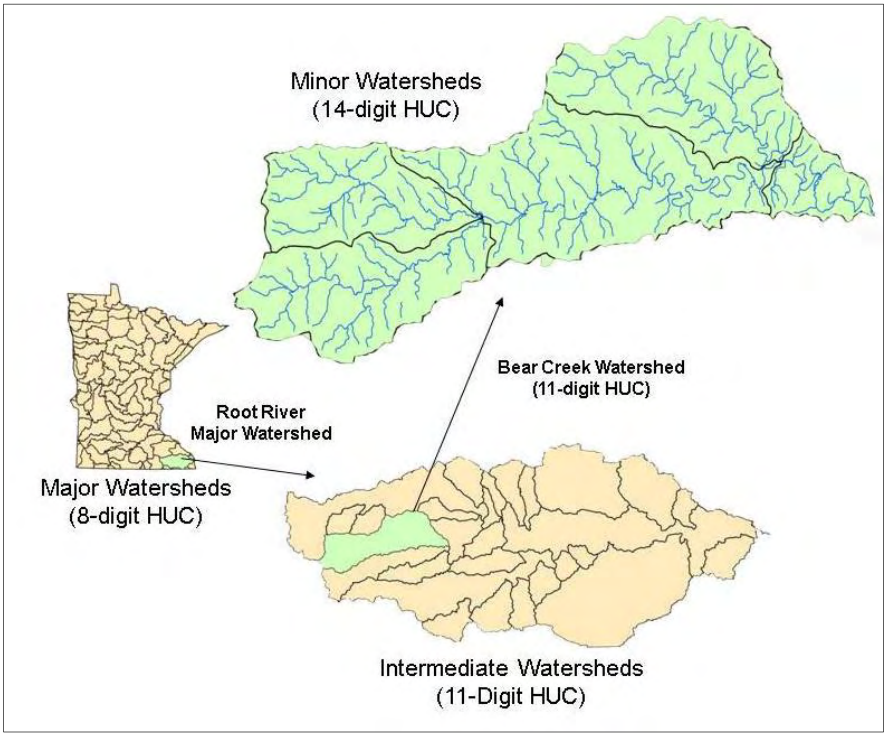
The on-going monitoring performed by the program is designed to measure and compare regional differences and long-term trends in water quality. This will be particularly helpful in putting the intensive watershed monitoring (IWM) data for a given watershed (see below) into a longer-term context, given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

Intensive watershed monitoring

Stream monitoring

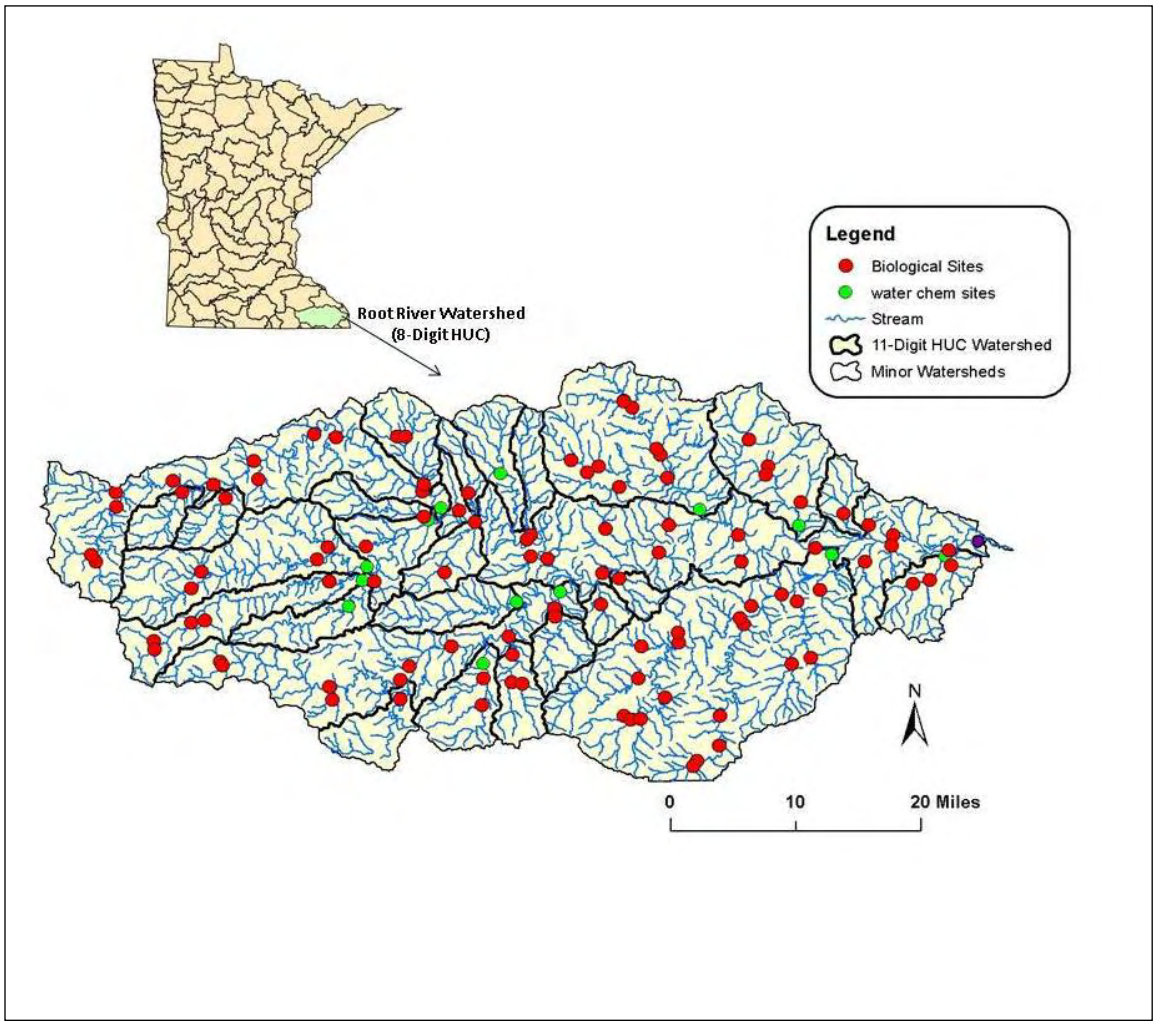
The IWM strategy utilizes a nested watershed design allowing the aggregation of watersheds from a coarse to a fine scale. The foundation of this comprehensive approach is the 81 major watersheds within Minnesota. Sampling occurs in each major watershed once every 10 years. In this approach, intermediate-sized (approximately 11-digit HUC) and "minor" (14-digit HUC) watersheds are sampled along with the major watershed outlet to provide a complete assessment of water quality (Fig. 2). River/stream sites are selected near the outlet at all watershed scales. This approach provides holistic and relatively unbiased assessment coverage of rivers and streams without monitoring every single stream reach (See Fig. 3 for an illustration of the monitoring site coverage within the Root River major watershed).

Figure 2: The intensive watershed monitoring design



The outlet of the major watershed (purple dot in Fig. 3) is sampled for biology, water chemistry, and fish contaminants to allow for the assessment of aquatic life, aquatic recreation, and aquatic consumption use-support. Each 11-digit HUC outlet (green dots in Fig. 3) is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use-support. Watersheds at this scale generally consist of major tributary streams with drainage areas ranging from 75 to 150 square miles. Lastly, most minor watersheds (typically 10-20 square miles) are sampled for biology (fish and invertebrates) to assess aquatic life use support (red dots in Fig. 3). Specific sites descriptions that were for the intensive monitoring effort in the Root River watershed can be found in Appendix 2 and 3.

Figure 3: Intensive watershed monitoring stations in the Root River watershed



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

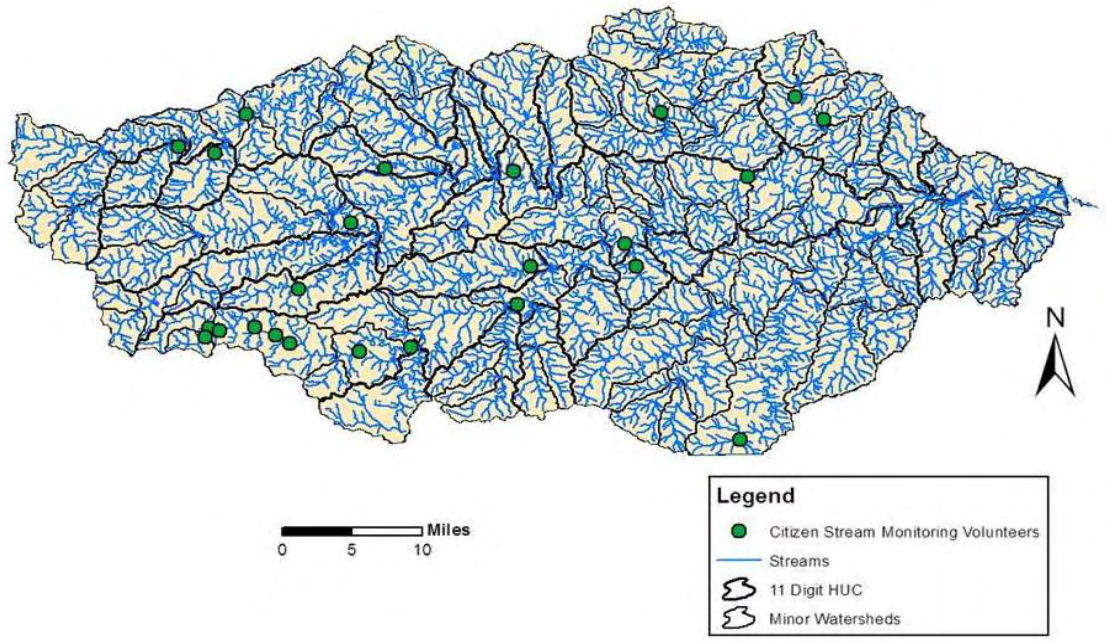
Citizen and local monitoring

Citizen monitoring is an important component of the watershed monitoring approach. The MPCA coordinates two programs aimed at encouraging citizen surface water monitoring: the Citizen Lake Monitoring Program (CLMP) and the Citizen Stream Monitoring Program (CSMP). Like the permanent load monitoring network, sustained citizen monitoring can provide the long-term picture needed to help evaluate current status and trends. The advance identification of lake and stream sites that will be sampled by agency staff provides an opportunity to actively recruit volunteers to monitor those sites, so that water quality data collected by volunteers are available for the years before and after the intensive monitoring effort by MPCA staff. This citizen-collected data helps agency staff interpret the results from the intensive monitoring effort, which only occurs one out of every 10 years. It also allows interested parties to track any water quality changes that occur in the years between the intensive monitoring events. Coordinating with volunteers to focus monitoring efforts where it will be most effective for planning and tracking purposes will help local citizens/governments see how their efforts are being used to inform water quality management decisions and affect change. Figure 4 provides an illustration of the locations where citizen monitoring data were used for assessment in the Root River watershed.

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

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

Figure 4: Monitoring locations of local groups and citizens in the Root River watershed



III. 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. The assessment and listing process involves dozens of MPCA staff, other state agencies and local partners. The goal of this effort is to use the best data and best science available to assess the condition of Minnesota's water resources. For a thorough review of the assessment methodology see *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List* (MPCA 2012). http://www.pca.state.mn.us/index.php/view-document.html?gid=8601

Water quality standards

Water quality standards are the fundamental benchmarks by which the quality of surface waters are measured and used to determine impairment. Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by Minnesota Water Quality Standards (Minn. R. ch. 7050 2008) (https://www.revisor.leg.state.mn.us/rules/?id=7050). These standards can be numeric or narrative in nature and define the concentrations or conditions of surface waters that allow them to meet their designated beneficial uses, such as for fishing (aquatic life), swimming (aquatic recreation) or human consumption (aquatic consumption). All surface waters in Minnesota, including lakes, rivers, streams, and wetlands are protected for aquatic life and recreation where these uses are attainable. Protection of aquatic life means the maintenance of healthy, diverse, and successfully reproducing populations of aquatic organisms, including fish and invertebrates. Protection of recreation means the maintenance of conditions suitable for swimming and other forms of water recreation. Protection of consumption means protecting citizens who eat fish inhabiting Minnesota waters or receive their drinking water from waterbodies protected for this use.

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

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

Assessment units

Assessments of use support in Minnesota are made for individual waterbodies. The waterbody unit used for river systems, lakes, and wetlands is called the "assessment unit". A stream or river assessment unit usually extends from one significant tributary stream to another or from the headwaters to the first tributary. A stream "reach" may be further divided into two or more assessment reaches when there is a

change in use classification (as defined in Minn. R. ch. 7050) or when there is a significant morphological feature, such as a dam or lake, within the reach. Therefore, a stream or river is often segmented into multiple assessment units that are variable in length. The MPCA is using the 1:24,000 scale, high resolution National Hydrologic Dataset (NHD) to define and index stream, lake, and wetland assessment units. Each river or stream reach is identified by a unique waterbody identifier (known as its AUID), comprised of the USGS eight digit hydrologic unit code plus a three character code that is unique within each HUC. Lake and wetland identifiers are assigned by the MDNR. The Protected Waters Inventory provides the identification numbers for lake, reservoirs, and wetlands. These identification numbers serve as the AUID and are composed of an eight digit number indicating county, lake, and bay for each basin.

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 status

Conceptually, the process for determining use attainment status of a waterbody is similar for each designated use: comparison of monitoring data to established water quality standards. However, the complexity of that process and the amount of information required to make accurate assessments varies between uses. In part, the level of complexity in the assessment process depends on the strength of the dose-response relationship; i.e., if chemical B exceeds water quality criterion X, how often is beneficial use Y truly not being attained. For beneficial uses related to human health, such as drinking water, the relationship is well understood and thus the assessment process is a relatively simple interpretation of numeric standards. In contrast, assessing whether a waterbody supports a healthy aquatic community is not as straightforward and often requires multiple lines of evidence to make use attainment decisions with a high degree of certainty. Incorporating a multiple lines of evidence approach into MPCA's assessment process has been evolving over the past few years. The current process used to assess the aquatic life use of rivers and streams is outlined below and in Figure 5.

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

The next step in the process is a Comprehensive Watershed Assessment meeting where reviewers convene to discuss the results of their desktop assessments for each individual waterbody. Implementing a comprehensive approach to water quality assessment requires a means of organizing and evaluating information to formulate a conclusion utilizing multiple lines of evidence. Occasionally, the evidence stemming from individual parameters are not in agreement and would result in discrepant assessments if the parameters were evaluated independently. However, the overall assessment

considers each piece of evidence to make a use attainment determination based on the preponderance of information available. See the *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List* (MPCA 2012) http://www.pca.state.mn.us/index.php/view-document.html?gid=8601 for guidelines and factors to consider when making such determinations.

Any new impairment determination (i.e., waterbody not attaining its beneficial use) is reviewed using GIS to determine if greater than 50 percent of the assessment unit is channelized. Currently, the MPCA is deferring any new impairment determinations on channelized reaches until new aquatic life use standards have been developed as part of the tiered aquatic life use framework. For additional information see *Tiered Aquatic Life Use (TALU) Framework* (http://www.pca.state.mn.us/nwqh8fb). Since large portions of a watershed may be channelized, reaches with biological data are evaluated on a "good-fair-poor" system to help evaluate their condition. (see Section VI below for more discussion)

The last step in the assessment process is the Professional Judgement Group or PJG meeting. At this meeting, results are shared and discussed with entities outside of the MPCA that may have been involved in data collection or that might have knowledge about the watershed that might affect the assessment. Information obtained during this meeting may be used to revise previous use attainment decisions. The result of this meeting is a compilation of the assessed waters which will be included in the watershed assessment report. Waterbodies that do not meet standards and, therefore, do not attain one or more of their designated uses, are considered impaired waters and are placed on the draft 303(d) Impaired Waters List.

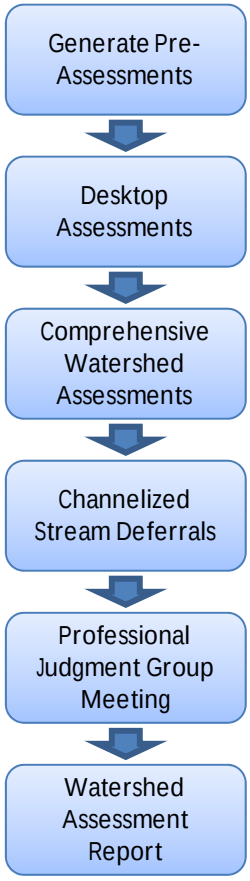
Data management

It is MPCA policy to use all credible and relevant monitoring data to assess surface waters. The MPCA relies on data it collects along with data from other sources, such as sister agencies, local governments, and volunteers. The data must meet rigorous quality-assurance protocols before being used. All monitoring data required or paid for by MPCA is entered into EQuIS (Environmental Quality Information System), MPCA's data system. The MPCA uploads the data from EQuIS to U.S. Environmental Protection Agency's (EPA) STORET data warehouse. Water quality monitoring projects required to store data in EQuIS are those with federal or state funding under CWA Section 319, Clean Water Partnership (CWP), CWLA Surface Water Assessment Grants, and the TMDL program. Many local projects not funded by MPCA choose to submit their data to the MPCA in EQuIS-ready format so that it may be utilized in the assessment process. Prior to each assessment cycle, the MPCA requests data from local entities and partner organizations using the most effective methods, including direct contacts and GovDelivery distribution lists.

Period of record

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

Figure 5: Flowchart of aquatic life use assessment process



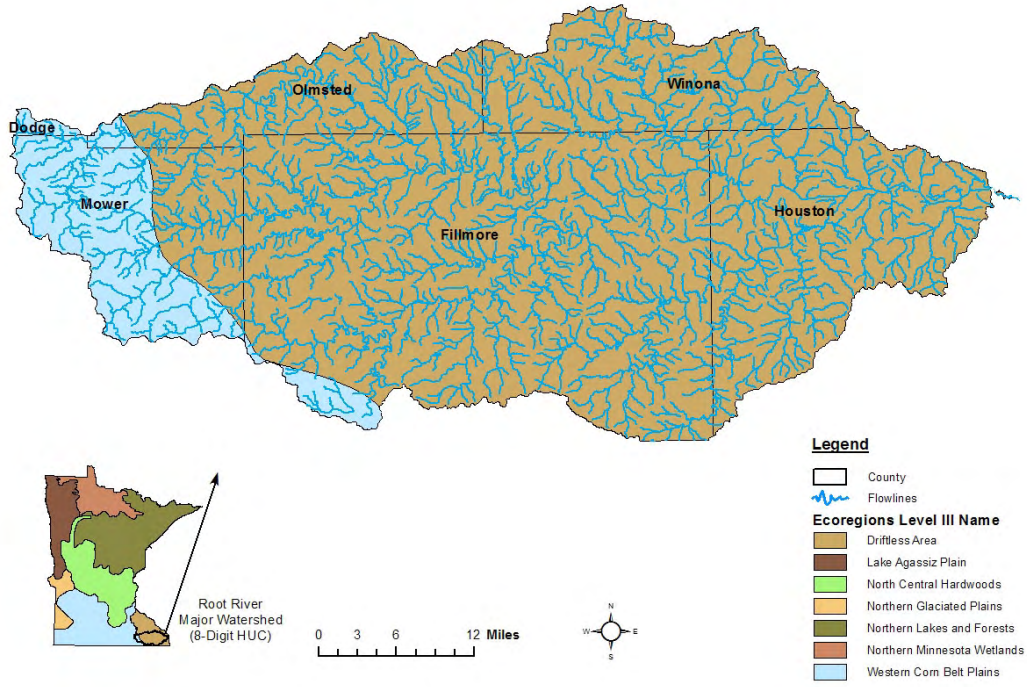
IV. The Root River Watershed Overview

The Root River watershed covers 430,974 hectares (1,064,961 acres) in southeast Minnesota within the Lower Mississippi River Basin. The watershed primarily lies within the Driftless Area ecoregion with a small portion in part of the Western Corn Belt Plains ecoregion (See Fig. 6). The watershed drains west to east before joining the Mississippi River approximately five miles east of the small town of Hokah, Minnesota. Counties containing parts of this watershed include Dodge, Mower, Olmsted, Winona, Fillmore, and Houston.

The Root River watershed avoided much of the historic glaciation that covered Minnesota, and is comprised of karst (limestone) topography. The limestone rock, as it erodes, forms underground streams, springs, and sink holes (USDA-NRCS 2009). The land has limited capacity to store water on the land surface; as a result, there are few lakes in the Root River watershed. Of the 5 basins greater than 4 ha (10 acres), 4 are less than 8 ha (20 acres) and are considered to be wetlands by the MDNR. The final basin, Lake Florence, was a reservoir on the Root River in Stewartville, but the dam was removed in the early 1990s and the water has returned to the river channel. No lake data was available to review for any basins; no further discussion on lakes will be included in this report.

Numerous small tributaries drain to the various forks and branches of the Root River. Several had too little chemistry data to be assessed for aquatic life, recreation, or drinking water uses. As a result, these tributaries will only have biological data discussed further in the watershed summaries that follow: Camp Creek watershed (South Branch Root River); Lost (Upper Bear) Creek, Rice Creek, Lynch Creek, and Dryer Valley Creek watersheds (Middle Branch Root River); and Gribben Creek, Diamond Creek, and Loony Creek watersheds (Root River).

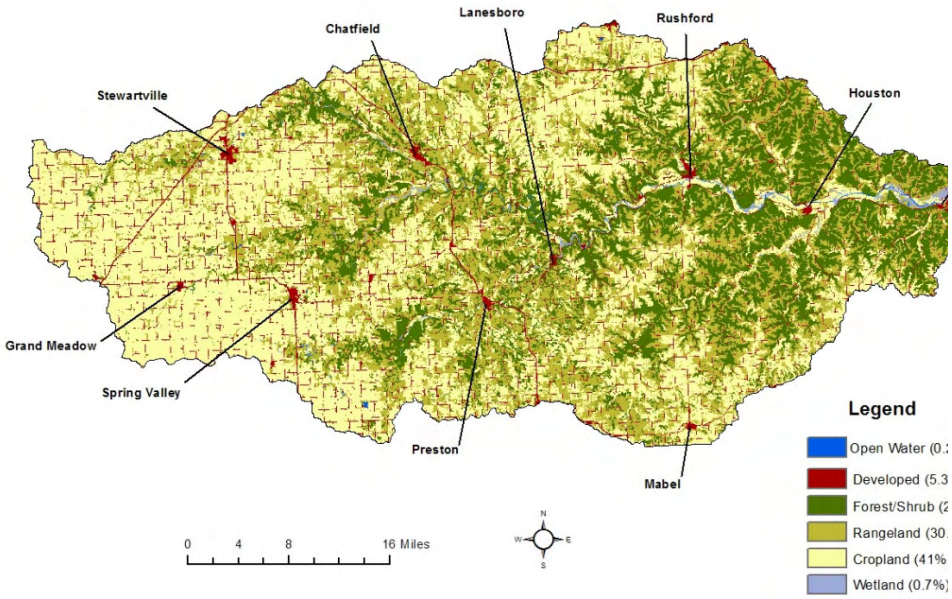
Figure 6: Ecoregion map of the Root River watershed



Land use summary

The Root River watershed has a variety of different land uses making up the landscape (See Fig. 6). Cropland is the most prevalent land use type (41.02 percent). This land use is common in the fertile plains area in the western portion of the watershed, but also in the river valleys located throughout the driftless area. Rangeland (30.7 percent) and forest/shrubland (22.1 percent) are the next most common land uses and found primarily in the rolling hills and bluff regions located in the eastern half of the watershed. Some development (5.3 percent) exists in the watershed and is located around the smaller cities and communities including Chatfield, Rushford, Stewartville, Preston, Spring Valley, Houston, Lanesboro, Grand Meadow, Hokah, and Mabel. Very few areas of wetlands (0.7 percent) and open water (0.2 percent) exist in the watershed.

Figure 7: Land use in the Root River watershed



Surface water hydrology

The headwaters of the Root River are located in western Mower County in an area that is primarily agriculture. The headwaters are separated into the North, Middle, and South branches of the Root River. These separate systems generally flow in an easterly direction through the relatively flat country sides of Mower County before entering the predominantly driftless areas of southern Olmsted and Fillmore counties.

In driftless areas, an influx of groundwater feeds streams, creating coldwater springs and tributaries capable of supporting both coldwater fish and invertebrate assemblages.

The North and Middle branches of the Root River are the first two main tributaries to join together as they combine approximately two miles south of the city of Chatfield. The South Branch Root River joins the main stem of the Root River approximately one mile northeast of the city of Lanesboro. The river continues to flow in an easterly direction winding through the scenic bluffs in Fillmore and Houston counties before it is joined with the South Fork Root River, the largest tributary, near the city of Houston. From there, it continues its easterly direction before joining the Mississippi River at Navigation Pool 7.

The South Fork Root River, as well as the North, Middle, and South branches of the Root River, are the major tributaries within the watershed. Other lesser, but still significant tributaries include: Bear Creek, Deer Creek, Spring Valley Creek, Willow Creek, Money Creek, Watson Creek, Trout Run Creek, Thompson Creek, Mill Creek, and Rush Creek.

Climate and precipitation

Average annual precipitation in the Root River watershed ranges from 32-35 inches, depending on location (Minnesota State Climatologists Office, 1999). During the 2008 water year (Oct. 2007-Sept. 2008), when most of the monitoring was conducted in the watershed, precipitation was significantly higher than average for the Root River watershed (See Fig. 8). A significant flood event did take place during the spring of 2008 as well as in late summer of 2007, which was not part of the 2008 water year. The maps in Figure 9 are taken from the State Climatology Office link http://climate.umn.edu/doc/hydro_yr_pre_maps.htm

Figure 8: Precipitation and departure from normal precipitation maps for Minnesota during the 2007-2008 water year

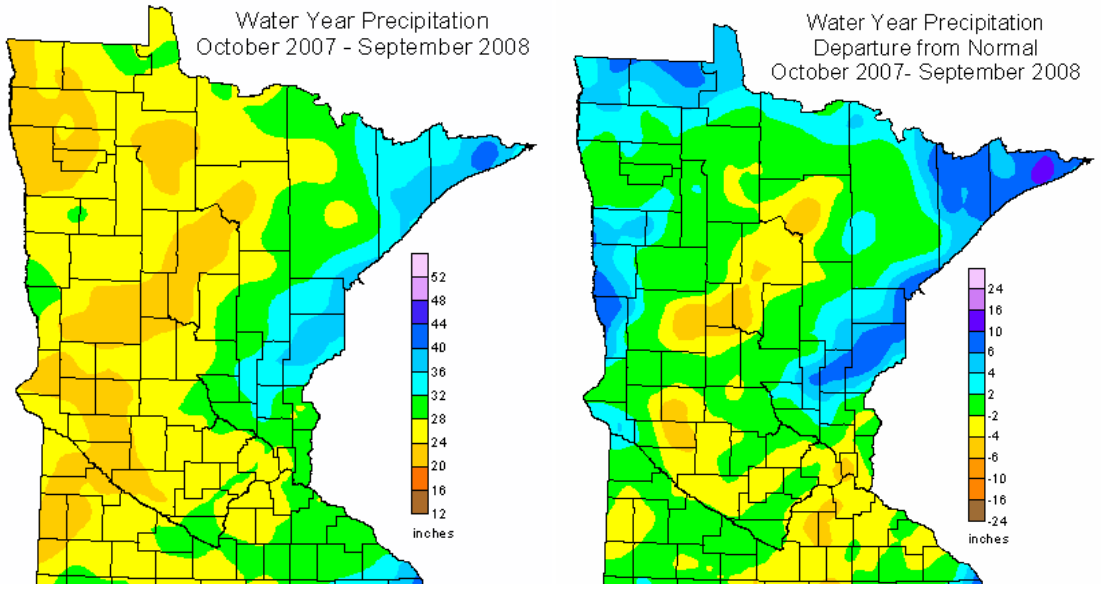
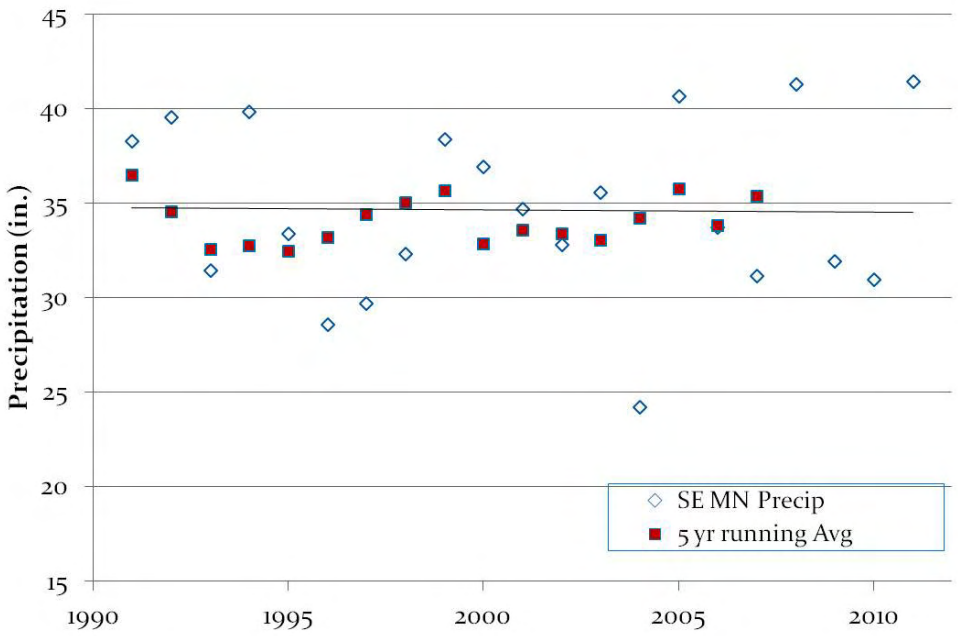


Figure 9 shows that rainfall in the southeast region and suggests no significant trend over the last 20 years. Though rainfall can vary in intensity and time of year, it would appear that southeast Minnesota precipitation has not changed dramatically over this time period.

Figure 9: Precipitation trends in southeast Minnesota with 5 year running average

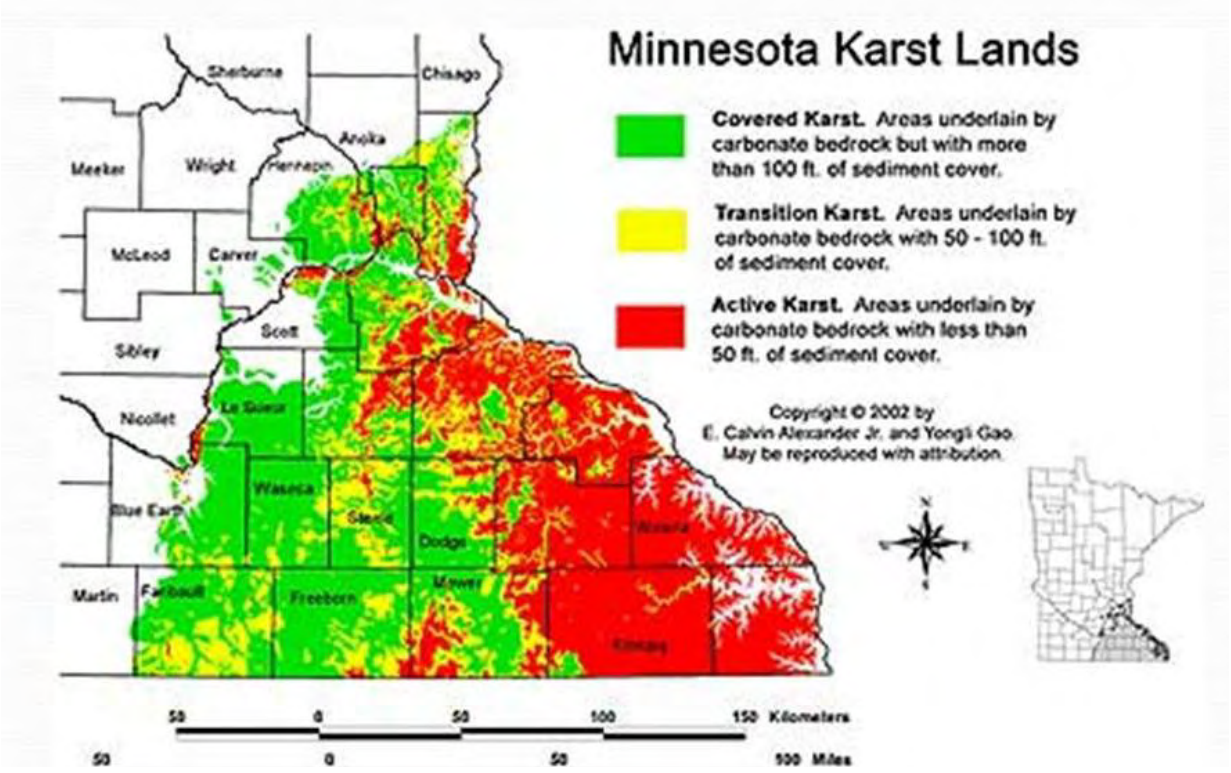


Hydrology and groundwater quality

Geology in southeast Minnesota is characterized by karst features (See Fig. 10). These geologic features occur where limestone is slowly dissolved by infiltrating rainwater, sometimes forming hidden, rapid pathways from pollution release points to drinking water wells or surface water (MPCA 2011).

Karst aquifers, like those commonly used in the Root River watershed, are very difficult to protect from activities at the ground surface. While pollutants are quickly transported to drinking water wells or surface water, conventional hydrogeologic tools such as monitoring wells are of limited usefulness. The best strategy is pollution prevention from common sources like septic systems, abandoned wells, and animal feedlot operations.

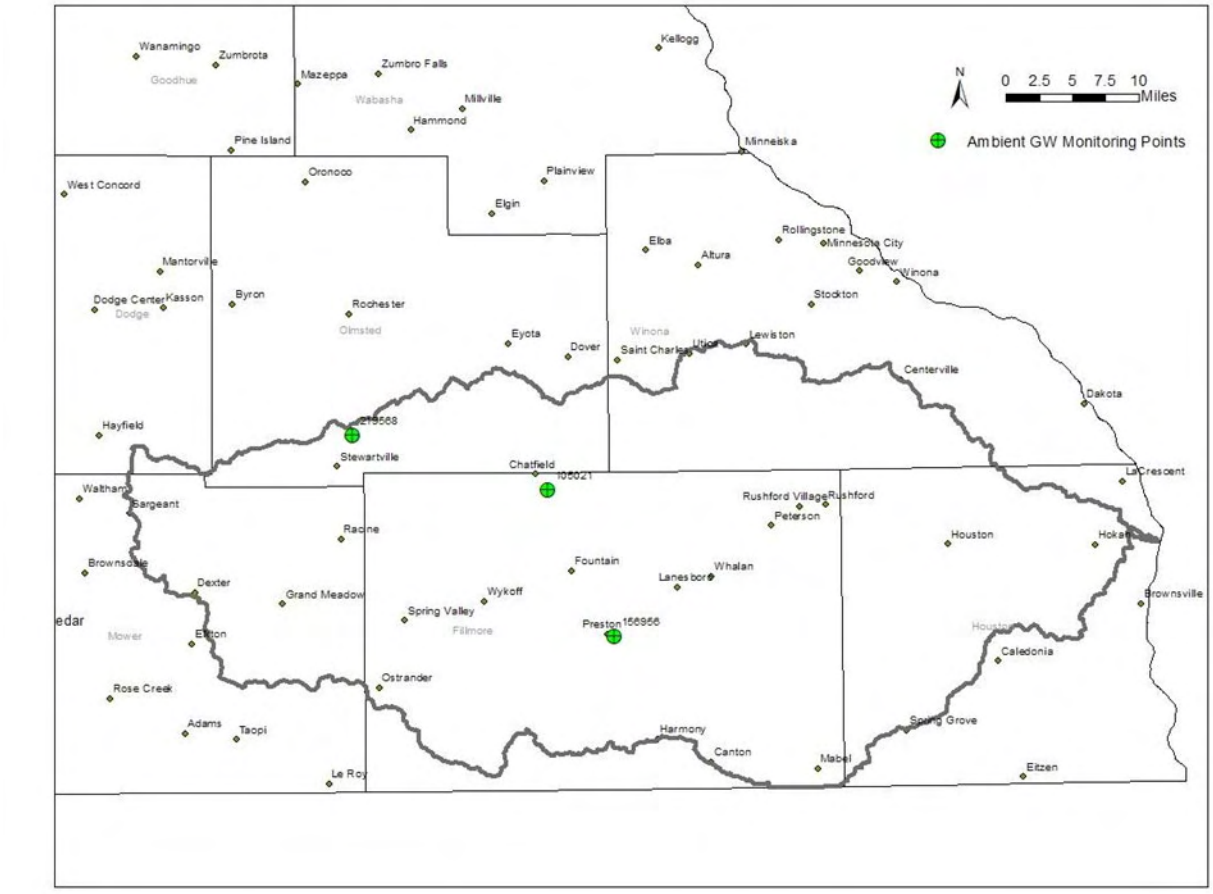
Figure 10: Minnesota karst lands



The Ambient Groundwater Monitoring Program at the MPCA tracks trends in statewide groundwater quality by sampling for a comprehensive suite of chemicals including nutrients, metals, and volatile organic compounds.

Three locations within the Root River watershed are monitored by the MPCA (See Fig. 11). These wells are domestic supply wells and draw from bedrock aquifers. Results from this monitoring have shown no exceedances of health-based standards for the sampled analytes.

Figure 11: Groundwater monitoring locations in the Root River watershed



V. Watershed-Wide Data Collection Methodology

Load monitoring

The Root River is monitored at Highway 25 near Mound Prairie approximately 12 river miles above the confluence with the Mississippi River. Many years of water quality data from throughout Minnesota combined with previous analysis of Minnesota's ecoregion patterns, resulted in the development of three "River Nutrient Regions" (RNR) (MPCA 2010a), each with unique nutrient standards. Of the state's three RNRs (North, Central, South), the Root's load monitoring station is located within the Central RNR.

Intensive water quality sampling occurs year round at all MWLMP sites. Thirty to thirty-five mid-stream grab samples are collected per site per year with sampling frequency greatest during periods of moderate to high flow. Because correlations between concentration and flow exist for many of the monitored analytes, and because these relationships can shift between storms or with season, computation of accurate load estimates requires frequent sampling of all major runoff events. Low flow periods are also sampled and are well represented but sampling frequency tends to be less as concentrations are generally more stable when compared to periods of elevated flow. Despite discharge related differences in sample collection frequency, this staggered approach to sampling generally results in samples being well distributed over the entire range of flows.

Water chemistry and discharge data are input into the "Flux32" load estimation program to estimate pollutant concentrations and loads on days when samples are not collected. Primary outputs include annual pollutant loads, defined as the amount (mass) of a pollutant passing a stream location over a defined period of time, and FWMC. Flow weighted mean concentrations are computed by dividing the pollutant load by the total seasonal flow volume. Annual pollutant loads and flow weighted means are calculated for TSS, TP, orthophosphate (OP), Total Kjeldahl Nitrogen (TKN) and nitrate-N).

Stream water sampling

Fifteen stations were sampled from May thru September in 2008 and again June thru August of 2009 to provide sufficient water chemistry data for assessing aquatic life and aquatic recreation designated uses in the 11-HUC subwatersheds (green dots in Fig. 3) with a drainage area greater than 30 square miles. Following IWM design, sampling locations were established near the outlets of these subwatersheds. See Appendix 3 for locations of stream water chemistry monitoring sites. See Appendix 1 for definitions of stream chemistry analytes monitored in this study.

Stream biological sampling

The biological monitoring component of IWM in the Root River watershed was completed during the summer of 2008. A total of 109 biological monitoring sites were established across the watershed and sampled. These sites were located near the outlets of most minor HUC-14 watersheds, selected following the sampling design. In addition, biological data from four existing monitoring stations within the watershed were included in the assessment process. These monitoring stations were established as part of a random Lower Mississippi River Basin survey in 2004 or as part of a 2007 investigation into the quality of channelized streams with intact riparian zones. While data from the last 10 years contributed to the watershed assessments, the majority of data utilized for the 2011 assessment was collected in 2008. A total of 109 stream assessment units were sampled for biology in the Root River watershed and aquatic life assessments were conducted for 86 of these. In anticipation of transitioning to a TALU framework, biological monitoring data was not assessed on channelized stream segments due to their potential to qualify for a 'modified' aquatic life use classification and its associated water quality criteria. Nonetheless, the biological information that was not used in the assessment process will be crucial to the stressor identification process and will also be used to investigate trends in water quality condition 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. Minnesota's streams and rivers were divided into nine distinct classes, with each class having its own unique fish IBI and invert IBI. The classification factors used to produce the nine classes were drainage area, gradient, water temperature, and geographic region of the state. Fish and macroinvertebrate communities occurring at sites within each class are more similar to each other than those occurring in other classes. These classification factors are unaffected by human disturbance to ensure that the framework reflects only natural variability and that the resulting IBIs reflect human-induced impacts to the waterbody. Indices of biological integrity development were stratified by class, with a unique suite of metrics, scoring functions, impairment thresholds, and confidence intervals identified for each. Indices of biological integrity scores higher than the impairment threshold indicate that the stream reach supports aquatic life. Contrarily, scores below the impairment threshold indicate that the stream reach does not support aquatic life. Confidence limits around the

impairment threshold help to ascertain where additional information may be considered to help inform the impairment decision. When IBI scores fall within the confidence interval, interpretation and assessment of waterbody condition involves consideration of potential stressors, and draws upon additional information regarding water chemistry, physical habitat, land use activities, etc. For individual biological monitoring station IBI scores, thresholds and confidence intervals for all biological monitoring sites within the watershed refer to Appendices 5-7.

Fish contaminants

Mercury and polychlorinated biphenyls (PCBs) were analyzed in fish tissue samples collected from the Root River in 1999, and 2004 by the MDNR fisheries, and in 2008 by the MPCA biomonitoring staff.

Captured fish were wrapped in aluminum foil and frozen until they were thawed, scaled, filleted, and ground. The homogenized fillets were placed in 125 mL glass jars with Teflon™ lids and frozen until thawed for mercury or PCBs analyses. The Minnesota Department of Agriculture laboratory performed all mercury and PCBs analyses of fish tissue.

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

Polychlorinated biphenyls in fish have not been monitored as intensively as mercury in the last three decades due to monitoring completed in the 1970s and 1980s. These studies identified that high concentrations of PCBs were only a concern downstream of large urban areas in large rivers, such as the Mississippi River and in Lake Superior. This implied that it was not necessary to continue widespread frequent monitoring of smaller river systems as is done with mercury. However, limited PCB monitoring was included in the watershed sampling design to ensure that this conclusion is still accurate. Impairment assessment for PCBs in fish tissue is based on the fish consumption advisories prepared by the Minnesota Department of Health. If the consumption advice is to restrict consumption of a particular fish species to less than a meal per week because of PCBs, the MPCA considers the lake or river impaired. The threshold concentration for impairment is 0.22 mg/kg PCBs and more restrictive advice is recommended for consumption (one meal per month).

VI. Individual Watershed Results

HUC-11 watershed units

Assessment results are presented for each of the HUC-11 watershed units within the Root River watershed. This is intended to enable the assessment of all surface waters at one time and the ability to develop comprehensive TMDL studies on a watershed basis, rather than the reach-by-reach and parameter-by-parameter approach often historically employed. This scale provides a robust assessment of water quality condition in the 11-digit watershed unit and is a practical size for the development,

management, and implementation of effective TMDLs and protection strategies. The primary objective is to portray all the impairments within a watershed resulting from the complex and multi-step assessment and listing process. The graphics presented for each of the HUC-11 watershed units contain the 2011 assessment results from the two year 2012 Assessment Cycle as well as any impairment listings from previous assessment cycles. Discussion of assessment results focuses primarily on the 2008 IWM effort but also considers available data from the last 10 years.

Given all the potential sources of data and differing assessment methodologies for indicators and designated uses, it is not currently feasible to provide results or summary tables for every monitoring station by parameter. However, in the following pages, an individual account of each HUC-11 watershed is provided. Each account includes a brief description of the subwatershed, a table summarizing stream aquatic life and aquatic recreation assessments, a table summarizing the biological condition of channelized streams and ditches, a stream habitat results table, a summary of water chemistry results for the HUC-11 outlet, and a narrative summary of the assessment results for the subwatershed. A brief description of each of these components 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 watershed (i.e., where sufficient information was available to make an assessment). Primarily, these tables reflect the results of the 2011 assessment process (2012 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 were made during the desktop phase of the assessment process (see Fig. 5). Assessment of aquatic life is derived from the analysis of biological (fish and invert IBIs), dissolved oxygen, turbidity, chloride, pH and un-ionized ammonia (NH_3) data, while the assessment of aquatic recreation in streams is based solely on bacteria (*Escherichia coli*) data. Included in each table is the specific aquatic life use classification for each stream reach: cold water community (2A); cool or warm water community (2B); or indigenous aquatic community (2C). Stream reaches that do not have sufficient information for either an aquatic life or aquatic recreation assessment (from current or previous assessment cycles) are not included in these tables, but are included in Appendix 4. Where applicable and sufficient data exists, assessments of other designated uses (e.g., drinking water and aquatic consumption) are discussed in the summary section of each HUC-11 as well as in the Watershed-Wide Results and Discussion section.

Channelized stream evaluations

Biological criteria have not been developed yet for channelized streams and ditches, therefore, assessment of fish and macroinvertebrate community data for aquatic life use support was not possible at some monitoring stations. A separate table provides a narrative rating of the condition of fish and macroinvertebrate communities at such stations based on IBI results. Evaluation criteria are based on aquatic life use assessment thresholds for each individual IBI class (see Appendices 8 and 9). Indices of biological integrity scores above this threshold are given a “good” rating, scores falling below this threshold by less than ~15 points (i.e., value varies slightly by IBI class) are given a “fair” rating, and scores falling below the threshold by more than ~15 points are given a “poor” rating. For more information regarding channelized stream evaluation criteria refer to Appendix 8.

Stream habitat results

Habitat information documented during each fish sampling visit is provided in each HUC-11 section. These tables convey 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 for each scoring category for that particular subwatershed. To read the habitat assessment protocol, see http://www.pca.state.mn.us/index.php/component/option,com_docman/task,doc_view/gid,6088.

Watershed outlet water chemistry results

These summary tables display the water chemistry results for the monitoring station representing the outlet of the HUC-11 watershed. This data, along with other data collected within the 10 year assessment window, can provide valuable insight on water quality characteristics and potential parameters of concern within the watershed. Parameters included in these tables are those most closely related to the standards or expectations used for assessing aquatic life and recreation. While not all of the water chemistry parameters of interest have established water quality standards, McCollor and Heiskary (1993) developed ecoregion expectations for a number of parameters that provide a basis for evaluating stream water quality data and estimating attainable conditions for an ecoregion. For comparative purposes, water chemistry results for the Root River watershed are compared to expectations developed by McCollor and Heiskary (1993) that were based on the 75th percentile of a long-term dataset of least impacted streams within each ecoregion.

HUC-11 watershed units

Table 1: Root River HUC-11 watershed units

HUC-11 Units	Area (Acres)	Percent of HUC-8	Number of Monitored Stream Reaches
Rush-Pine Creek	86,855	8	7
Money Creek	48,976	5	6
Mill Creek	20,652	2	2
Trout Run	20,462	2	3
North Branch Root River	104,941	10	7
Dyer Valley	12,981	1	1
Lynch Creek	8,036	1	1
Chatfield	6,225	1	1
Loony Creek	10,729	1	1
Lost Creek	12,045	1	1
Root River	142,025	13	14
Robinson Creek	11,190	1	1

HUC-11 Units	Area (Acres)	Percent of HUC-8	Number of Monitored Stream Reaches
Carey Creek	11,676	1	1
Bear Creek	63,555	6	4
Middle Branch Root River	21,524	2	5
Rice Creek	15,525	1	2
South Fork Root River	184,597	17	22
Thompson Valley	23,538	2	4
Diamond Creek	6,891	1	2
Deer Creek	37,602	4	3
Watson Creek	21,711	2	1
South Branch Root River	88,781	8	12
Gribben Creek	8,316	1	2
Spring Valley Creek	19,234	2	1
Duschee Creek	14,606	1	1
Camp Creek	16,975	2	2
East Willow Creek	23,078	2	2
Canfield Creek	18,398	2	1

North Branch Root River Watershed Unit HUC 07040008010

Watershed description

The North Branch Root River Watershed Unit, located in parts of northeast Mower County, southern Olmsted County, and northwest Fillmore County, drains an area of 164.1 square miles. This watershed forms one of the major tributaries to the Root River. Land use in the watershed is dominated by cropland (58.8 percent). Other significant land uses are rangeland (23.1 percent), forest/shrubland (10 percent), and developed land (7.3 percent). The North Branch of the Root River gets its start in the township of Dexter in Mower County. From this point, the stream flows northeast to the High Forest Township in Olmsted County where it begins heading east before turning northeast near the city of Stewartville. The river then heads southeast upon reaching the township of Pleasant Grove in Olmsted County before joining the Root River approximately 2.5 miles southeast of the city of Chatfield. The outlet of this unit is represented by site 08LM012 on the North Branch Root River.

Stream water chemistry assessment results

Water quality data was available on three sections of the main stem North Branch Root River; no tributaries had water chemistry or bacteria data available for review. Turbidity impairments were confirmed by recent data in the headwaters area and the reach just above Mill Creek. The downstream end of the reach had elevated turbidity measurements as well, in addition to elevated bacteria levels causing aquatic recreation use impairment.

Stream biological and use assessment

Table 2: Aquatic life and recreation assessments on assessed AUIDs in the North Branch Root River 11 HUC

	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-535, Root River, North Branch, Mill Cr to M Br Root R	3.69	2B	08LM012 10EM123	Upstream of Lost Loop, 2 mi. SE of Chatfield 0.75 mi. downstream of CSAH 2, 1 mi. S of Chatfield	MTS	MTS	-	EXP	MTS	MTS	MTS	-	EX	FS	NS
***07040008-706**, Unnamed creek, Unnamed cr to N Br Root R*	3.7	2B	08LM101	Upstream of 680th Ave, 8 mi. SE of Hayfield	MTS	EXP	-	-	-	-	-	-	-	NS	NA
***07040008-716**, Root River, North Branch, Unnamed cr to Mill Cr*	33.58	2B	08LM084 04LM025 08LM017 04LM130 08LM032	Downstream of CSAH 2, 0.5 mi. W of Chatfield Upstream of Hwy 30, 4 mi. NW of Chatfield Upstream of CSAH 19, 6 mi. SW of Eyota Upstream of CR 19, 4 miles NW of Cummingsville. Upstream of 15th Ave NE, 1.5 mi. NE of Stewartville	MTS	EXP	-	EXP	-	MTS	-	-	-	NS	NA
***07040008-717**, Root River, North Branch, Headwaters to Carey Cr*	33.14	2B	08LM039 08LM054 08LM097	Upstream of CR 115, 5 mi. W of Stewartville Upstream of 680th Ave, 8.5 mi. SE of Hayfield Upstream of CSAH 7, 4 mi. NW of Dexter	MTS	EXP	-	EXS	-	-	-	-	-	NS	NA
***07040008-F41**, Unnamed creek, Unnamed cr to Unnamed cr*	1.86	2B	08LM047	Downstream of CSAH 7, 3 mi. NW of Dexter	EXP	EXP	-	-	-	-	-	-	-	FS	NA
***07040008-F43**, Unnamed creek, Unnamed cr to Unnamed cr*	2.71	2B	07LM023	Downstream of CR 2, 2 mi. NW of Dexter	-	-	-	-	-	-	-	-	-	NA	NA
***07040008-F46**, Unnamed creek, Unnamed cr to Unnamed cr*	1.18	2B	08LM041	Upstream of Hwy 30, 1 mi. E of Stewartville	EXP	EXS	-	-	-	-	-	-	-	NS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment = full support of designated use.

Biological sampling of channelized stream reaches

Table 3: Non-assessed biological stations on channelized AUIDs in the North Branch Root River 11 HUC

AUID	Biological Station ID	Station location	Fish Quality	Macroinvertebrate Quality
07040008-F43, *Unnamed creek, Unnamed cr to Unnamed cr*	07LM023	Downstream of CR 2, 2 mi. NW of Dexter	Fair	-

North Branch Root River 10X stream water chemistry

Table 4: Outlet water chemistry results for the North Branch Root River 11 HUC

Station location:	ROOT RIVER, NORTH BRANCH AT LOST LOOP, 2 MILES SE OF CHATFIELD
Storet ID:	S004-825
Station #:	08LM012

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	10	10	15	10	10	18	10	10	9	10	18	19
Minimum	12	8.28	230	.025	3.5	7.94	.035	3.6	453	8.6	13.3	6
Maximum	21.1	14.45	2419.6	.05	11	8.52	.3	160	597	18.4	22.9	100
Mean[1]	19.06	14.45	595.2	.028	6.07	8.13	.092	28.56	55.56	15.68	18.23	54
Median	19.65	9.35	517.2	.025	5.4	8.06	.07	12.5	560	16.4	18.4	57
WQ standard[2]	230	5.0	126/1260			6.5-9		60				20
# WQ exceedances[3]	0/10	0/10	15/15			0		1/10				4/19

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 5: Minnesota Stream Habitat Assessment (MSHA) for the North Branch Root River 11 HUC

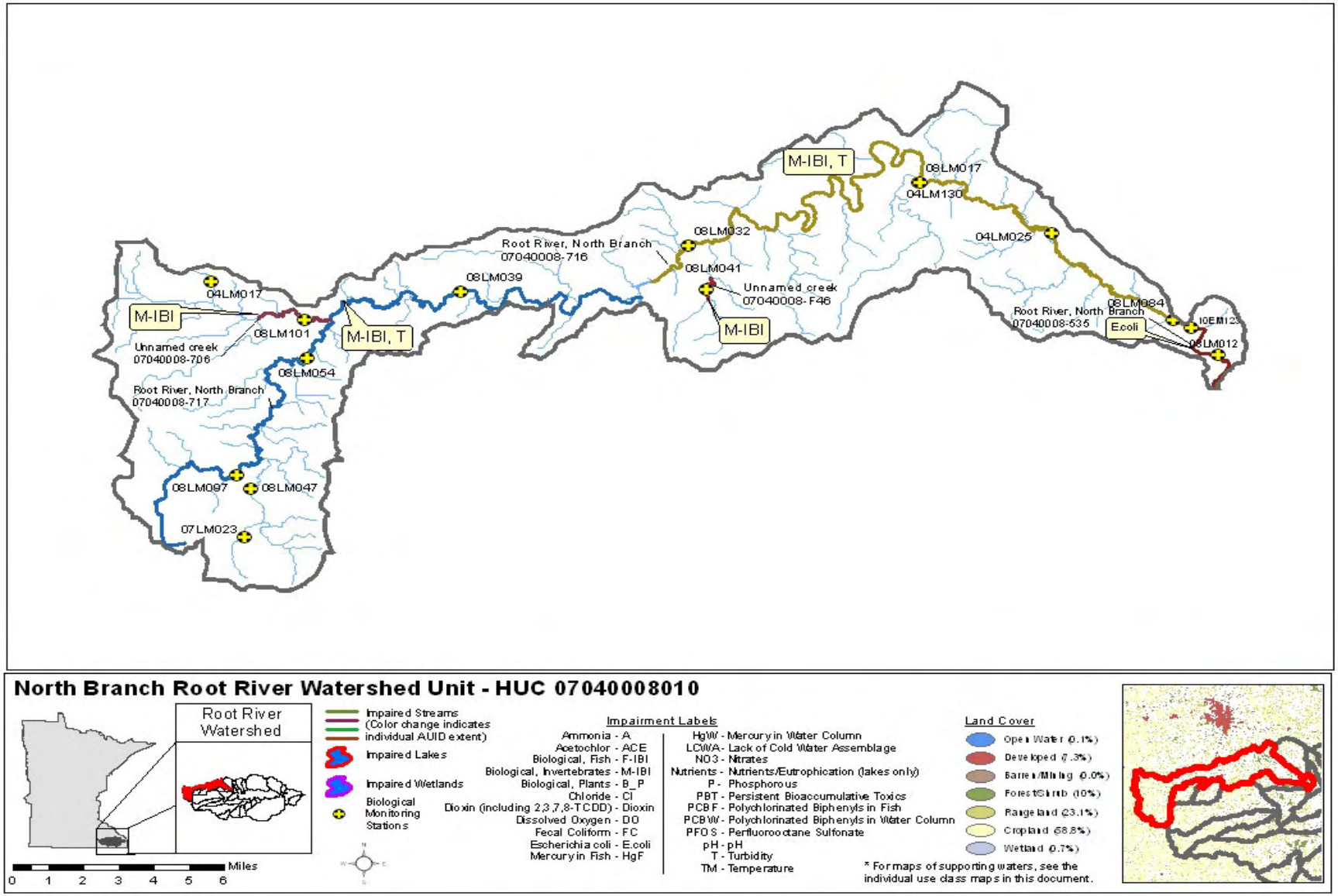
Site ID	Stream Name	Visits	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM025	Root River, North Branch	1	0	7.5	18.6	8	23	57.1	Fair
04LM130	Root River, North Branch	1	2.5	9	18	16	32	77.5	Good
07LM023	Trib. to Root River, North Branch	1	0	8	16.2	9	25	58.2	Fair
08LM012	Root River, North Branch	2	0.6	7	20.3	10	29	67	Good
08LM017	Root River, North Branch	2	2.5	10.5	24.6	15	31	83.6	Good
08LM032	Root River, North Branch	1	0	8.5	16.1	5	17	46.6	Fair
08LM039	Root River, North Branch	1	0	9	20.1	6	27	62.1	Fair
08LM041	Trib. to Root River, North Branch	1	0	8.5	12.3	5	18	43.8	Poor
08LM047	Trib. to Root River, North Branch	1	0	9	18.1	6	23	56.1	Fair
08LM054	Root River, North Branch	1	0	9	15.7	8	22	54.7	Fair
08LM084	Root River, North Branch	2	0	9.5	21.6	10	23.5	64.6	Fair
08LM097	Root River, North Branch	1	0	10	12.8	13	23	58.8	Fair
08LM101	Unnamed Creek	1	0	8	10	7	17	42	Poor
10EM123	Root River, North Branch	1	0.5	10	21.7	10	29	71.2	Good
Average Habitat Results: *North Branch Root River 11-HUC Watershed*			0.4	8.8	17.6	9.1	24.3	60.2	

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)

North Branch Root River Watershed Unit summary

The North Branch Root River watershed shows impairments for invertebrates on four AUIDs located throughout the watershed. Turbidity is high along the main stem confirming the existing listed impairment. Bacteria readings indicate an impairment for aquatic recreation near the outlet. Fish communities met expectations throughout the watershed. One site monitored was considered channelized and had a "fair" fish quality using the channelized stream scoring system. The habitat evaluations performed in the North Branch Root River watershed showed four sites with a "good" rating, eight with "fair" and two sites with a "poor" rating.

Figure 12: Currently listed impaired waters by parameter and land use characteristics in the North Branch Root River Watershed Unit



Mill Creek Watershed Unit HUC 07040008040

Watershed description

The Mill Creek Watershed Unit, located in southeastern Olmsted and northwestern Fillmore counties, drains an area of 32.3 square miles. The headwaters of Mill Creek originate just south of the city of Eyota. The creek flows in a southeasterly direction to its confluence with the North Branch Root River just south of the city of Chatfield. The landscape is dominated by a mixture of forest/shrubland (46.7 percent), rangeland (38.2 percent), and cropland (10.5 percent). An approximately 7 mile stretch of Mill Creek is a designated trout stream. Mill Creek is the only named stream in this watershed and is the largest tributary to the North Branch Root River. The outlet of this watershed is represented by site 04LM129 in Chatfield.

Stream water chemistry assessment results

Water quality data was available on the 8 mile segment immediately upstream of the North Branch Root River. Bacteria data collected exceeded standards resulting in an aquatic recreation use impairment. Available water chemistry data was not sufficient to indicate supporting conditions for aquatic life; what is available is meeting standards.

Stream biological and use assessment

Table 6: Aquatic life and recreation assessments on assessed AUIDs in the Mill Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-536, *Mill Creek, T105 R12W S14, north line to N Br Root R*	8.07	2A	04LM129 08LM043	Downstream of Hwy 30, in Chatfield Downstream of CR 137, 4.5 mi. NW of Chatfield	NA	NA	-	MTS	MTS	MTS	MTS	-	EX	NA	NS
07040008-F67, *Unnamed creek, Headwaters to Mill Cr*	2.34	2B	10EM187	One mi. upstream of Hwy 52, 3 mi. N of Chatfield	NA	NA	-	-	-	-	-	-	-	NA	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

Table 7: Non-assessed biological stations on channelized AUIDs in the Mill Creek 11-HUC

AUID	Biological Station ID	Station location	Fish Quality	Macroinvertebrate Quality
***07040008-536**, Mill Creek, T105 R12W S14, north line to N Br Root R*	04LM129	Downstream of Hwy 30, in Chatfield	Fair	Poor

Mill Creek 10X stream water chemistry

Table 8: Outlet water chemistry results for the Mill Creek 11 HUC

Station location:	MILL CK AT MN-30 IN CHATFIELD
Storet ID:	S004-828
Station #:	04LM129

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	10	10	16	10	10	19	10	10	9	10	20	20
Minimum	12.2	8.6	125.9	<.025	4.4	7.88	.034	2.8	560	11.1	12.3	15
Maximum	16.2	13.1	2400	<.025	8.7	8.15	.242	130	598	17.0	20.4	100
Mean[1]	14.52	11.25	428.88	<.025	6.02	8.02	.074	23.82	583.78	14.81	16.18	83.55
Median	14.7	11.18	388	<.025	5.75	8.0	.042	6.9	585	15.35	16.0	100
WQ standard[2]	230	7.0	126/1260			6.5-8.5		60				20
# WQ exceedances[3]	0/10	0/10	14/16			0/19		1/10				1/20

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 9: Minnesota Stream Habitat Assessment (MSHA) for the Mill Creek 11 HUC

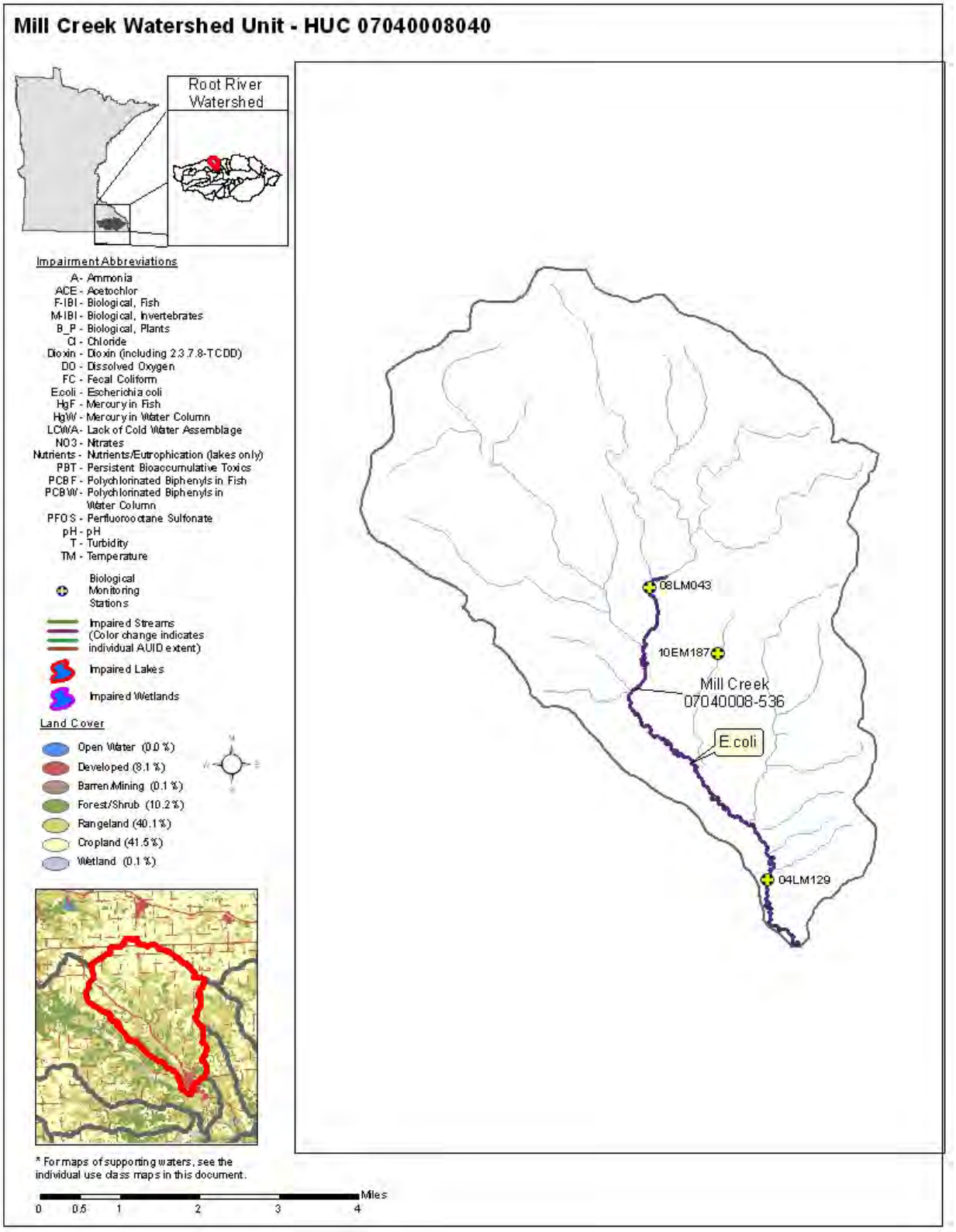
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM129	Mill Creek	2	0	6	19.4	8.5	20.5	54.4	Fair
08LM043	Mill Creek	1	2.5	6	15.8	5	20	49.3	Fair
10EM187	Unnamed Creek	1	0	15	3	9	14	41	Poor
Average Habitat Results: *Mill Creek 11 - HUC Watershed*			0.8	9	12.7	7.5	18.2	48.2	

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)

Mill Creek Watershed Unit summary

The Mill Creek watershed showed an impairment for bacteria near the outlet of the watershed. Other water chemistry parameters measured met standards, but there was not enough data available to make a formal assessment. Biological visits were not assessed due to channelization. The monitored site had a "fair" fish quality and a "poor" invertebrate quality rating using the channelized stream scoring system. The habitat evaluations performed on Mill Creek both show a "fair" rating, while the tributary, Unnamed Creek, showed a "poor" rating.

Figure 13: Currently listed impaired waters by parameter in the Mill Creek Watershed Unit



Trout Run Creek Watershed Unit HUC 07040008130

Watershed description

The Trout Run Creek Watershed Unit, located in southeastern Olmsted, southwestern Winona, and northern Fillmore County, drains an area of 32 square miles. Trout Run Creek flows in a southerly direction before entering the Root River just south of the small locality known as Bucksnort in Pilot Mound Township situated in northern Fillmore County. Trout Run Creek flows through a matrix of cropland (45.3 percent), rangeland (34.7 percent), and forest/shrubland (14.7 percent). Trout Run Creek consists of roughly a 13 miles stretch of designated trout stream. Trout Run Creek is the only named stream in the watershed. The outlet of this watershed unit is represented by site 08LM008. This site is co-located with an MDNR water quality and long-term fish monitoring station to take advantage of existing data by external partners.

Stream water chemistry assessment results

Water quality data was available for one section of Trout Run Creek (lower 13 miles of the reach) and a small tributary creek. Trout Run Creek was split into two portions during the assessments; an upper 1.7 mile reach and a lower 11.9 mile reach. The available chemistry data pertains only to the lower portion. Turbidity was elevated and is a possible stressor, but was not identified as an impairment to aquatic life. Bacteria are exceeding standards, resulting in not supporting conditions for aquatic recreation. Drinking water standards for nitrate/nitrite apply to 2A designated cold waters such as Trout Run. It met the criteria for nitrate/nitrite and drinking water use is thus not impaired.

Stream biological and use assessment

Table 10: Aquatic life and recreation assessments on assessed AUIDs in the Trout Run Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-G88, *Trout Run Creek, Unnamed cr to M Br Root R*	11.91	2A	08LM008	Upstream of CSAH 43, 5.5 mi. E of Chatfield	MTS	EXP	-	EXP	MTS	MTS	MTS	-	EX	FS	NS
07040008-G87, *Trout Run Creek, T105 R10W S18, north line to Unnamed cr*	1.72	2A	04LM098	Upstream of CR 10, 6 miles NE of Chatfield.	MTS	EXS	-	-	-	-	-	-	-	NS	NA
07040008-690, *Unnamed creek, Headwaters to Unnamed cr*	2.78	2B	-	-	-	-	-	-	MTS	-	-	-	IF	IF	IF

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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Trout Run Creek Watershed Unit.

Trout Run Creek 10X stream water chemistry

Table 11: Outlet water chemistry results for the Trout Run Creek 11 HUC

Station location:	TROUT RUN CREEK AT CSAH 43, 5.5 MILES NE OF CHATFIELD
Storet ID:	S004-822
Station #:	08LM008

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	11	11	17	11	11	19	11	11	9	11	20	20
Minimum	14	8.6	214.2	<.025	5.5	7.91	.031	2	550	.5	11.4	9
Maximum	15.6	12.29	2400	.06	7.7	8.43	.227	110	609	14.5	17.3	100
Mean[1]	14.99	11.10	472.06	<.025	7.26	8.12	.085	22.09	589.11	12.06	13.81	81.55
Median	15	11.24	330	<.025	7.4	8.1	.056	6.4	597	13.1	13.82	100
WQ standard[2]	230	7.0	126/1260			6.5-8.5		60				20
# WQ exceedances[3]	0/11	0/11	17/17			0/19		2/11				1/20

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

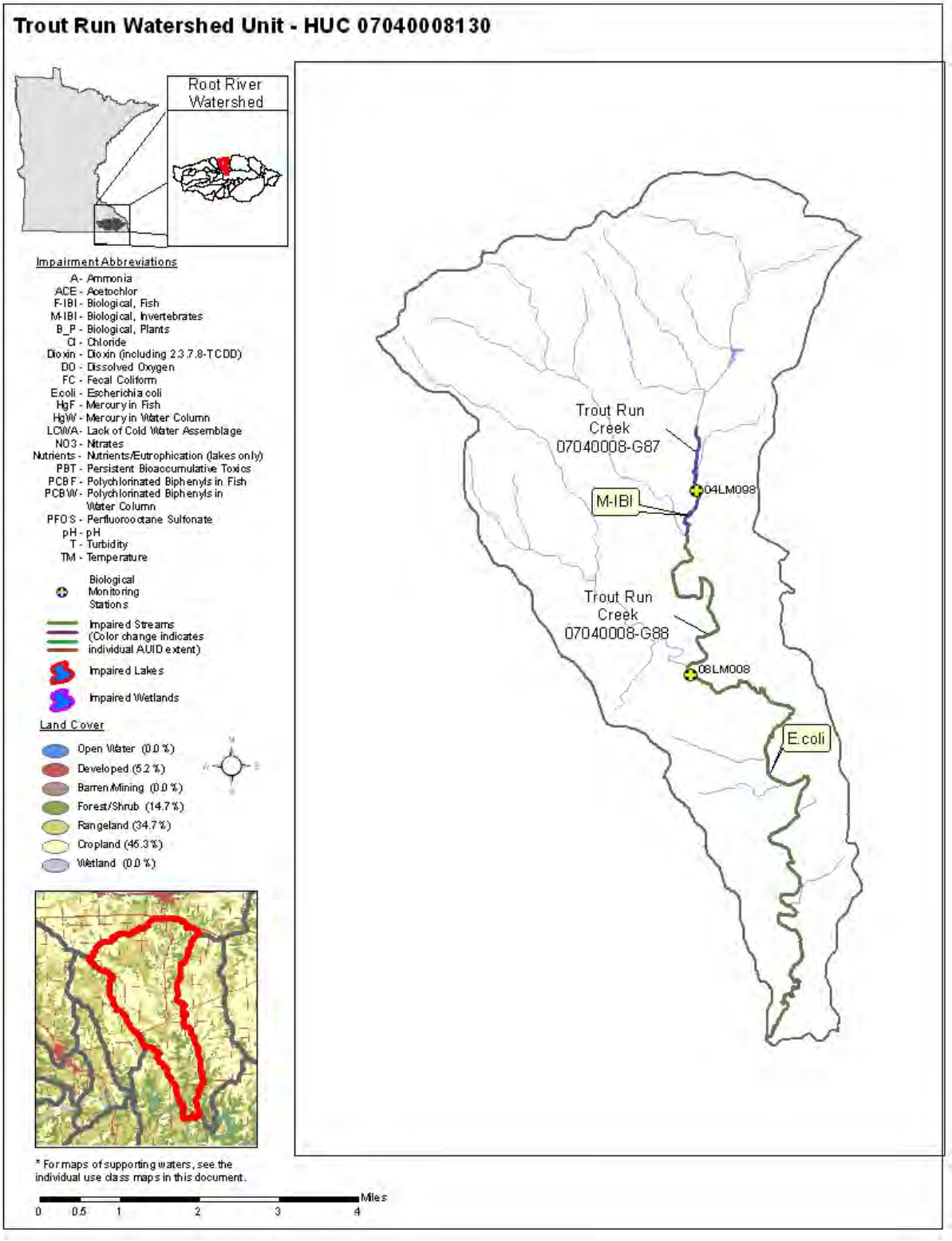
Table 12: Minnesota Stream Habitat Assessment (MSHA) for the Trout Run Creek 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM098	Trout Run Creek	2	0	7.5	8.1	6	14	35.6	Poor
08LM008	Trout Run Creek	1	5	10.5	19.2	13	27	74.7	Good
Average Habitat Results: *Trout Run Creek 11- HUC Watershed*			2.5	9	13.7	9.5	20.5	55.2	

Trout Run Creek Watershed Unit summary

The Trout Run Creek watershed showed a bacteria impairment near the watershed outlet. Turbidity had elevated measurements indicating a potential stressor. The drinking water use for nitrates met standards. Fish communities met expectations at all sites, while invertebrates indicate an impairment for aquatic life in the headwaters of the watershed. The habitat evaluation performed on Trout Run Creek showed a "poor" rating in the headwaters with metrics consistent with turbidity issues. The habitat evaluation showed a "good" rating at the outlet site

Figure 14: Currently listed impaired waters by parameter in the Trout Run Creek Watershed Unit



Bear Creek Watershed Unit HUC 07040008080

Watershed description

The Bear Creek Watershed Unit, located in eastern Mower and Western Fillmore County, drains an area of 99.3 square miles. This watershed has its beginnings primarily in Grand Meadow Township in eastern Mower County. The Bear Creek watershed flows in an easterly direction before flowing into the Middle Branch Root River (Deer Creek) near the small community of Fillmore located in western Fillmore County. This watershed consists mostly of cropland (65.3 percent) and rangeland (20.9 percent). The watershed consists of roughly 1.7 miles of designated trout streams with the majority located on a tributary named Kedron Creek. North Fork Bear Creek and South Fork Bear Creek are the other two named tributaries in the watershed. The outlet of the Bear Creek Watershed Unit is represented by site 08LM014 on Bear Creek and is located 1 mile west of Fillmore.

Stream water chemistry assessment results

Water quality data was available only on the lower reach of Bear Creek, the 7 miles downstream of Kedron Creek. Transparency data was available on the reach, indicating that standards were met most of the time; the existing dataset for chemical parameters for this reach are not sufficient enough to determine aquatic life use support alone. Excessive bacteria were detected on the reach, resulting in impaired conditions for aquatic recreation.

Stream biological and use assessment

Table 13: Aquatic life and recreation assessments on assessed AUIDs in the Bear Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-542, *Bear Creek, Kedron Cr to M Br Root R*	7.2	2B	08LM014	Downstream of Nature Rd, 3 mi. N of Wykoff	MTS	MTS	-	MTS	MTS	MTS	MTS	-	EX	FS	NS
07040008-544, *Bear Creek, Headwaters to Kedron Cr*	31.21	2B	08LM079 08LM058	Downstream of Twp 422, 6 mi. NW of Wykoff Downstream of CSAH 2, 2 mi. NE of Grand Meadow	MTS	EXP	-	-	-	-	-	-	-	NS	NA
07040008-584, *Kedron Creek, Headwaters to T104 R13W S35, east line*	12.35	2B	08LM067	Upstream of CSAH 4, 6 mi. NW of Wykoff	MTS	-	-	-	-	-	-	-	-	FS	NA
07040008-F45, *Bear Creek, North Fork, Unnamed cr to Unnamed cr*	1.31	2B	08LM055	Upstream of CSAH 8, 2 mi. N of Grand Meadow	-	-	-	-	-	-	-	-	-	NA	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use

Biological sampling of channelized stream reaches

Table 14: Non-assessed biological stations on channelized AUIDs in the Bear Creek 11-HUC

AUID	Biological Station ID	Station location	Fish Quality	Macroinvertebrate Quality
***07040008-F45**, Bear Creek, North Fork, Unnamed cr to Unnamed cr*	08LM055	Upstream of CSAH 8, 2 mi. N of Grand Meadow	Good	Poor

Bear Creek 10X stream water chemistry

Table 15: Outlet water chemistry results for the Bear Creek 11 HUC

Station location:	BEAR CREEK AT NATURE RD, 3 MILES N OF WYKOFF
Storet ID:	S004-827
Station #:	08LM014

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	11	10	16	11	11	19	11	11	9	11	19	20
Minimum	11.9	7.6	131.4	<.025	5.4	7.8	.026	3.2	501	10.2	10.5	14
Maximum	16.5	16.12	1400	<.025	11	8.59	.198	79	574	17.4	21.8	100
Mean[1]	14.46	10.42	403.15	<.025	7.61	8.22	.058	15.35	542.44	14.13	17.22	60.3
Median	14.1	9.11	425.6	<.025	7.4	8.18	.051	7.6	534	13.4	17	54.5
WQ standard[2]	230	5.0	126/1260			6.5-9		60				20
# WQ exceedances[3]	0/11	0/10	16/16			0/19		1/11				1/20

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 16: Minnesota Stream Habitat Assessment (MSHA) for the Bear Creek 11 HUC

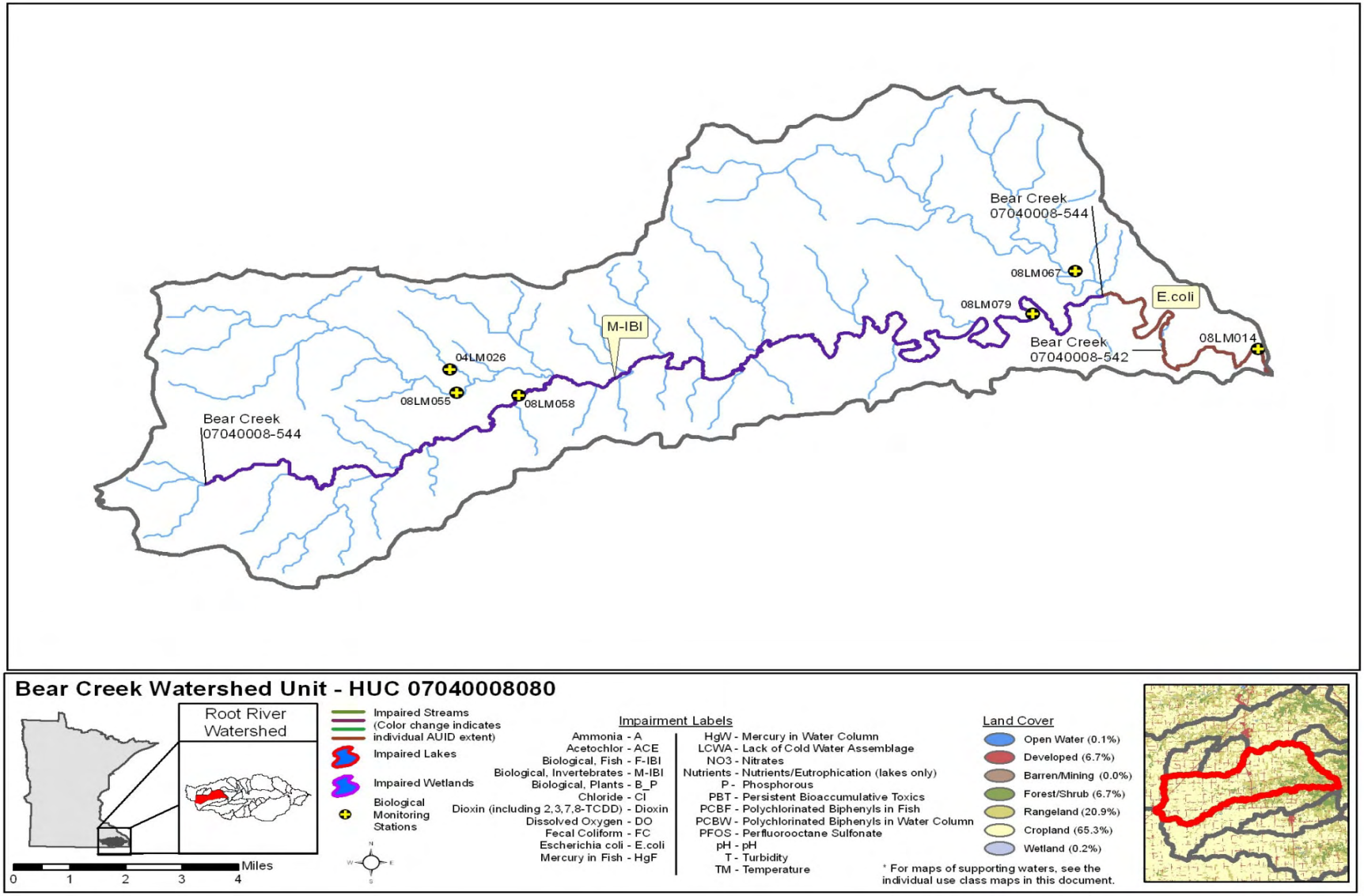
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM014	Bear Creek	1	3.8	10.5	20.3	12	34	80.5	Good
08LM055	Bear Creek, North Fork	1	0	8	17.2	11	15	51.2	Fair
08LM058	Bear Creek, South Fork	1	0	11	20.2	7	27	65.2	Fair
08LM067	Kedron Creek	1	0	9.5	15.7	8	22	55.2	Fair
08LM079	Bear Creek	1	1	11	21.7	11	27	71.7	Good
Average Habitat Results: *Bear Creek 11-HUC Watershed*			1	10	19	9.8	25	64.8	

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

Bear Creek Watershed Unit summary

The Bear Creek watershed indicates an impairment for bacteria at the outlet. Fish communities met expectations throughout the watershed. An impairment for invertebrates was found along the main stem of Bear Creek. Other available water chemistry parameters met standards throughout the watershed, but did not have enough data to determine use support. One site monitored was considered channelized and had a “good” fish quality and a “poor” macroinvertebrate rating using the channelized stream scoring system. The habitat evaluations performed within the watershed showed the two sites on the main-stem of Bear Creek with a “good” rating, while the three sites located on tributaries all had a habitat rating of “fair”.

Figure 15: Currently listed impaired waters by parameter in the Bear Creek Watershed Unit



Spring Valley Creek Watershed Unit HUC 07040008090

Watershed description

The Spring Valley Creek Watershed Unit, located in eastern Mower and western Fillmore County, drains an area of 30.1 square miles. This watershed begins in the Frankford and Bennington townships in eastern Mower County flowing in an easterly fashion. Upon reaching the city of Spring Valley the creek flows in a northeasterly direction before entering the Middle Branch Root River (Deer Creek) approximately 1 mile southwest of the community of Fillmore in western Fillmore County. The landscape primarily consists of cropland (60.4 percent) and rangeland (19.9 percent), but also has forested (10.6 percent) and developed (8.8 percent) areas. The watershed consists of roughly 16.5 miles of designated trout stream with most of it entirely on the main-stem. There are many small tributaries in the watershed, but Spring Valley Creek is the only named stream. The outlet of this watershed unit is represented by site 08LM006 on Spring Valley Creek and located 2.5 miles northwest of the town of Wykoff.

Stream water chemistry assessment results

Water quality data was available on the 17 mile reach of Spring Valley Creek upstream of Deer Creek. Available transparency data was meeting standards. Drinking water data for nitrate/nitrite was approaching the standard; it was not listed as impaired at this time. Bacteria exceeded the standard; the reach is considered impaired for aquatic recreation use.

Stream biological use and assessment

Table 17: Aquatic life and recreation assessments on assessed AUIDs in the Spring Valley Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-548, *Spring Valley Creek, T103 R13W S29, west line to Deer Cr*	17.32	2A	08LM006	Downstream of Orchard Rd, 2.5 mi. W of Wykoff	EXS	EXS	-	MTS	MTS	MTS	MTS	-	EX	NS	NS
			04LM058	Along County Route 8, Spring Valley Township, 5.4 mi SW of Fillmore.											
			10EM015	Upstream and downstream of Hwy 63, in Spring Valley											

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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

Table 18: Non-assessed biological stations on channelized AUIDs in the Spring Valley Creek 11-HUC

AUID	Biological Station ID	Station location	Fish Quality	Macroinvertebrate Quality
***07040008-548**, Spring Valley Creek, T103 R13W S29, west line to Deer Cr*	10EM015	Upstream and downstream of Hwy 63, in Spring Valley	Good	Fair

Spring Valley Creek 10X stream water chemistry

Table 19: Outlet water chemistry results for the Spring Valley Creek 11 HUC

Station location:	SPRING VALLEY CREEK AT ORCHARD RD, 2.5 MILES W OF WYKOFF
Storet ID:	S000-769
Station #:	08LM006

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	13	10	17	13	13	19	13	13	9	13	20	20
Minimum	13.8	8.3	261.3	<.025	7.9	7.64	.052	.5	557	12.4	11.1	22
Maximum	25.2	15.06	2419.6	<.025	9.7	8.55	.184	46	638	24.1	18.8	100
Mean[1]	19.47	10.51	796.93	<.025	8.65	8.05	.116	6.838	596.78	18.85	15.21	82.9
Median	19	9.26	1046.2	<.025	8.6	8.02	.114	3.6	594	18.3	15.33	100
WQ standard[2]	230	7.0	126/1260			6.5-8.5		60				20
# WQ exceedances[3]	0/13	0/10	17/17			1/19		0/13				0/20

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 20: Minnesota Stream Habitat Assessment (MSHA) for the Spring Valley Creek 11 HUC

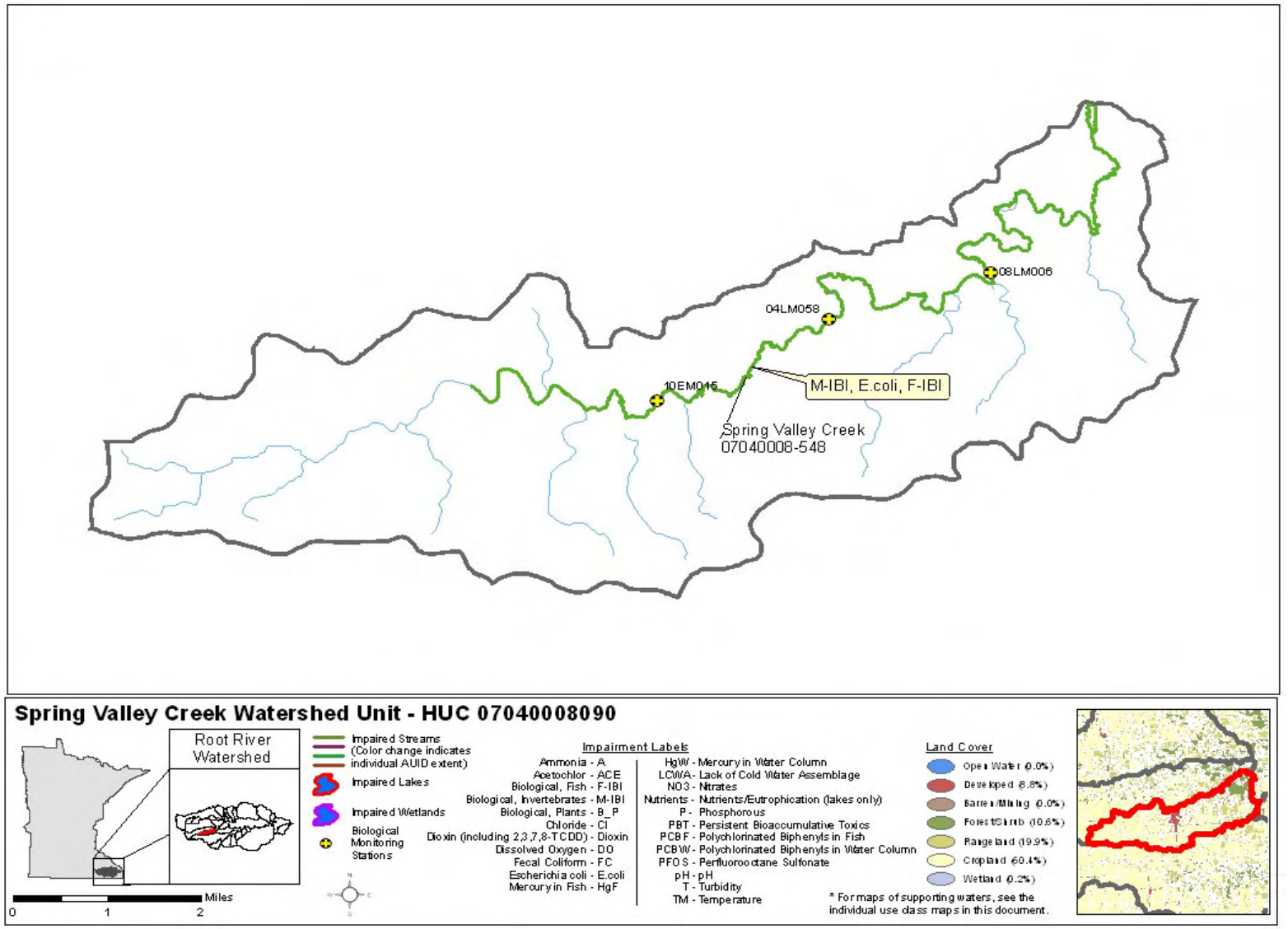
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM058	Spring Valley Creek	1	2	7	22.2	16	20	67.2	Good
08LM006	Spring Valley Creek	1	2.5	1.5	20.2	7	26	57.2	Fair
10EM015	Spring Valley Creek	1	2	7	18.5	3	24	54.5	Fair
Average Habitat Results: *Spring Valley Creek 11- HUC Watershed*			2.2	5.2	20.3	8.7	23.3	59.6	

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

Spring Valley Creek Watershed Unit summary

The Spring Valley Creek watershed showed impairments for fish, invertebrates, and bacteria all at the most downstream AUID. The data for nitrite/nitrate was approaching the standard for drinking water use, but was not listed at this time. One site monitored was considered channelized and had a "good" fish quality and a "fair" macroinvertebrate rating using the channelized stream scoring system. The habitat evaluation performed in the Spring Valley Creek watershed shows "fair" ratings at the pour point site as well as the site located in the city of Spring Valley. A "good" habitat rating was found at a location in between the two sites.

Figure 16: Currently listed impaired waters by parameter in the Spring Valley Creek Watershed Unit



Deer Creek Watershed Unit HUC 07040008070

Watershed description

The Deer Creek Watershed Unit, located in eastern Mower and western Fillmore County, drains an area of 58.8 square miles. The watershed begins primarily in the Township of Clayton in eastern Mower County and flows northeasterly to Grand Meadow. Deer Creek then moves more in an easterly direction before combining with Bear Creek near the small community of Fillmore located in western Fillmore County. The Deer Creek watershed consists mainly of cropland (70.4 percent), but also smaller areas of ranglands (14.8 percent), forests (8.6 percent), and development (6 percent). Despite the many tributaries, Deer Creek is the only named stream in the watershed. When Spring Valley Creek enters Deer Creek, the AUID changes to Middle Branch Root River (Deer Creek). The outlet of the watershed is represented by station 08LM013 on Middle Branch Root River (Deer Creek) about 2.5 miles northwest of the town of Wykoff.

Stream water chemistry assessment results

Water quality data was available on the 37 mile reach of Deer Creek, from its headwaters to the confluence with the Middle Branch Root River. The reach was considered to be impaired for aquatic recreation uses, with excessive levels of bacteria present. Available transparency and dissolved oxygen data indicate that they are likely not stressing aquatic life.

Stream biological and use assessment

Table 21: Aquatic life and recreation assessments on assessed AUIDs in the Deer Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-545, Root River, Middle Branch (Deer Creek), Spring Valley Cr to Bear Cr	1.25	2B	08LM013	Downstream of CSAH 8, 3 mi. NW of Wykoff	MTS	MTS	-	MTS	MTS	MTS	MTS	-	EX	FS	NS
***07040008-546**, Deer Creek, Headwaters to M Br Root R*	37.89	2B	08LM080 04LM107 08LM059 08LM077	Upstream of CSAH 38, 4.5 mi. NW of Wykoff Upstream of CR 1, 2.5 miles N of Spring Valley Downstream of CSAH 8, 1 mi. S of Grand Meadow Upstream of CR 5, 3.5 mi. SW of Grand Meadow	MTS	MTS	-	-	-	-	-	-	EX	FS	NS
***07040008-F44**, County Ditch 8, Unnamed cr to Deer Cr*	2.24	2B	08LM078	Upstream of CR 5, 4 mi. SW of Grand Meadow	-	-	-	-	-	-	-	-	-	NA	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use

Biological sampling of channelized stream reaches

Table 22: Non-assessed biological stations on channelized AUIDs in the Deer Creek 11-HUC

AUID	Biological Station ID	Station location	Fish Quality	Macroinvertebrate Quality
***07040008-546**, Deer Creek, Headwaters to M Br Root R*	08LM077	Upstream of CR 5, 3.5 mi. SW of Grand Meadow	Good	Poor
***07040008-F44,** County Ditch 8, Unnamed cr to Deer Cr*	08LM078	Upstream of CR 5, 4 mi. SW of Grand Meadow	Good	Poor

Deer Creek 10X stream water chemistry

Table 23: Outlet water chemistry results for the Deer Creek 11 HUC

Station location:	DEER CREEK AT CSAH 8, 3 MILES NW OF WYKOFF
Storet ID:	S004-826
Station #:	08LM013

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	10	10	16	10	10	19	10	10	9	10	20	20
Minimum	10.4	8.2	120	<.025	6.4	7.9	.041	1.2	477	9.34	11.2	12
Maximum	17.5	14.26	2000	<.025	11	8.57	.217	110	594	19.3	20.9	100
Mean[1]	15.68	10.67	495.73	<.025	7.85	8.24	.092	15.92	555.78	15.76	16.81	66.45
Median	16.4	10.09	400.3	<.025	7.5	8.23	.087	5.4	563	15.9	17.01	62
WQ standard[2]	230	5.0	126/1260			6.5-9		60				20
# WQ exceedances[3]	0/10	0/10	15/16			0/19		1/10				1/20

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 24: Minnesota Stream Habitat Assessment (MSHA) for the Deer Creek 11 HUC

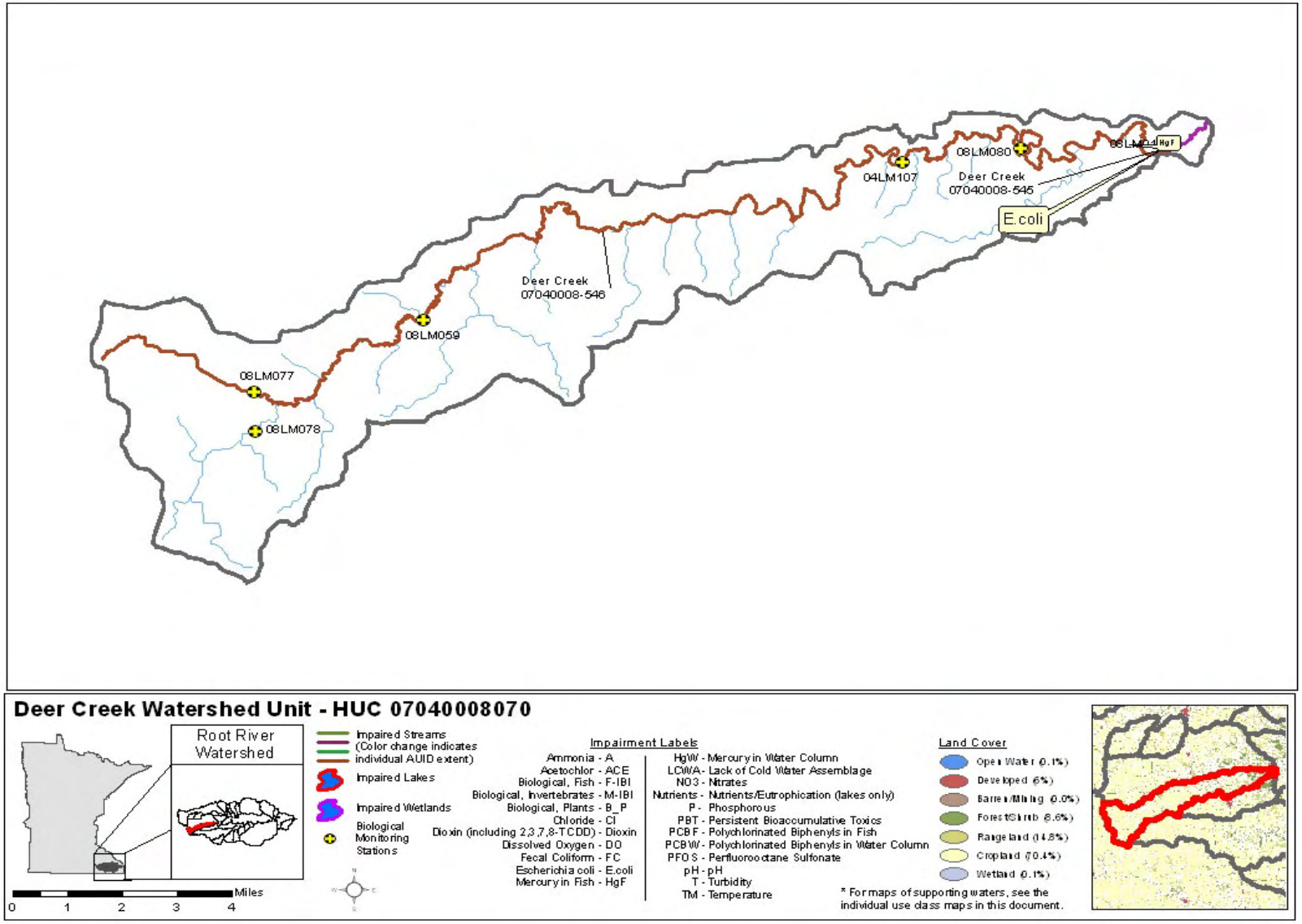
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM107	Deer Creek	2	1.9	7.5	21	8.5	26	64.9	Fair
08LM013	Deer Creek	1	3.5	7	21.8	9	28	69.3	Good
08LM059	Deer Creek	1	0	7	13	5	15	40	Poor
08LM077	Deer Creek	1	0	8	18	10	19	55	Fair
08LM078	Trib to Deer Creek	1	0	7	17	8	6	38	Poor
08LM080	Deer Creek	1	2.5	12	22	13	30	79.5	Good
Average Habitat Results: *Deer Creek 11-HUC Watershed*			1.3	8.1	18.8	8.9	20.7	57.8	

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

Deer Creek Watershed Unit summary

The Deer Creek watershed showed an impairment for bacteria. Fish and invertebrate communities both met expectations throughout the watershed. All available water chemistry met standards. Two sites monitored were considered channelized and they both had a "good" fish quality and a "poor" macroinvertebrate quality rating using the channelized stream scoring system. The habitat evaluations performed within the watershed show two "poor" and one "fair" rating in the upper headwater reaches, while two ratings of "good" and one rating of "fair" was found in the lower reaches.

Figure 17: Currently listed impaired waters by parameter in the Deer Creek Watershed Unit



Watson Creek Watershed Unit HUC 07040008180

Watson Creek

The Watson Creek Watershed Unit, located in central Fillmore County, drains an area of 33.9 square miles. The watershed begins in the Township of Fillmore and flows easterly before entering the South Branch Root River approximately 2.5 miles west of the city of Lanesboro. Watson Creek flows through an area of mostly rangeland (40.3 percent) and cropland (36.3 percent) with smaller forested (16.3 percent) and developed (7 percent) areas scattered throughout the watershed. A roughly 15.5 mile reach of Watson Creek is a designated trout stream. Watson Creek is the only named stream within the watershed. The outlet of the watershed is represented by station 08LM004 on Watson Creek about 3 miles northeast of the city of Preston.

Stream water chemistry assessment results

Water quality data was available on the 16 mile reach of Watson Creek immediately upstream of the South Branch Root River. An existing impairment of drinking water was confirmed and a new impairment for aquatic recreation use due to excessive bacteria was added for this reach. Sediment was identified as a possible stressor to aquatic life on this reach.

Stream biological and use assessment

Table 25: Aquatic life and recreation assessments on assessed AUIDs in the Watson Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-552, *Watson Creek, T103 R11W S30, west line to S Br Root R*	16.94	2A	04LM057 08LM004	Downstream of U.S. Route 52, 2 miles NW of Preston Downstream of CSAH 17, 4 mi. NE of Preston	EXS	EXS	-	IF	MTS	MTS	MTS	-	EX	NS	NS

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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Watson Creek Watershed Unit.

Watson Creek 10X stream water chemistry

Table 26: Outlet water chemistry results for the Watson Creek 11 HUC

Station location:	WATSON CREEK AT CSAH 17, 3 MILES NE OF PRESTON
Storet ID:	S003-388
Station #:	08LM004

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	11	10	15	11	11	18	11	11	9	11	19	19
Minimum	12.5	8.7	191.8	<.025	9.1	8.0	.048	6.4	641	10.5	10.4	4
Maximum	84.4	11.6	2419.6	.05	580	8.25	.407	420	680	30.1	23.6	100
Mean[1]	20.31	10.04	602.89	<.025	61.9	8.14	.118	62.42	657.44	13.74	16.92	67.21
Median	14	10	488.4	<.025	10	8.15	.083	14	651	12.3	17	80
WQ standard[2]	230	7.0	126/1260			6.5-8.5		60				20
# WQ exceedances[3]	0/11	0/10	15/15			0/18		2/11				2/19

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 27: Minnesota Stream Habitat Assessment (MSHA) for the Watson Creek 11 HUC

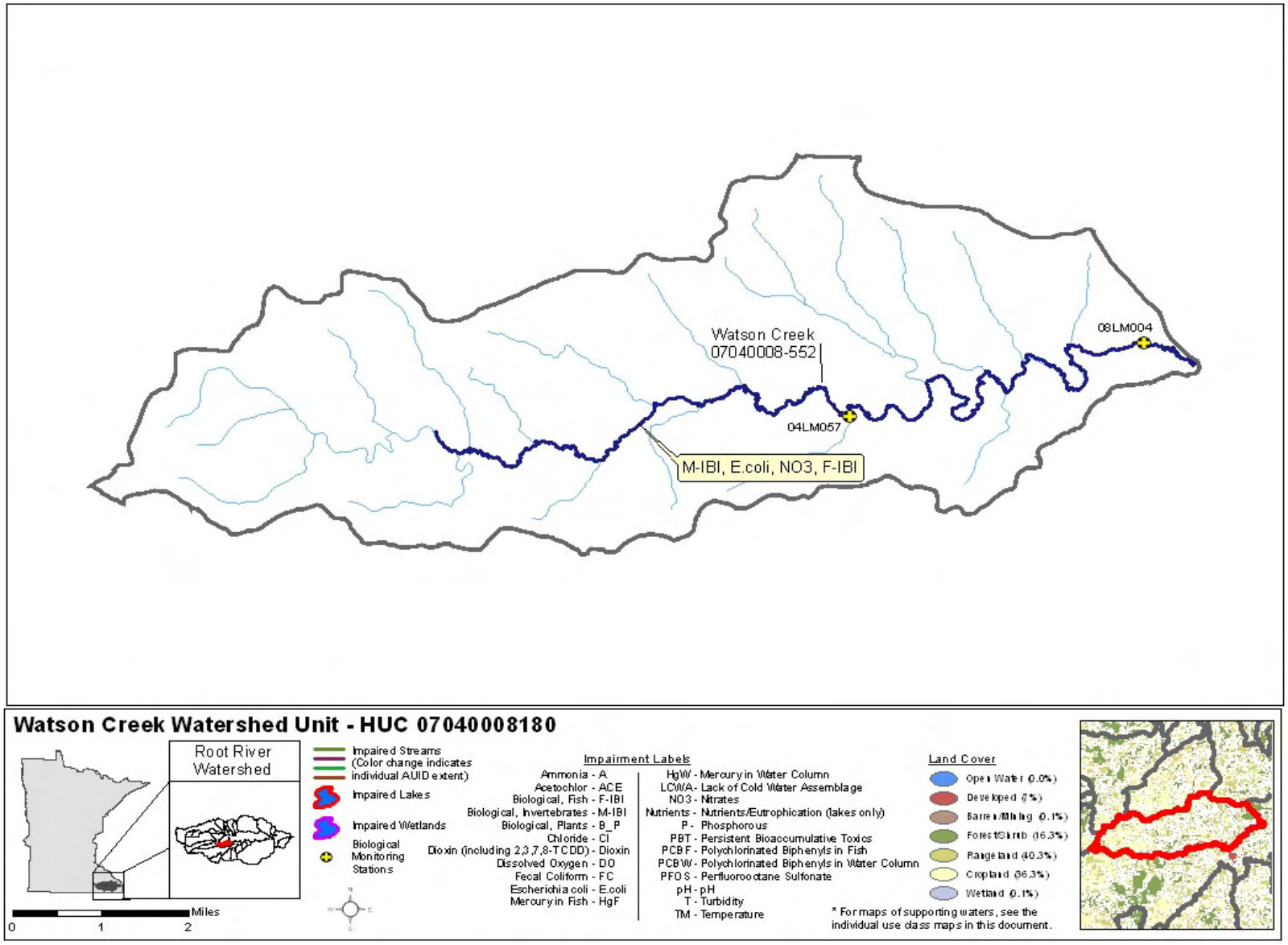
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM057	Watson Creek	1	5	9.5	15.2	6	12	47.7	Fair
08LM004	Watson Creek	1	2.5	10	17.5	13	24	67	Good
Average Habitat Results: *Watson Creek 11- HUC Watershed*			3.8	9.8	16.3	9.5	18	57.3	

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

Watson Creek Watershed Unit summary

The Watson Creek watershed showed impairments for fish, invertebrates, and bacteria. The nitrite/nitrate levels confirm an existing impairment for drinking water. The habitat evaluation performed on Watson Creek showed a "fair" rating at the headwaters site and a "good" rating at the pour point location. The watershed has shown potential sediment stressors during water chemistry samplings as well as in the habitat metrics. Elevated temperatures for a coldwater system may also be inhibiting the biological communities.

Figure 18: Currently listed impaired waters by parameter in the Watson Creek Watershed Unit



East Willow Creek Watershed Unit HUC 07040008160

Watershed description

The East Willow Creek Watershed Unit, located in southern Fillmore County, drains an area of 36.1 square miles. The watershed begins in the Township of Bristol and flows northerly before emptying into the South Branch Root River approximately 0.5 miles southwest of the city of Preston. The land use of the watershed is dominated by cropland (43.1 percent) in the upper half and a mix of rangeland (39 percent), cropland, and to a lesser extent forest/shrub (16.3 percent) in the lower portion. The watershed contains roughly 10.8 miles of designated trout waters with 9.4 miles of those waters residing on Willow Creek itself. Crystal Creek and Willow Creek are the only named streams within the watershed. The outlet of the watershed is represented by station 08LM005 on Willow Creek about 3 miles southwest of the city of Preston.

Stream water chemistry assessment results

Water quality data was available on the 9 mile reach of Willow Creek immediately upstream of the South Branch Root River. An existing impairment of drinking water was confirmed and a new impairment for aquatic recreation use due to excessive bacteria was added for this reach.

Stream biological and use assessment

Table 28: Aquatic life and recreation assessments on assessed AUIDs in the East Willow Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-558, Willow Creek, T101 R11W S12, west line to S Br Root R	9.92	2A	04LM021 08LM005 10EM143 08LM038	Downstream of Hwy 15, 1 mi. SW of Preston Downstream of CSAH 12, 1 mi. S of Preston 0.75 mi. upstream of CSAH 15, 3 mi. SW of Preston Downstream of Jumper Rd, 5 mi. NW of Harmony	MTS	EXP	-	IF	MTS	MTS	MTS	-	EX	NS	NS
07040008-F08, Unnamed creek (Willow Creek Tributary), T102 R11W S24, west line to Willow Cr	0.81	2A	08LM035	Downstream of CSAH 15, 3 mi. SW of Preston	EXS	EXP	-	-	-	-	-	-	-	IF	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the East Willow Creek Watershed Unit.

Willow Creek 10X stream water chemistry

Table 29: Outlet water chemistry results for the East Willow Creek 11 HUC

Station location:	WILLOW CREEK AT SCAH 15, 2.5 MILES S OF PRESTON
Storet ID:	S004-948
Station #:	08LM005

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	10	10	16	10	10	19	10	10	9	10	20	20
Minimum	13.2	9.06	220	<.025	9.5	7.21	.035	1.6	633	10.3	11	12
Maximum	87.6	12.72	2419.6	<.025	11	8.18	.222	120	686	30.8	19.8	100
Mean[1]	22.93	10.74	975.76	<.025	10.27	7.75	.079	16.52	659.11	14.07	14.64	63.1
Median	15.85	10.44	1059.95	<.025	10	7.75	.068	4.8	659	12.35	14.5	60
WQ standard[2]	230	7.0	126/1260			6.5-8.5		60				20
# WQ exceedances[3]	0/10	0/10	16/16			0/19		1/10				1/20

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

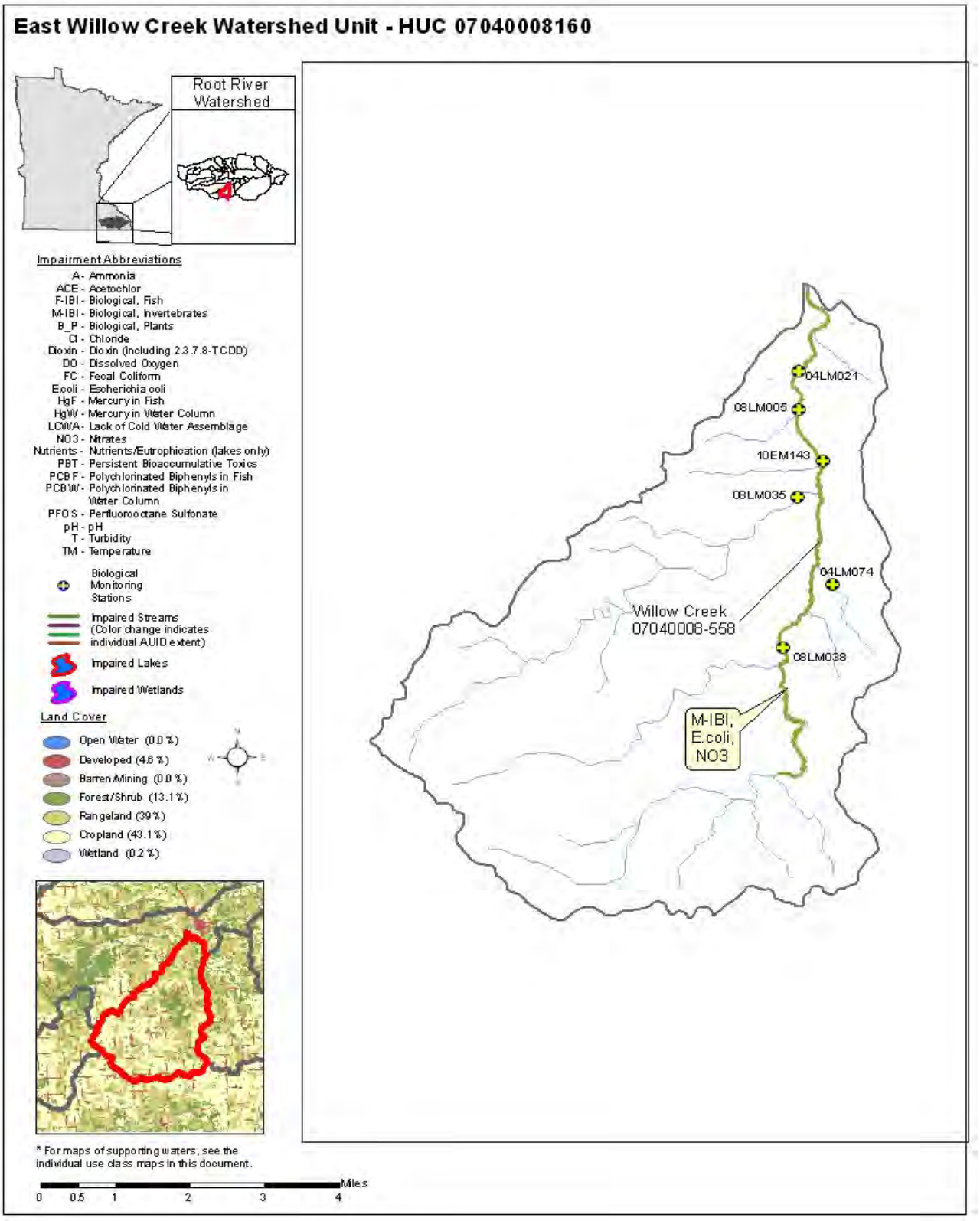
Table 30: Minnesota Stream Habitat Assessment (MSHA) for the East Willow Creek 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM021	Willow Creek	2	2	2.5	21.8	8	23	56.8	Fair
04LM074	Trib to Willow Creek	1	1	7	22	4	15	49	Fair
08LM005	Willow Creek	1	0	4	17.4	12	20	53.4	Fair
08LM035	Trib to Willow Creek	2	0	7.3	18.3	12	31.5	69.1	Good
08LM038	Willow Creek	3	1.3	12.5	20.9	13.7	32.7	81	Good
10EM143	Willow Creek	1	1.3	10.5	21.9	8	19	60.6	Fair
Average Habitat Results: *East Willow Creek 11-HUC Watershed*			0.9	7.3	20.4	9.6	23.5	61.6	

East Willow Creek Watershed Unit summary

The East Willow Creek watershed showed impairments for bacteria, of invertebrates, and of drinking water. Fish communities met expectations throughout the watershed except at site 08LM035 (Trib. to Willow Creek). However, even though the sampling location was not channelized; the majority of the stream AUID was considered to be altered and therefore, was not assessed. The habitat evaluation performed with the East Willow Creek watershed showed four sites with a "fair" rating and two sites with a "good" rating. Turbidity could be a possible stressor for aquatic life due to observed bank erosion and a few elevated transparency readings

Figure 19: Currently listed impaired waters by parameter in the East Willow Creek Watershed Unit



Thompson Valley Watershed Unit HUC 07040008270

Watershed description

The Thompson Valley Watershed Unit, located in eastern Houston County, drains an area of 36.7 square miles. The watershed begins in the southern portion of the township of Union and flows in a northeasterly direction before dumping into the Root River in the town of Hokah. Over half of the landscape is forested (50.6 percent) with areas of both rangeland (31 percent) and cropland (14.3 percent) mixed as well in the upper half of the watershed. The watershed contains roughly 15.5 miles of designated trout waters. Named streams in this watershed unit are Butterfield Creek, Indian Springs Creek, Sullivan Creek, and Thompson Creek. The outlet of the watershed is represented by station 08LM010 on Thompson Creek located on the southwestern edge of the town of Hokah.

Stream water chemistry assessment results

Water quality data was available on the 5 mile reach of Thompson Creek immediately upstream of the Root River. Aquatic recreation use was determined to be impaired by excessive bacteria in the stream. Available chemistry data indicates that sediment may be a stressor in the watershed. Limited dissolved oxygen and nitrate data both met standards.

Stream biological and use assessment

Table 31: Aquatic life and recreation assessments on assessed AUIDs in the Thompson Valley 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-507, *Thompson Creek, T103 R5W S12, south line to Root R*	5.15	2A	08LM010	Downstream of Butterfield Valley Rd, in Hokah	EXP	MTS	-	IF	MTS	-	MTS	-	EX	FS	NS
07040008-571, *Thompson Creek, Unnamed cr to T103 R5W S13, north line*	2.75	2A	08LM092	Downstream of Loomis Rd, 4 mi. SW of Hokah	MTS	MTS	-	-	-	-	-	-	-	FS	NA
07040008-653, *Butterfield Creek, T103 R4W S18, east line to Thompson Cr*	3.83	2A	08LM091	Upstream of Butterfield Valley Rd, 1 mi. S of Hokah	MTS	MTS	-	-	-	-	-	-	-	FS	NA
07040008-655, *Sullivan Creek, T103 R5W S26, south line to Thompson Cr*	5.29	2A	08LM090	Upstream of CSAH 20, 4 mi. SW of Hokah	MTS	MTS	-	-	-	-	-	-	-	FS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Thompson Valley Watershed Unit.

Thompson Creek 10X stream water chemistry

Table 32: Outlet water chemistry results for the Thompson Valley 11 HUC

Station location:	THOMPSON CREEK AT BUTTERFIELD VALLEY RD IN HOKAH
Storet ID:	S004-823
Station #:	08LM010

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100 ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	12	10	16	12	12	18	12	12	9	12	19	19
Minimum	6.85	8.3	196.8	<.025	1.4	7.97	.047	20	506	9.21	10.3	14
Maximum	7.93	12.04	1203.3	.07	1.8	8.29	.14	83	556	10.5	21.9	100
Mean[1]	7.55	9.44	480.23	<.025	1.48	8.15	.066	32.42	526.44	9.95	15.75	58.53
Median	7.75	9.15	465	<.025	1.5	8.15	.061	27	526	10.05	15.5	59
WQ standard[2]	230	7.0	126/1260			6.5-8.5		60				20
# WQ exceedances[3]	0/12	0/10	16/16			0/18		1/12				1/19

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 33: Minnesota Stream Habitat Assessment (MSHA) for the Thompson Valley 11 HUC

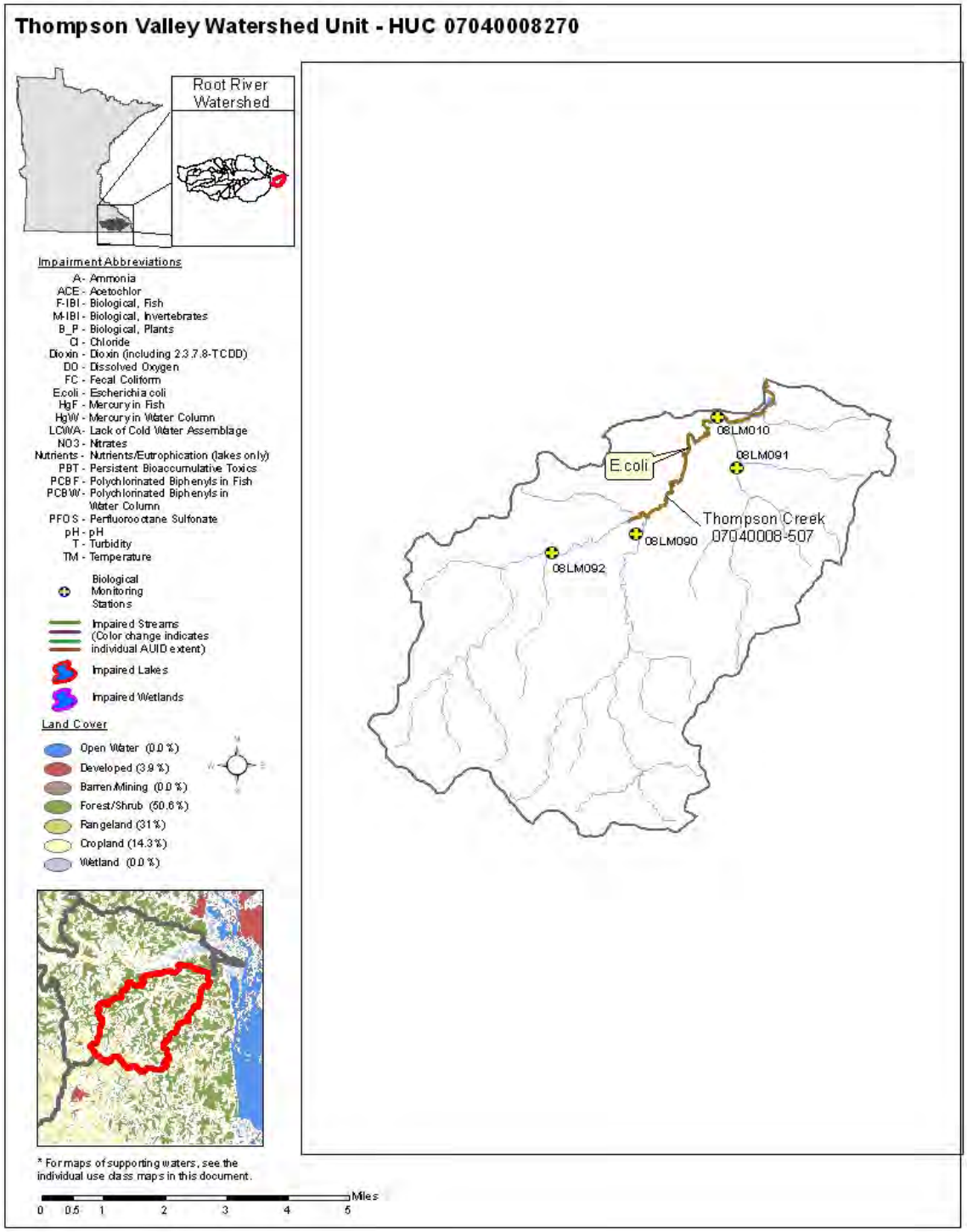
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM010	Thompson Creek	1	4.3	6.5	14.2	7	21	52.9	Fair
08LM090	Sullivan Creek	1	2.5	9.5	16.9	10	29	67.9	Good
08LM091	Butterfield Creek	1	5	12	18.8	13	32	78.8	Good
08LM092	Thompson Creek	1	2.5	12.5	16.4	12	22	65.4	Fair
Average Habitat Results: *Thompson Valley 11-HUC Watershed*			3.6	10.1	16.3	10.5	26	66.5	

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)

Thompson Valley Watershed Unit summary

Thompson Valley watershed showed an impairment for bacteria. Fish and invertebrate communities both met expectations throughout the watershed. Available water chemistry met the standards. The habitat evaluation performed within the Thompson Valley watershed showed two “fair” ratings on Thompson Creek, while the two major tributaries to this system both had a “good” rating.

Figure 20: Currently listed impaired waters by parameter in the Thompson Valley Watershed Unit



Money Creek Watershed Unit HUC 07040008240

Watershed description

The Money Creek Watershed Unit, located in southern Winona and northwest Houston counties, drains an area of 76.4 square miles. The watershed begins near the small community of Wilson and flows in a southeasterly direction before dumping into the Root River approximately 1.5 miles northwest of the city of Houston. The land use in the Money Creek watershed consists mainly of forests (46.7 percent), rangeland (38.2 percent), and cropland (10.5 percent). The watershed contains roughly 21.1 miles of designated trout waters. Named streams within this watershed unit are East Branch Wiscoy Creek, West Branch Wiscoy Creek, Campbell Creek, Corey Creek, and Money Creek. The outlet of the watershed is represented by station 08LM011 on Money Creek located 3 miles northwest of the city of Houston.

Stream water chemistry assessment results

Water quality data was available on two reaches of Money Creek and three tributaries. The upstream portion of Money Creek is considered to be cold water and has limited data; the downstream portion is considered to be warm water and is a high gradient reach. Sampling confirmed existing aquatic recreation (bacteria) and aquatic life (turbidity) impairments. The lower portion of Money Creek did meet the nitrate standards. Corey Creek, a tributary to Money Creek, had elevated sediment levels, a possible stressor to aquatic life downstream. The remaining tributaries had small datasets consisting only of transparency data with limited exceedances of the standard.

Stream biological and use assessment

Table 34: Aquatic life and recreation assessments on assessed AUIDs in the Money Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-521, Money Creek, T105 R7W S21, north line to Root R	18.72	2B	08LM011 04LM016 08LM061	Upstream of Hwy 76, 3 mi. NW of Houston Downstream of Hwy 76, 1 mi. N of Houston Adjacent to Cone Dale Dr, 3 mi. NW of Money Creek	MTS	MTS	-	EXP	MTS	MTS	MTS	-	EX	NS	NS
07040008-564, *Unnamed creek (West Branch Wiscoy Creek), Unnamed cr to Money Cr*	2.55	2A	-	-	-	-	-	IF	-	-	-	-		IF	NA
07040008-575, *Money Creek, T105 R7W S3, north line to T105 R7W S16, south line*	5.26	2A	-	-	-	-	-	MTS	-	-	-	-		NA	NA
07040008-631, *Corey Creek, T105 R6W S18, east line to Money Cr*	5.79	2A	08LM018	Downstream of CSAH 17, 3.5 mi. NW of Money Creek	EXS	MTS	-	IF	-	-	-	-		NS	NA
07040008-636, *Campbell Creek, Headwaters to Money Cr*	7.63	2A	08LM109	Upstream of CSAH 26, 1 mi. E of Money Creek	MTS	MTS	-	-	-	-	-	-		FS	NA
07040008-B02, *Unnamed creek (East Branch Wiscoy Creek), Unnamed cr to T105 R7W S15, west line*	0.88	2B	-	-	-	-	-	MTS	-	-	-	-		IF	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Money Creek Watershed Unit.

Money Creek 10X stream water chemistry

Table 35: Outlet water chemistry results for the Money Creek

Station location:	MONEY CREEK AT MN 76, 3 MILES NW OF HOUSTON
Storet ID:	S004-824
Station #:	08LM011

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	10	10	15	10	10	18	10	10	9	10	19	19
Minimum	6.62	8.15	185	<.025	.69	7.93	.072	13	529	12.9	12.6	9
Maximum	7.71	11.23	2400	.05	1.6	8.25	.237	170	592	14.6	23.5	100
Mean[1]	7.17	9.36	584.31	<.025	.97	8.12	.118	48.5	555.89	13.94	17.19	50.9
Median	7.21	9.35	547.5	<.025	.95	8.16	.106	39	552	14.1	17.5	50
WQ standard[2]	230	5.0	126/1260			6.5-9		60				20
# WQ exceedances[3]	0/10	0/10	15/15			0/18		2/10				1/19

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 36: Minnesota Stream Habitat Assessment (MSHA) for the Money Creek 11 HUC

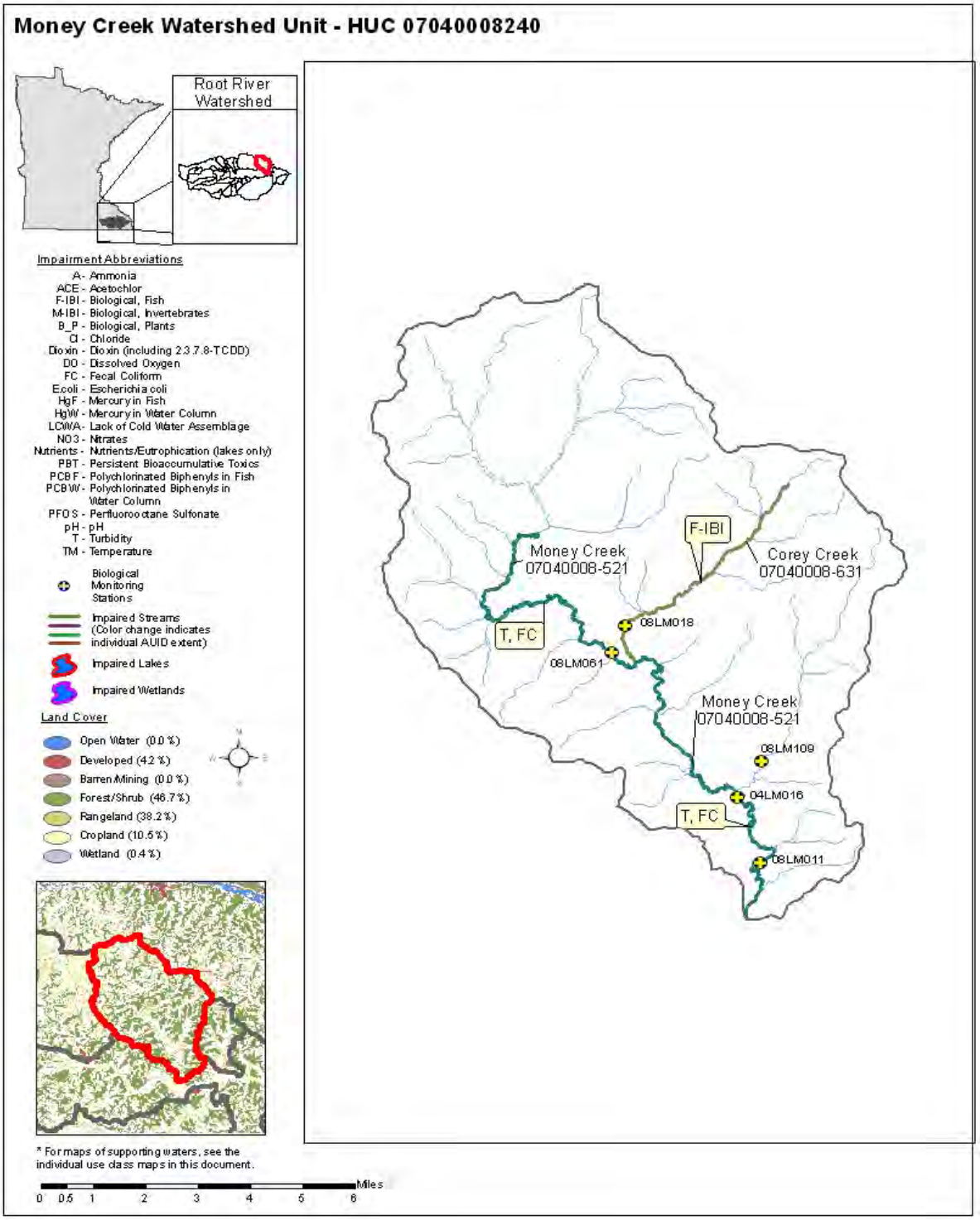
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM016	Money Creek	1	0	7.5	18	10	17	52.5	Fair
08LM011	Money Creek	1	2	4	16.8	5	18	45.8	Fair
08LM018	Corey Creek	2	1.6	10	16.5	10.5	24	62.7	Fair
08LM061	Money Creek	1	0	7	14	5	18	44	Poor
08LM109	Campbell Creek	1	2.5	11.5	16.3	11	22	63.3	Fair
Average Habitat Results: *Money Creek 11-HUC Watershed*			1.2	8	16.3	8.3	19.8	53.7	

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)

Money Creek Watershed Unit summary

The Money Creek area was hit particularly hard by the August 2007 flood. The watershed showed impairments for aquatic life due to turbidity and bacteria. Corey Creek showed an impairment for fish. The habitat evaluations performed in the watershed show four “fair” ratings and one “poor” rating. A possible turbidity stressor was indicated by both elevated levels and the habitat metrics on Corey Creek.

Figure 21: Currently listed impaired waters by parameter in the Money Creek Watershed Unit



Rush-Pine Creek Watershed Unit HUC 07040008230

Watershed description

The Rush-Pine Creek Watershed Unit, located in parts of south central Winona, northeastern Fillmore, and northwestern Houston counties, drains an area of 135.8 square miles. The watershed begins near the towns of Utica and Lewiston in Winona County and flows primarily in a southeasterly direction before entering the Root River in the city of Rushford. The landscape consists mostly of cropland (46.5 percent), rangeland (29.1 percent), and forests (18.9 percent). The watershed contains roughly 52 miles of designated trout waters. Named streams within this watershed unit are Dry Run, Borson Spring, Coolridge Creek, Ahrensfeld Creek, Ferguson Valley Creek, Hemmingway Creek, Pine Creek, and Rush Creek. The outlet of the watershed is represented by station 08LM003 on Rush Creek located in the city of Rushford.

Stream water chemistry assessment results

Water quality data was available on two reaches of Rush Creek, immediately upstream of the Root River and one tributary to Pine Creek. The most complete data was available on the lower 5 miles of Rush Creek, indicating impairment of aquatic recreation due to excess bacteria. Available sediment and dissolved oxygen data did not appear to be stressing aquatic life. Based on a limited data set, the nitrate standard is being met. The upstream reach of Rush Creek and Coolridge Creek had limited datasets consisting only of transparency data, but the reaches did not appear to be impaired by sediment.

Stream biological and use assessment

Table 37: Aquatic Life and recreation assessments on assessed AUIDs in the Rush-Pine Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-523, *Rush Creek, Pine Cr to Root R*	5.53	2A	08LM003	Downstream of Hwy 43, in Rushford	-	-	-	MTS	MTS	MTS	MTS	-	EX	IF	NS
07040008-524, *Rush Creek, Unnamed cr to Pine Cr*	16.38	2A	08LM074 08LM056 04LM032 08LM023	Upstream of CSAH 25, 4 mi. NW of Rushford Downstream of Enterprise Valley Dr, 3.5 mi. S of Lewiston Downstream of Hwy 29, 2 mi. S of Lewiston Upstream of CSAH 29, 3 mi. S of Lewiston	MTS	EXS	-	MTS	-	-	-	-	-	NS	NA
07040008-526, *Pine Creek, T104 R9W S4, north line to Rush Cr*	20.3	2B	04LM095 04LM097 08LM063	Upstream of Hwy 2, 3 miles NW of Rushford Fremont Township, just upstream of mouth of Hemingway Creek, 6 miles NW of Rushford. Upstream of Dendal Dr, 7 mi. NW of Rushford	MTS	EXP	-	-	-	-	-	-	-	NS	NA

07040008-576, *Pine Creek, Headwaters to T105 R9W S32, south line*	9.25	2B	08LM098	Downstream of Grover Dr., 8 mi. SE of St. Charles	MTS	EXS	-	-	-	-	-	-	-	NS	NA
07040008-608, *Hemmingway Creek, T105 R9W S28, north line to Pine Cr*	4.55	2A	04LM200	Upstream 100m of confluence with Pine Creek	MTS	MTS	-	-	-	-	-	-	-	FS	NA
07040008-609, *Unnamed creek (Coolridge Creek), Unnamed cr to Pine Cr*	1.13	2A	04LM096	Upstream of CR 2, 7 miles NW of Rushford	MTS	MTS	-	MTS	-	-	-	-	-	FS	NA
07040008-685, *Unnamed creek, T106 R9W S34, west line to Rush Cr*	1.93	2A	08LM028	Upstream of CSAH 29, 3 mi. S of Lewiston	MTS	MTS	-	-	-	-	-	-	-	FS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

Table 38: Non-assessed biological stations on channelized AUIDs in the Rush-Pine Creek 11-HUC

AUID	Biological Station ID	Station location	Fish Quality	Macroinvertebrate Quality
***07040008-523**, Rush Creek, Pine Cr to Root R*	08LM003	Downstream of Hwy 43, in Rushford	Good	Fair

Rush Creek 10X stream water chemistry

Table 39: Outlet water chemistry results for the Rush-Pine Creek 11 HUC

Station location:	RUSH CREEK AT CSAH 27 IN RUSHFORD
Storet ID:	S001-689
Station #:	08LM003

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	11	11	17	11	11	19	11	11	9	11	20	20
Minimum	8.8	8.41	69.7	<.025	3.7	8.11	.047	5.6	523	11.8	13.41	9
Maximum	10.9	11.04	2400	<.025	4.2	8.35	.277	230	564	13.7	23.8	100
Mean[1]	10.2	9.81	284.16	<.025	3.91	8.23	.088	35.33	548.22	12.84	16.89	82.8
Median	10.2	10.2	228.2	<.025	3.9	8.21	.067	8.4	548	12.9	17.3	100
WQ standard[2]	230	7.0	126/1260			6.5-8.5		60				20
# WQ exceedances[3]	0/11	0/11	15/17			0/19		1/11				1/20

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 40: Minnesota Stream Habitat Assessment (MSHA) for the Rush-Pine Creek 11 HUC

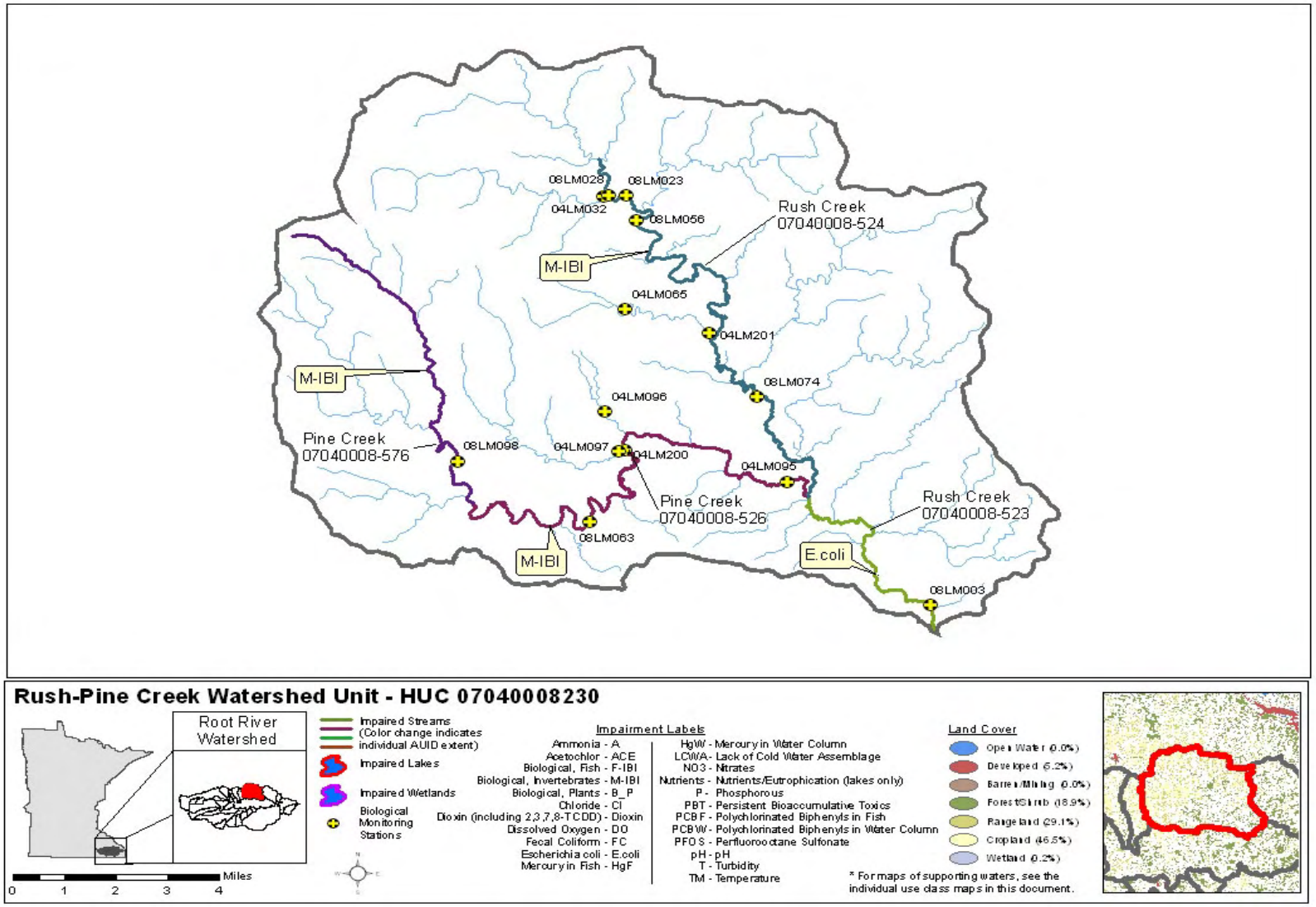
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM032	Rush Creek	1	0	11	22	14	28	75	Good
04LM095	Pine Creek	3	1.5	4.3	17	10.7	22.3	55.8	Fair
04LM096	Coolridge Creek	1	5	14	22	11	33	85	Good
04LM097	Pine Creek	1	5	11	18	8	21	63	Fair
04LM200	Hemingway Creek	1	5	12	22.2	12	29	80.2	Good
08LM003	Rush Creek	2	2.4	7.5	14	7	15	45.9	Fair
08LM028	Trib to Rush Creek	1	0	15	21.2	13	28	77.2	Good
08LM056	Rush Creek	1	2.5	7	22	5	30	66.5	Good
08LM063	Pine Creek	1	5	15	22	17	30	89	Good
08LM074	Rush Creek	1	0	11.5	16.1	12	29	68.6	Good
08LM098	Pine Creek	1	0	7.5	11	6	17	41.5	Poor
Average Habitat Results: *Rush-Pine Creek 11-HUC Watershed*			2.4	10.5	18.9	10.5	25.7	68	

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)

Rush-Pine Creek Watershed Unit summary

The Rush-Pine Creek watershed showed impairments for invertebrates through a majority of the watershed. These impairments may have been caused by the severe flood that occurred throughout this watershed in 2007 and the slower recovery time of invertebrate communities. A bacteria impairment was also found near the watershed outlet. One site monitored was considered channelized and had a "good" fish quality and a "fair" macroinvertebrate quality rating using the channelized stream scoring system. Fish communities met expectations throughout the watershed. The habitat evaluation performed in the Rush-Pine Creek watershed showed one "poor" rating in the headwaters of Pine Creek, three "fair" ratings, and seven "good" ratings.

Figure 22: Currently listed impaired waters by parameter in the Rush-Pine Creek Watershed Unit



South Fork Root River Watershed Unit HUC 07040008255

Watershed description

The South Fork Root River Watershed Unit, located in southeastern Fillmore and southwestern Houston counties, drains an area of 288.6 square miles. The watershed originates near the small towns of Canton and Harmony located in southeastern Fillmore County. The South Fork Root River flows in a northeasterly direction through a landscape dominated by rangeland (37.8 percent), cropland (31.9 percent) and forest/shrub (25.9 percent) before entering the Root River approximately 1 mile northeast of the city of Houston. The watershed contains roughly 89.2 miles of designated trout waters. Named streams within this watershed unit include Wisel, Riceford, Frego, Newburg, Vest, Maple, Beaver, East Fork Beaver, Girl Scout Camp, Swede Bottom, Shattuck, Sorenson, Bridge and Badger creeks and the South Fork Root River. The outlet of the watershed is represented by station 08LM009 on the South Fork Root River located one mile east of the city of Houston.

Stream water chemistry assessment results

Water quality data was available on 6 reaches of the South Fork Root River, spanning from the headwaters to the confluence with the Root River. Turbidity was identified as impairing aquatic life use upstream of Wisel Creek and downstream of Beaver Creek; the portions upstream of Wisel Creek are considered to be cold water and have a more stringent standard (10 NTU) than the downstream portions (25 NTU). The lower reach was also impaired for aquatic recreation use (bacteria) and aquatic life use (macroinvertebrates). The 9 mile reach upstream of Riceford Creek was impaired for fish consumption due to mercury in fish tissue. No tributary data was available for review.

Stream biological and use assessment

Table 41: Aquatic life and recreation assessments on assessed AUIDs in the South Fork Root River 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-508, *Root River, South Fork, Beaver Cr to Root R*	8.48	2B	08LM009	Upstream of Swede Bottom Rd, 1 mi. E of Houston	MTS	EXP	-	EXP	MTS	MTS	MTS	-	EX	NS	NS
07040008-509, *Root River, South Fork, Riceford Cr to Beaver Cr*	6.67	2B	08LM104	Downstream of East Twin Ridge Rd, 4 mi. SW of Houston	MTS	EXP	-	IF	-	-	-	-	-	NS	NA
07040008-510, *Root River, South Fork, Wisel Cr to T102 R8W S2, east line*	10.06	2A	08LM102 10EM146	Downstream of Hwy 43, 9 mi. N of Mabel Upstream of Hwy 43, 9 mi. N of Mabel	MTS	EXP	-	-	-	-	-	-	-	NS	NA
07040008-511, *Root River, South Fork, T102 R9W S26, west line to Wisel Cr*	6.58	2A	08LM016 04LM069	Downstream of Deer Rd, 8.5 mi. NE of Harmony ~7.6 mi. NE of Harmony	MTS	MTS	-	EXP	-	-	MTS	-	-	NS	NA
07040008-512, *Wisel Creek, T102 R8W S31, west line to S Fk Root R*	8.99	2A	08LM030	Downstream of CSAH 18, 5.5 mi. NW of Mabel	MTS	MTS	-	-	-	-	MTS	-	-	FS	NA
07040008-513, *Wisel Creek, Headwaters to T102 R9W S36, east line*	6.73	2B	08LM088	Upstream of CSAH 24, 4 mi. NE of Canton	MTS	MTS	-	-	-	-	-	-	-	FS	NA
07040008-515, *Riceford Creek, Headwaters to T101 R8W S17, east line*	4.26	2B	08LM110	Upstream of CSAH 28, in Mabel	MTS	EXS	-	-	-	-	-	-	-	IF	NA
07040008-516, *Riceford Creek, T101 R8W S26, west line to T101 R8W S25, east line*	3.42	7	04LM112	Upstream of Hwy 44 in Mabel	-	-	-	-	-	-	-	-	-	-	-

***07040008-517**, Riceford Creek, T101 R7W S30, west line to north line*	0.38	2B	-	-	-	-	-	-	-	-	MTS	-	-	NA	NA
***07040008-518**, Riceford Creek, T101 R7W S19, south line to T102 R7W S30, north line*	13.52	2A	04LM117 08LM140 08LM111	2 mi N of Riceford Upstream of Elm Dr, 4 mi. NE of Mabel Downstream of Mapleleaf Rd, 3 mi. E of Mabel	MTS	EXS	-	-	-	-	-	-	-	NS	NA
***07040008-519**, Riceford Creek, T102 R7W S19, south line to S Fk Root R*	10.48	2B	08LM100 04LM060	Downstream of Creamery Dr, 8.5 mi. NW of Spring Grove Upstream of CR 4, 6.8 miles NNW of Spring Grove	MTS	EXP	-	-	-	-	-	-	-	NS	NA
***07040008-568**, Beaver Creek West, T102 R7W S26, south line to E Beaver Cr*	7.47	2A	08LM107	Downstream of CSAH 12, 4.5 mi. W of Caledonia	MTS	MTS	-	-	-	-	-	-	-	FS	NA
***07040008-570**, Beaver Creek, T103 R6W S30, south line to S Fk Root R*	4.14	2A	08LM105	Upstream of CSAH 10, 4 mi. SW of Houston	MTS	MTS	-	-	-	-	-	-	-	FS	NA
***07040008-572**, Root River, South Fork, T102 R8W S1, west line to Riceford Cr*	9.16	2B	08LM062 04LM116	Downstream of CSAH 15, 8 mi NW of Spring Grove 1 Mile Downstream of county road 15, 1.5 Miles SW of Yucatan	MTS	MTS	-	MTS	-	-	-	-	-	FS	NA
***07040008-573**, Root River, South Fork, Headwaters to T102 R9W S27, east line*	11.46	2B	04LM113	downstream of CR 18, 5 miles NE of Harmony	EXP	EXS	-	EXP	-	MTS	-	-	-	NS	NA
***07040008-616**, Shattuck Creek (Nepstad Creek), T102 R9W S2, west line to S Fk Root R*	6.7	2A	08LM025	Upstream of 401st Ave, 7 mi. SE of Lanesboro	MTS	MTS	-	-	-	-	MTS	-	-	FS	NA
***07040008-617**, Unnamed creek (Maple Creek), T103 R8W S28, west line to T102 R8W S3, south line*	4.19	2A	08LM033	Upstream of Hwy 43, 9 mi. SE of Lanesboro	MTS	MTS	-	-	-	-	MTS	-	-	FS	NA

***07040008-632**, Beaver Creek East, T102 R6W S17, east line to Beaver Cr*	3.15	2A	08LM106	Upstream of CSAH 1, 3.5 mi. W of Caledonia	MTS	MTS	-	-	-	-	-	-	-	FS	NA
***07040008-633**, Badger Creek, Unnamed cr to S Fk Root R*	6.4	2A	08LM108	Adjacent to Hwy 76, 3.5 mi. S of Houston	MTS	MTS	-	-	-	-	-	-	-	FS	NA
***07040008-F49**, Donaldson Creek, Unnamed cr to Wisel Cr*	3.26	2B	08LM096	Upstream of CSAH 24, 5 mi. NE of Canton	MTS	-	-	-	-	-	-	-	-	FS	NA
***07040008-F52**, Sorenson Creek, Unnamed cr to Unnamed cr*	0.98	2B	08LM087	Downstream of Diamond Dr, 4 mi. NE of Canton	MTS	EXP	-	-	-	-	-	-	-	NS	NA
***07040008-F54**, Bridge Creek, Unnamed cr to Unnamed cr*	6.71	2A	08LM103	Downstream of John Deere Dr, 6.5 mi. SW of Houston	MTS	EXS	-	-	-	-	-	-	-	NS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the South Fork Root River watershed unit.

South Fork Root River 10X stream water chemistry

Table 42: Outlet water chemistry results for the South Fork Root River 11 HUC

Station location:	ROOT RIVER, SOUTH FORK AT SWEDE BOTTOM 1 MILE E OF HOUSTON
Storet ID:	S004-830
Station #:	08LM009

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	11	11	17	11	11	19	11	11	9	11	20	20
Minimum	7.51	8	248.9	<.025	4.2	8.01	.085	32	544	11.6	12.7	3
Maximum	8.68	10.76	2500	<.025	5	8.3	.543	470	588	13.9	22.5	72
Mean[1]	8.25	9.13	562.61	<.025	4.48	8.19	.17	109.46	565	13.01	16.64	36.8
Median	8.36	9.1	370	<.025	4.5	8.22	.117	58	563	13	16.35	37.5
WQ standard[2]	230	5.0	126/1260			6.5-9		60				20
# WQ exceedances[3]	0/11	0/11	17/17			0/19		5/11				4/20

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 43: Minnesota Stream Habitat Assessment (MSHA) for the South Fork Root River 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM060	Riceford Creek	1	4	12	10	9	15	50	Fair
04LM069	Root River, South Fork	1	2.5	11.5	22	13	28	77	Good
04LM112	Riceford Creek	2	1	6.3	12.9	8.5	17	45.6	Fair
04LM113	Root River, South Fork	1	1	7	19.5	13	30	70.5	Good
04LM116	Root River, South Fork	1	2.5	9.5	20.2	7	22	61.2	Fair
04LM117	Riceford Creek	1	0	4	18.6	13	25	60.6	Fair
08LM009	Root River, South Fork	1	0	3	17	7	14	41	Poor

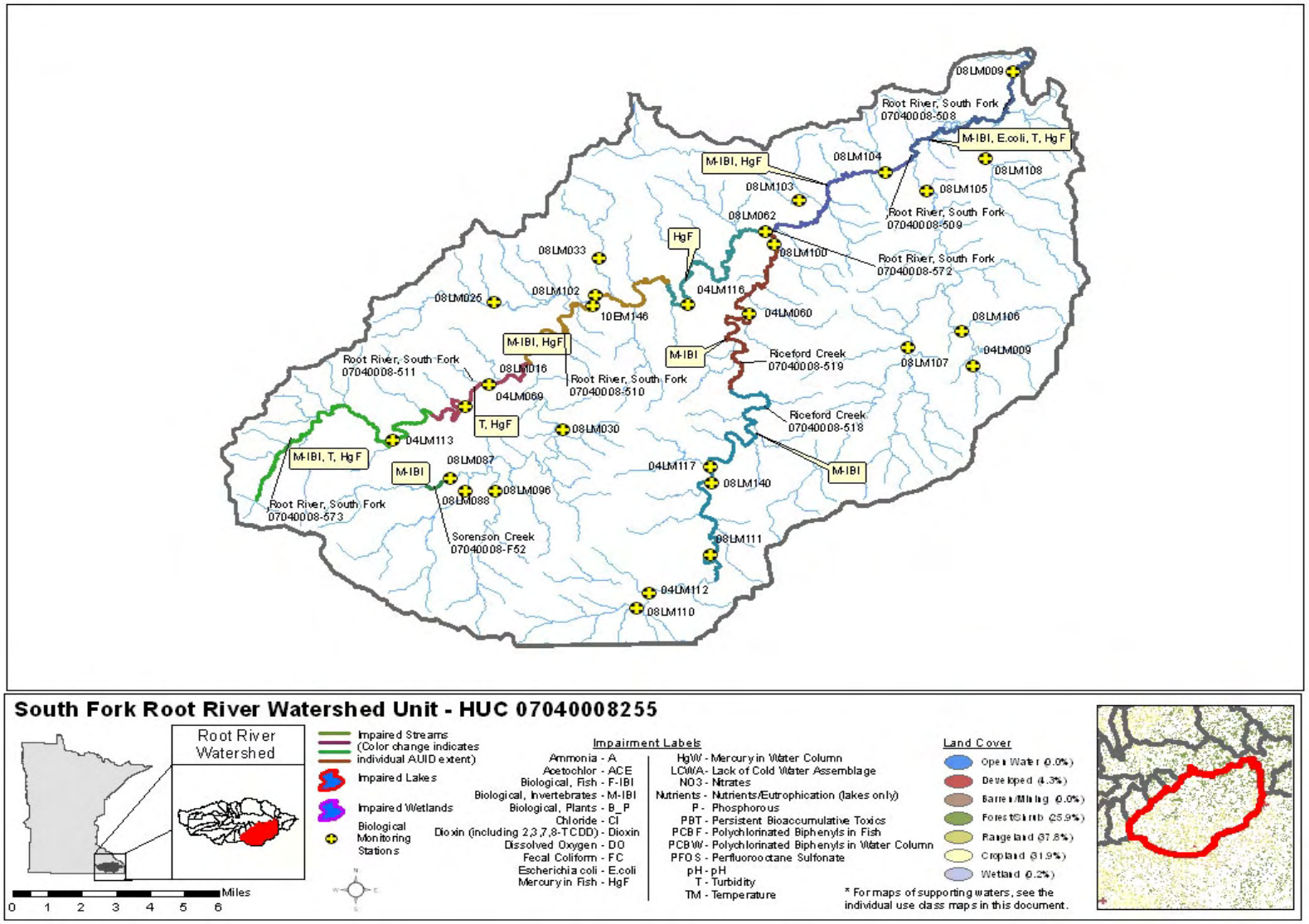
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM016	Root River, South Fork	2	4.4	12.5	23	12.5	31	83.3	Good
08LM025	Shattuck Creek	1	3.8	14	21	10	26	74.8	Good
08LM030	Wisel Creek	2	5	13	20.5	12	25	75.5	Good
08LM033	Trib to Root River, South Fork	1	5	14	20.9	14	31	84.9	Good
08LM062	Root River, South Fork	1	0	7	16.2	11	15	49.2	Fair
08LM087	Sorenson Creek	1	0	10	4	14	15	43	Poor
08LM088	Wisel Creek	1	0	6	13.1	7	25	51.1	Fair
08LM096	Trib to Wisel Creek	1	0	7	10	1	9	27	Poor
08LM100	Riceford Creek	1	0	8	14.2	10	26	58.2	Fair
08LM102	Root River, South Fork	1	3.5	8	24	13	31	79.5	Good
08LM103	Bridge Creek	1	2.5	9	18.1	14	30	73.6	Good
08LM104	Root River, South Fork	1	0	8	15.1	10	24	57.1	Fair
08LM105	Beaver Creek	1	1.25	5	17	6	16	45.3	Fair
08LM106	Beaver Creek, East Fork	1	5	15	26	17	33	96	Good
08LM107	Beaver Creek	1	5	14	24	12	35	90	Good
08LM108	Badger Creek	2	1.3	5	20.5	10	15.5	62.3	Fair
08LM110	Riceford Creek	1	0	8.5	7	4	15	34.5	Poor
08LM111	Riceford Creek	1	0	9	14.4	12	28	63.4	Fair
08LM140	Riceford Creek	1	3.8	11	20.9	8	29	72.7	Good
08EM146	Root River, South Fork	1	5	13	23	7	24	72	Good
Average Habitat Results: *South Fork Root River 11-HUC Watershed*			2.1	9.3	17.5	10.2	23.9	62.9	

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)

South Fork Root River Watershed Unit summary

The South Fork Root River watershed showed multiple impairments of invertebrates and due to turbidity. The most downstream AUID indicated an impairment due to bacteria. Fish communities met expectations throughout the watershed. The elevated turbidity levels are likely impacting aquatic life. The habitat evaluations performed in the South Fork Root River watershed showed four "poor" ratings, eleven "fair" ratings, and twelve "good" ratings.

Figure 23: Currently listed impaired waters by parameter in the South Fork Root River Watershed Unit



Middle Branch Root River Watershed Unit HUC 07040008100

Watershed description

The Middle Branch Root River Watershed Unit, located in northwestern Fillmore County, encompasses an area of 33.6 square miles. This watershed unit links the confluences of the Bear and Deer Creek watersheds to the convergence with the North Branch Root River. It flows generally in a northeasterly direction. The landscape consists of mostly rangeland (38 percent), cropland (32.7 percent), and forests (23.1 percent). The watershed contains roughly 5.4 miles of designated trout waters. Named streams within this watershed unit are Curtis, Carson, Jordan, and Shady creeks and Middle Branch Root River. The outlet of the watershed is represented by station 08LM007 on the Middle Branch Root River located 3 miles south of the city of Chatfield.

Stream water chemistry assessment results

Water quality data was available on the 1.5 mile reach of the Middle Branch Root River immediately upstream of the North Branch Root River. Excess bacteria in the stream triggered an aquatic recreation use impairment for the reach.

Stream biological and use assessment

Table 44: Aquatic life and recreation assessments on assessed AUIDs in the Middle Branch Root River 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-506, *Root River, Middle Branch, Upper Bear Cr to N Br Root R*	1.59	2B	08LM007	Downstream of CSAH 7, 3 mi. S of Chatfield	MTS	EXP	-	IF	MTS	-	MTS	-	EX	NS	NS
07040008-541, *Curtis Creek, Headwaters to M Br Root R*	3.24	2A	08LM015	Downstream of CSAH 5, 2 mi. N of Wykoff	MTS	EXP	-	-	-	-	-	-	-	NS	-
07040008-595, *Carson Creek (Little Jordan Creek), Unnamed cr to M Br Root R*	1.07	2A	-	-	-	-	-	-	-	-	MTS	-	-	IF	NA
07040008-713, *Jordan Creek, Unnamed cr to Unnamed cr*	0.57	2B	08LM068	Downstream of 181st Ave, 5 mi. N of Wykoff	MTS	MTS	-	-	-	-	-	-	-	IF	NA
07040008-B96, *Root River, Middle Branch, T103 R12W S4, south line to Upper Bear Cr*	9.76	2B	04LM072	SE1/4, Sec 35,1.5 miles NNE out of Fillmore	MTS	MTS	-	-	-	-	-	-	-	FS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Middle Branch Root River Watershed Unit.

Middle Branch Root River 10X stream water chemistry

Table 45: Outlet water chemistry results for the Middle Branch Root River 11 HUC

Station location:	ROOT RIVER, MIDDLE BRANCH AT CSAH 7, 3 MILES S OF CHATFIELD
Storet ID:	S004-821
Station #:	08LM007

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	11	10	16	11	11	19	11	11	9	11	20	20
Minimum	10.1	8.5	140	<.025	4.8	8	.037	3.6	486	8.89	13.2	6
Maximum	15.6	14.65	1986.3	<.025	9.4	8.52	.274	170	568	17.3	22.6	100
Mean[1]	13.68	10.66	419.84	<.025	6.71	8.22	.075	26.93	539.56	14.45	18.37	60.95
Median	13.7	9.85	344.8	<.025	6.9	8.17	.051	10	537	14.3	18.5	61
WQ standard[2]	230	5.0	126/1260			6.5-9		60				20
# WQ exceedances[3]	0/11	0/10	16/16			0/19		1/11				2/20

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 46: Minnesota Stream Habitat Assessment (MSHA) for the Middle Branch Root River 11 HUC

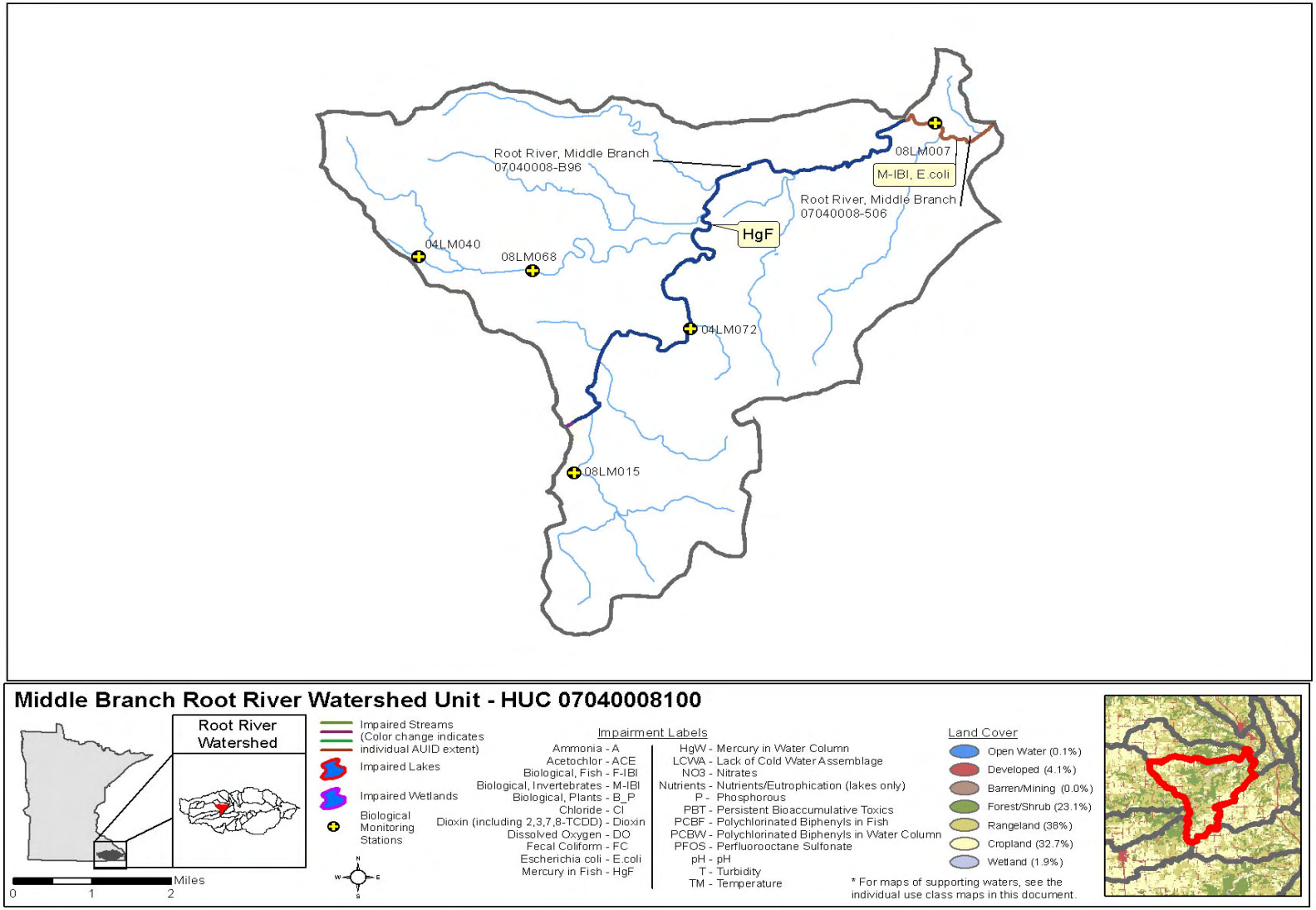
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM072	Root River, Middle Branch	1	2.5	9.5	22	8	22	64	Fair
08LM007	Root River, Middle Branch	1	0	7.5	13.3	7	25	52.8	Fair
08LM015	Curtis Creek	2	1.8	6	20.7	6.5	25	60	Fair
08LM068	Jordan Creek	1	1.5	5.5	14.7	10	24	55.7	Fair
Average Habitat Results: *Middle Branch Root River 11-HUC Watershed*			1.4	7.1	17.7	7.9	24	58.1	

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)

Middle Branch Root River Watershed Unit summary

The Middle Branch Root River watershed showed impairments due to bacteria and of invertebrates both at the most downstream AUID. All other water chemistry data met standards. Fish communities met expectations throughout the watershed. The habitat evaluations performed on the Middle Branch Root River and its tributaries all showed a “fair” rating.

Figure 24: Currently listed impaired waters by parameter in the Middle Branch Root River Watershed Unit



South Branch Root River Watershed Unit HUC 07040008200

Watershed description

The South Branch Root River Watershed Unit, located in southeastern Mower and central Fillmore counties, drains an area of 138.8 square miles. This watershed is one of the main contributors to the Root River. The headwaters of this watershed form in the township of Clayton in Mower County and flows generally in an easterly direction. Upon reaching the historic village of Forestville, the South Branch Root River heads in a northeasterly direction before entering the Root River approximately 1.5 miles northeast of the city of Lanesboro. The land use is dominated by cropland (53.1 percent), followed by rangeland (24.4 percent) and forest/shrubland (15.9 percent). The watershed contains roughly 39.8 miles of designated trout waters. Named streams within this watershed unit are: Judicial Ditch 1, Etna, North Branch Forestville, Forestville, and Canfield creeks, and the South Branch Root River. The outlet of the watershed is represented by station 08LM002 on the South Branch Root River located in the city of Lanesboro.

Stream water chemistry assessment results

Water quality data was available on 8 reaches in the watershed; 5 reaches on the main stem and 3 tributaries. Drinking water exceeded nitrate standards on two of the tributaries and one reach of the main stem between Canfield and Willow Creeks. Elevated levels of pesticides were detected in the watershed, but were not enough to be considered impaired. Excess bacteria and sediment appear to be affecting aquatic recreation and life uses throughout the watershed unit.

Stream biological and use assessment

Table 47: Aquatic life and recreation assessments on assessed AUIDs in the South Branch Root River 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-550, *Root River, South Branch, Duschee Cr to M Br Root R*	3.56	2A	08LM002	Downstream of CSAH 8, in Lanesboro	MTS	EXP	-	IF	MTS	MTS	MTS	-	EX	NS	NS
07040008-551, *Root River, South Branch, Watson Cr to Duschee Cr*	6.08	2A	-	-	-	-	-	IF	-	-	-	-	-	IF	NA
07040008-553, *Root River, South Branch, Camp Cr to Watson Cr*	5.35	2A	08LM037	Downstream of Hwy 52, 1 mi. E of Preston	MTS	MTS	-	-	-	-	-	-	-	FS	NA
07040008-554, *Root River, South Branch, Willow Cr to Camp Cr*	3.01	2A	-	-	-	-	-	EXP	-	-	-	-	-	NS	NA
07040008-555, *Root River, South Branch, Canfield Cr to Willow Cr*	12.03	2A	08LM053 04LM110	Downstream of CSAH 12, 4 mi. W of Preston Downstream of C.R. 118 in Forestville State Park	MTS	MTS	IF	IF	MTS	MTS	MTS	-	EX	FS	NS
07040008-556, *Root River, South Branch, T102 R12W S21, north line to Canfield Cr*	8.11	2A	08LM029	Downstream of Maple Rd, 6 mi. S of Wykoff	MTS	EXP	-	IF	-	-	-	-	-	NS	NA
07040008-561, *Judicial Ditch 1, Unnamed cr to S Br Root R*	1.31	2B	08LM034	Downstream of 200 St, 4.5 mi. SE of Grand Meadow	-	-	-	EXP	-	-	-	-	-	NS	NA
07040008-562, *Etna Creek, Unnamed cr to S Br Root R*	0.69	2A	-	-	-	-	-	IF	-	-	-	-	-	IF	NA

07040008-563, *Forestville Creek, Unnamed cr to S Br Root R*	1.9	2A	08LM020	Adjacent to CR 118, 5 mi. S of Wykoff	MTS	MTS	-	EXP	-	MTS	MTS	-	-	FS	NA
07040008-586, *Root River, South Branch, Headwaters to T102 R12W S16, south line*	26.32	2B	04LM111 08LM019 09LM001	Upstream of CR 114, 1 mile N. of Etna Upstream of 151st Ave, 7 mi. SW of Wykoff Upstream of 770 St, 4.5 mi. SE of Grand Meadow	MTS	MTS	-	EXP	MTS	MTS	-	-	-	FS	NA
07040008-597, *Etna Creek, T102 R13W S36, west line to Unnamed cr*	0.57	2A	08LM026	Downstream of 153rd Ave, 8 mi. SW of Wykoff	MTS	EXP	-	-	-	-	-	-	-	NS	NA
07040008-599, *Unnamed creek (Forestville Creek Tributary), T102 R12W S15, north line to Forestville Cr*	0.72	2A	04LM011	1 mi. W of Forestville	MTS	MTS	-	-	-	-	-	-	-	FS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

Table 48: Non-assessed biological stations on channelized AUIDs in the South Branch Root River 11-HUC

AUID	Biological Station ID	Station location	Fish Quality	Macroinvertebrate Quality
07040008-561, *Judicial Ditch 1, Unnamed cr to S Br Root R*	08LM034	Downstream of 200 St, 4.5 mi. SE of Grand Meadow	Good	Poor
07040008-586, *Root River, South Branch, Headwaters to T102 R12W S16, south line*	09LM001	Upstream of 770 St, 4.5 mi. SE of Grand Meadow	Good	Poor

South Branch Root River 10X stream water chemistry

Table 49: Outlet water chemistry results for the South Branch Root River 11 HUC

Station location:	ROOT RIVER, SOUTH BRANCH AT ELMWOOD ST W IN LANESBORO
Storet ID:	S004-829
Station #:	08LM002

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	11	10	15	11	11	18	11	11	9	11	19	19
Minimum	11.1	7.87	30.1	<.025	6.7	8.205	.04	7.2	576	11.3	10.3	6
Maximum	13.1	11.97	2419.6	.1	9.1	8.3	.364	210	622	16.2	23.5	100
Mean[1]	12.28	9.93	175.83	<.025	7.08	8.2	.093	32.86	601.89	14.35	17.16	62.63
Median	12.7	10.38	170	<.025	6.7	8.205	.072	13	601	14.6	16.3	68
WQ standard[2]	230	7.0	126/1260			6.5-8.5		60				20
# WQ exceedances[3]	0/11	0/10	15/15			0/18		1/11				2/19

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 50: Minnesota Stream Habitat Assessment (MSHA) for the South Branch Root River 11 HUC

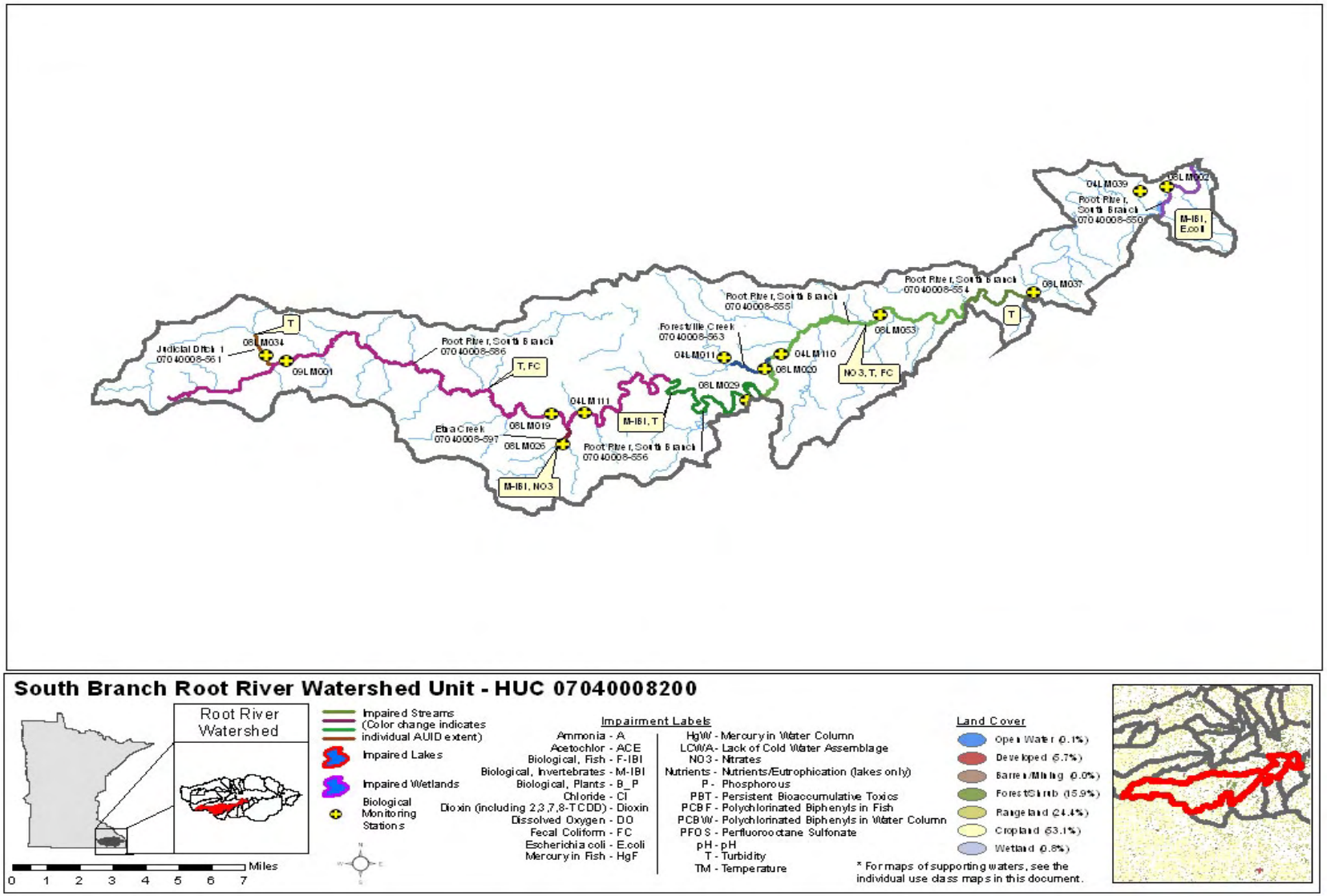
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM011	Trib to Forestville Creek	1	3.5	10.5	21.3	14	33	82.3	Good
04LM110	Root River, South Branch	1	5	13.5	22.7	17	34	92.2	Good
04LM111	Root River, South Branch	1	3.5	7.5	19.6	10	21	61.6	Fair
08LM002	Root River, South Branch	1	2.5	11	21.4	12	33	79.9	Good
08LM019	Root River, South Branch	1	0	9.5	19	11	30	69.5	Good
08LM020	Forestville Creek	1	5	14.5	21.6	11	31	83.1	Good
08LM026	Etna Creek	1	0	6	18.5	12	31	67.5	Good
08LM029	Root River, South Branch	1	3	7	24.4	10	31	75.4	Good
08LM034	Judicial Ditch 1	2	0	8	16.5	8.5	18.5	51.5	Fair
08LM037	Root River, South Branch	1	2	7.5	21.5	11	23	65	Fair
08LM053	Root River, South Branch	2	0	12.5	21.8	13	32.5	79.8	Good
09LM001	Root River, South Branch	1	0	8.5	18	10	10	46.5	Fair
Average Habitat Results: *South Branch Root River 11-HUC Watershed*			2	9.7	20.5	11.6	27.3	71.2	Good

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

South Branch Root River Watershed Unit summary

The South Branch Root River watershed showed a bacteria impairment at the outlet. Multiple invertebrate, turbidity, and drinking water impairments were found. Fish communities met expectations throughout the watershed. Two sites monitored were considered channelized and had a “good” fish quality and a “poor” macroinvertebrate quality rating using the channelized stream scoring system. The South Branch Root River watershed had habitat evaluations showing four “fair” ratings and nine “good” ratings. Elevated nutrients and sediment levels are having negative impacts on the watershed.

Figure 25: Currently listed impaired waters by parameter in the South Branch Root River Watershed Unit



Root River Watershed Unit HUC 07040008280

Watershed description

The Root River Watershed Unit, located in the northern halves of Fillmore and Houston counties, encompasses an area of 222 square miles. The watershed unit includes the Root River main-stem from the North Branch Root River to its confluence with the Mississippi River. The river flows in an easterly direction through many of the valleys and past many of the bluffs that comprise the driftless area in southeastern Minnesota. The landscape is primarily forested (41 percent), but also is used as rangeland (30.5 percent), and cropland (20.2 percent). The watershed contains roughly 28.6 miles of designated trout waters. Named streams in this watershed include Mahoney, Wadden Valley, Torkelson, Raaen, Big Springs, Camp Hayward, Ferndale Creek, Daley, Crystal, Storer, Brush Valley, Mound Prairie creeks and the Middle Branch Root and Root Rivers. The outlet of this watershed is represented by site 08LM001 on the Root River located approximately three miles northeast of the town of Hokah in eastern Houston County.

Stream water chemistry assessment results

Water quality data was available on two reaches of the Middle Branch Root River and four reaches on the main stem Root River. Data on the Middle Branch reaches was inconclusive; small datasets and flow biased datasets prevented the determination of aquatic recreation and life use support. Pesticide data from this part of the watershed was meeting standards. Turbidity was considered impaired on three of the four Root River reaches and noted as high on the fourth reach. All nitrate samples exceeded the ecoregion expectation. Macroinvertebrate communities were impacted on the reaches downstream of the South Fork Root River and fish consumption was also impaired due to mercury in fish tissue. Bacteria exceeded standards on the most downstream reach. These downstream impairments match the impairments coming from the South Fork Root River and are likely cumulative impacts.

Stream biological and use assessment

Table 51: Aquatic life and recreation assessments on assessed AUIDs in the Root River 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-501, Root River, Thompson Cr to Mississippi R	5.65	2B	08LM001	Downstream of Hwy 26, 3 mi. NE of Hokah	MTS	EXP	MTS	EXS	MTS	MTS	MTS	-	EX	NS	NS
***07040008-502**, Root River, S Fk Root R to Thompson Cr*	11.1	2B	02LM011 08LM093	Upstream of Hwy 16 bridge 0.5 miles NW of Hokah At CSAH 25, 6 mi. NE of Houston	MTS	EXS	IF	EXP	MTS	MTS	MTS	-	-	NS	NA
***07040008-520,** Root River, Money Cr to S Fk Root R*	3.44	2B	08LM057 04LM118	Upstream of Hwy 76, 0.5 mi. N of Houston Upstream of Hwy 76, 0.5 mi. NW of Houston	MTS	EXP	IF	IF	MTS	MTS	MTS	-	-	NS	NA
***07040008-522**, Root River, Rush Cr to Money Cr*	12.41	2b	08LM065	Adjacent to Hwy 16, 3.5 mi. SE of Rushford	MTS	EXP	-	-	-	-	-	-	-	NS	NA
***07040008-527**, Root River, M Br Root R to Rush Cr*	20.3	2B	08LM064 10EM079 08LM071	Upstream of Hwy 16, 2 mi. NE of Peterson Adjacent to Hwy 16, 2 mi. NE of Whalan Adjacent to Hwy 16, 1 mi. NE of Whalan	MTS	EXS	-	EXP	-	-	-	-	-	NS	NA
***07040008-528**, Root River, Middle Branch, Trout Run Cr to S Br Root R*	16.31	2B	08LM070 08LM069	Adjacent to Goodview Dr, 3.5 mi. NW of Lanesboro Upstream of CSAH 21, 5 mi. NW of Lanesboro	MTS	EXP	-	IF	-	MTS	-	-	IF	NS	IF
***07040008-530**, Root River, Middle Branch, Rice Cr to Trout Run Cr*	6.65	2B	-	-	-	-	-	MTS	-	-	-	-	IF	IF	IF
***07040008-605,** Unnamed creek (Wadden Valley Creek), Unnamed cr to M Br Root R*	1.2	2B	08LM024	Adjacent to Hobbit Ln, 4 mi. NW of Lanesboro	MTS	EXP	-	-	-	-	-	-	-	NS	NA

***07040008-607**, Torkelson Creek, T104 R10W S25, north line to M Br Root R*	2.02	2A	-	-	-	-	-	-	-	-	MTS	-	-	IF	NA
***07040008-623,** Big Springs Creek, Unnamed cr to Root R*	4.1	2A	08LM073	Adjacent to CR 105, 6 mi. NE of Lanesboro	MTS	MTS	-	-	-	-	-	-	-	FS	NA
***07040008-638**, Daley Creek, R103 R7W S8, west line to Root R*	3.45	2A	08LM066	Downstream of Chisholm Rd, 5 mi. SE of Rushford	MTS	MTS	-	-	-	-	-	-	-	FS	NA
***07040008-643**, Storer Creek, T104 R5W S17, north line to Root R*	4.23	2A	08LM095	Adjacent to Storer Valley Rd, 4.5 mi. NE of Houston	MTS	MTS	-	-	-	-	-	-	-	FS	NA
***07040008-650**, Crystal Creek, T103 R5W S19, west line to T103 R5W S6, north line*	6.02	2A	08LM089	Downstream of Sanden Rd, 4 mi. E of Houston	EXP	MTS	-	-	-	-	-	-	-	FS	NA
***07040008-658**, Unnamed creek (Camp Hayward Creek), Unnamed cr to T104 R8W S31, north line*	1.31	2A	08LM085 08LM142	Downstream of CSAH 25, 1.5 mi. S of Peterson Upstream of Hatchery Rd. on W side of CSAH 25, 1.5 mi. S of Peterson	MTS	MTS	-	-	-	-	-	-	-	FS	NA
***07040008-659,** Unnamed creek, T104 R8W S32, east line to Unnamed cr*	0.68	2A	08LM141	Upstream of CSAH 25, 1.5 mi. S of Peterson	MTS	EXP	-	-	-	-	-	-	-	NS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Middle Branch Root River Watershed Unit.

Root River 10X stream water chemistry

Table 52: Outlet water chemistry results for the Root River 11 HUC

Station location:	ROOT RIVER AT BRIDGE ON MN-26 3 MI EAST OF HOKAH
Storet ID:	S000-065
Station #:	08LM001

Parameter	Chloride	D.O.	E. coli	NH_3	NO_2+ NO_3	pH	TP	TSS	Spec. cond.	Sulfate	Temp.	T-tube
Units	mg/l	mg/l	#/100ml	mg/l	mg/l		mg/l	mg/l	*u*S/cm	mg/l	˚C	cm
# Samples	12	10	17	12	13	11	13	13	12	12	13	19
Minimum	8.07	7.48	40.4	<.025	3.8	7.89	.068	18.0	440	8.02	12.7	2
Maximum	13.1	10.87	2419.6	<.025	7.0	8.4	.406	310.0	579	14.9	29.7	100
Mean[1]	10.71	8.96	235.27	<.025	5.03	8.26	.169	95.17	546.778	12.868	19.42	40.84
Median	11.05	8.64	210	<.025	4.6	8.305	.132	72.0	562	13.5	19.1	44
WQ standard[2]	230	5.0	126/1260			6.5-9		60				20
# WQ exceedances[3]	0/12	0/10	10/17			0/11		7/13				4/13

[1]Geometric mean of all samples is provided for *E. coli*.
[2]Total suspended solids and Transparency tube standards are surrogate standards derived from the turbidity standard of 25
[3]Represents exceedances of individual maximum standard for *E. coli* (1260/100ml) or fecal coliform.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Root River 11 HUC, a component of the IWM work conducted in 2008 and 2009. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Stream habitat

Table 53: Minnesota Stream Habitat Assessment (MSHA) for the Root River 11 HUC

Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
02LM011	Root River	1	4.3	9.5	14	4	17	48.8	Fair
04LM118	Root River	1	2.5	8	19.4	10	31	70.9	Good
08LM001	Root River	1	2.5	9.5	18.9	9	21	60.9	Fair
08LM024	Wadden Valley Creek	1	0	9	21.2	7	27	64.2	Fair
08LM057	Root River	1	2.5	8.5	17.2	8	17	53.2	Fair
08LM064	Root River	1	2.5	9	15.8	8	20	55.3	Fair
08LM065	Root River	1	2.5	7.5	18	5	21	54	Fair

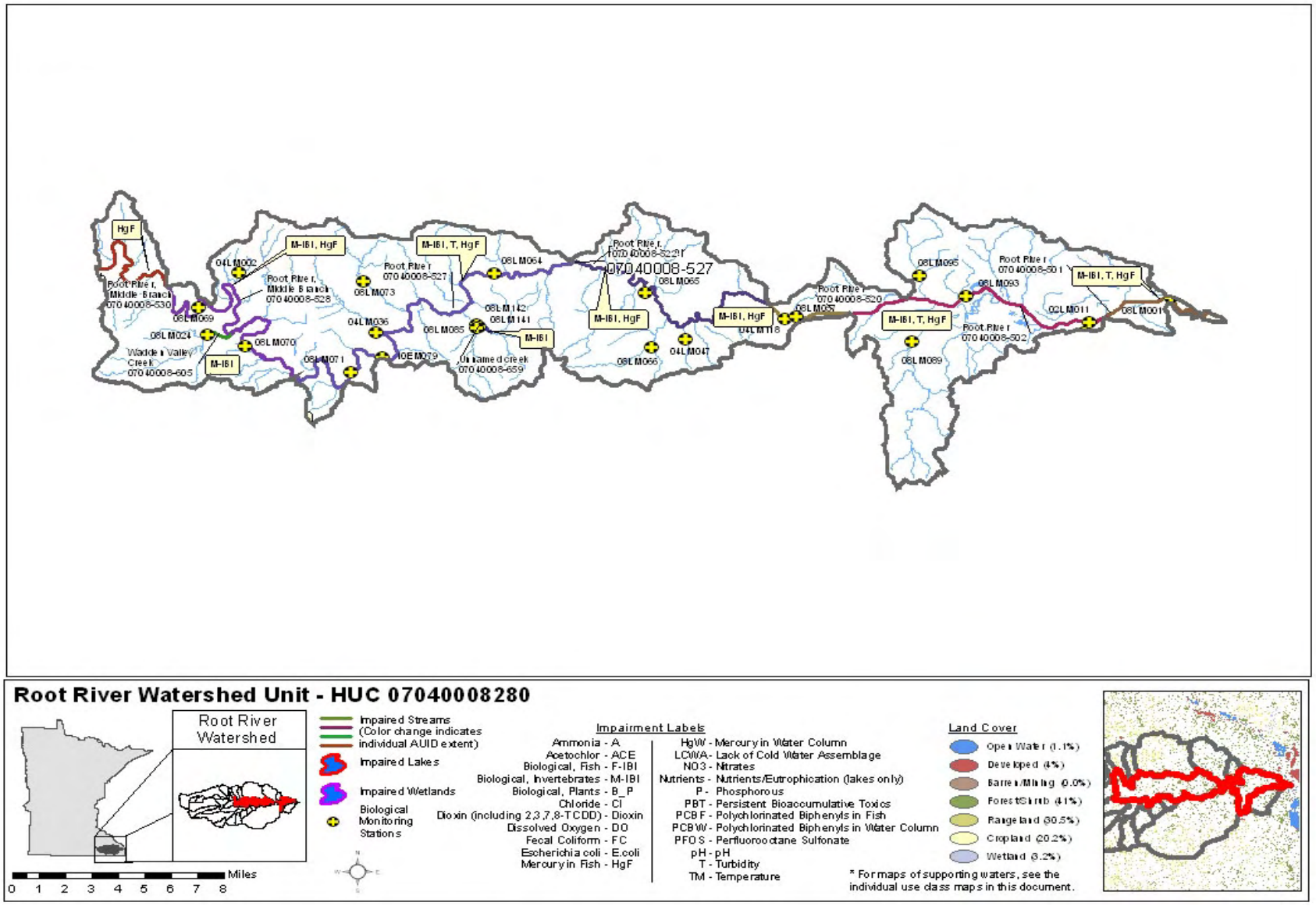
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM066	Daley Creek	1	5	12	18.5	17	34	86.5	Good
08LM069	Root River	1	2.5	12.5	22	10	28	75	Good
08LM070	Root River	1	5	12	17.7	7	22	63.7	Fair
08LM071	Root River	1	2.5	5.5	17.1	5	18	48.1	Fair
08LM073	Big Springs Creek	1	5	14	18.2	16	34	87.2	Good
08LM085	Trib to Root River	1	5	11	17	13	26	72	Good
08LM089	Crystal Creek	1	2.5	11.5	21.6	12	29	76.6	Good
08LM093	Root River	1	2.5	9	19	8	17	55.5	Fair
08LM095	Storer Creek	1	5	11	19.4	6	25	66.4	Good
08LM141	Trib to Root River	1	2	9	17	10	25	63	Fair
08LM142	Trib to Root River	1	5	12	21.6	17	27	82.6	Good
10EM079	Root River	1	5	10.5	20.6	12	26	74.1	Good
Average Habitat Results: *Root River 11-HUC Watershed*			3.4	10.1	18.6	9.7	24.5	66.2	

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)

Root River Watershed Unit summary

The Root River watershed showed a bacteria impairment at the most downstream AUID. Multiple impairments of invertebrates due to turbidity were found. Fish communities met expectations throughout the watershed. The habitat evaluations show 10 sites with a "fair" rating and nine with a "good" rating.

Figure 26: Currently listed impaired waters by parameter in the Root River Watershed Unit



Duschee Creek Watershed Unit HUC 07040008190

Watershed description

The Duschee Creek Watershed is located in the south central portion of the Root River watershed. The watershed has a drainage area of 22.8 square miles consisting mostly of rangeland (50.4 percent), forests (23.2 percent), and cropland (21.9 percent). Duschee Creek starts in Preston Township in south central Fillmore County and flows in a northerly direction before joining the South Branch Root River just outside of the city of Lanesboro. Biological station 08LM048 represents the outlet for this watershed.

Stream water chemistry assessment results

Water quality data was available on the 8 mile reach of Duschee Creek immediately upstream of the South Branch Root River. Sediment was identified as a likely stressor, but the dataset was not strong enough to warrant a listing for turbidity.

Stream biological and use assessment results

Table 54: Aquatic life and recreation assessments on assessed AUIDs in the Duschee Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-560, *Duschee Creek, T102 R10W S1, east line to S Br Root R*	8.04	2A	08LM048	Downstream of Grosbeak Rd, 1 mi. SW of Lanesboro	EXP	EXP	-	IF	-	-	-	-	-	IF	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Duschee Creek Watershed Unit.

Stream habitat

Table 55: Minnesota Stream Habitat Assessment (MSHA) for the Duschee Creek 11 HUC

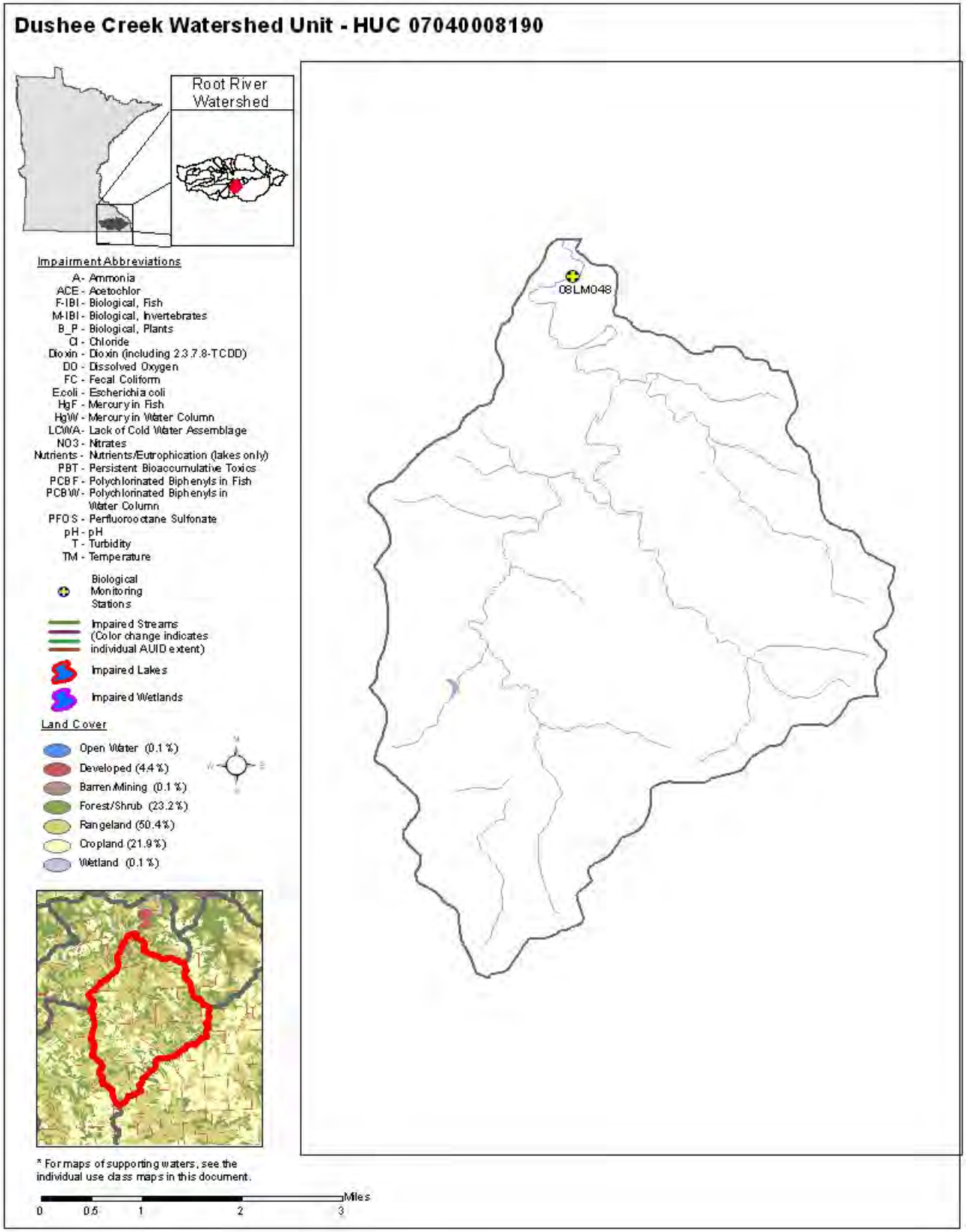
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM048	Duschee Creek	1	2	7.5	19.2	13	17	58.7	Fair
Average Habitat Results: *Duschee Creek 11- HUC Watershed*			2	7.5	19.2	13	17	58.7	

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)

Duschee Creek Watershed Unit summary

The Duschee Creek watershed did not have any impairments, however the 2008 sampling location was determined to be unrepresentative of the watershed. Further sampling was conducted in 2011 and the initial results show a supporting fish community. Invertebrate results are still pending. The habitat evaluation performed on Duschee Creek shows a “fair” rating.

Figure 27: Currently listed impaired waters by parameter in the Duschee Creek Watershed Unit



Camp Creek Watershed Unit HUC 07040008170

Watershed description

The Camp Creek Watershed is located in the south central portion of the Root River watershed. The watershed has a drainage area of 26.6 square miles consisting of rangeland (39.5 percent), cropland (37.2 percent) and forests (17.1 percent). Camp Creek and its main tributary, Partridge Creek, starts in Harmony Township in south central Fillmore County and flows in a northerly direction before joining the South Branch Root River just outside of the city of Preston. Biological station 08LM046 represents the outlet for this watershed.

Stream biological and use assessment results

Table 56: Aquatic life and recreation assessments on assessed AUIDs in the Camp Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-559, *Camp Creek, Headwaters to S Br Root R*	11.73	2A	08LM046 08LM075	Upstream of Cottage Grove Rd, 1 mi. SE of Preston Downstream of CSAH 16, 4 mi. S of Preston	EXS	EXS	-	-	-	-	MTS	-	-	NS	NA
07040008-678, *Partridge Creek, Unnamed cr to T102 R10W S21, west line*	0.75	2B	08LM036	Downstream of CSAH 16, 4 mi. SE of Preston	MTS	MTS	-	-	-	-	-	-	-	FS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Camp Creek Watershed Unit.

Stream habitat

Table 57: Minnesota Stream Habitat Assessment (MSHA) for the Camp Creek 11 HUC

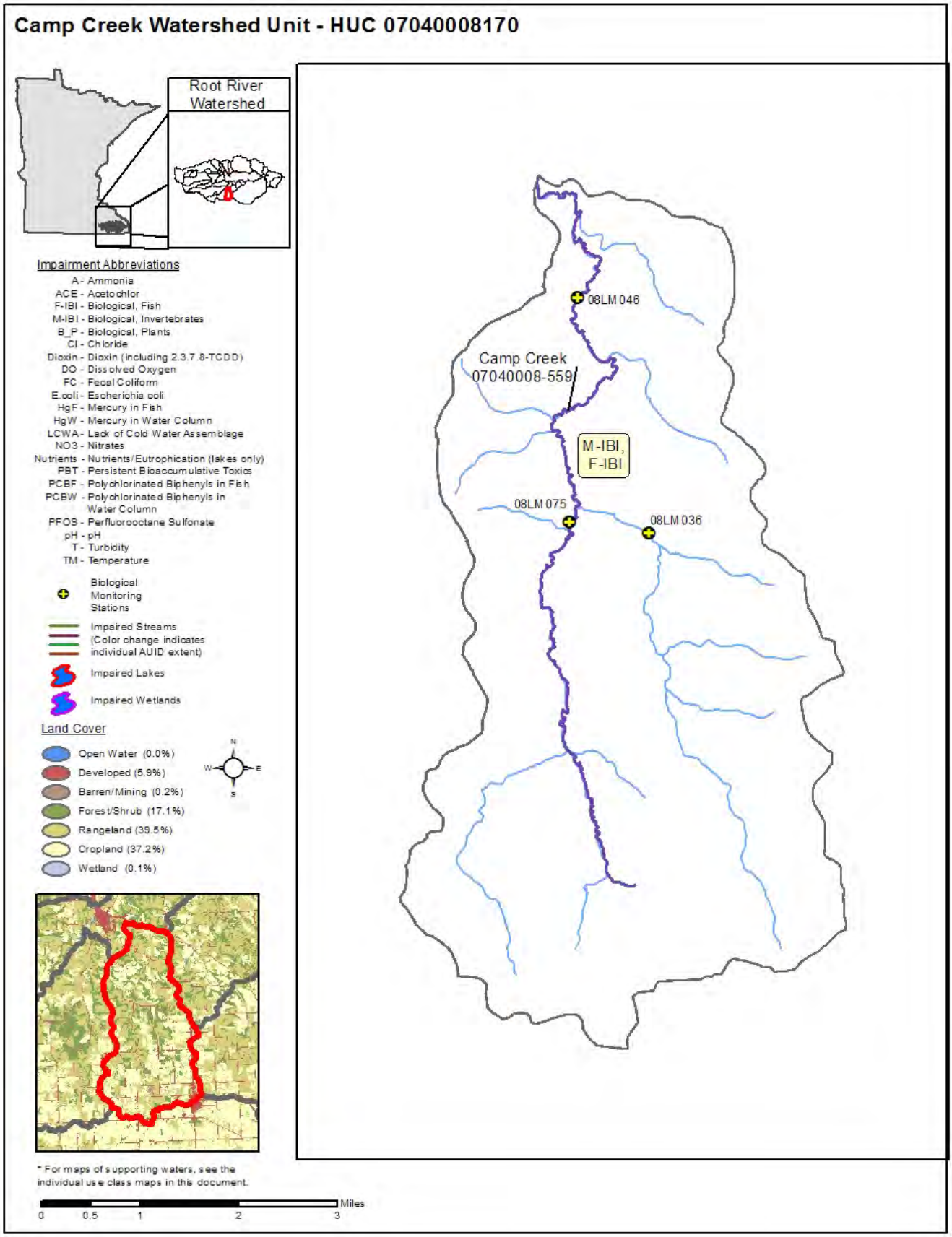
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM036	Partridge Creek	1	0	9.5	19.9	5	23	57.4	Fair
08LM046	Camp Creek	1	4	11.5	18.6	12	20	66.1	Good
08LM075	Camp Creek	1	5	10	21.4	16	31	83.4	Good
Average Habitat Results: *Camp Creek 11-HUC Watershed*			3	10.3	20	11	24.7	69	

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)

Camp Creek Watershed Unit summary

The Camp Creek watershed showed a fish and an invertebrate impairment on Camp Creek itself. Partridge Creek met biological expectations for both fish and invertebrates. The habitat evaluation performed on two sites along Camp Creek shows a "good" rating, while the one site on Partridge Creek had a "fair" rating.

Figure 28: Currently listed impaired waters by parameter in the Camp Creek Watershed Unit



Robinson Creek Watershed Unit HUC 07040008020

Watershed description

The Robinson Creek watershed is located in the northwestern portion of the Root River watershed. The watershed has a drainage area of 17.5 square miles and is 1 percent of the entire Root River watershed. The landscape consists of mostly cropland (74.6 percent) and rangeland (14.9 percent). Robinson Creek starts in the township of Pleasant Valley in northeast Mower County and flows in a northeasterly direction before joining the North Branch Root River near the outside of the small village of High Forest located in southwestern Olmsted County. Biological station 08LM045 represents the outlet for this watershed.

Stream water chemistry assessment results

Water quality data was available for the entire reach of Robinson Creek, which drains to the North Branch Root River. Excess bacteria confirmed an existing aquatic recreation impairment. Turbidity was low and not thought to be a stressor in this watershed.

Stream biological and use assessment results

Table 58: Aquatic life and recreation assessments on assessed AUIDs in the Robinson Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-503*, Robinson Creek, Headwaters to N Br Root R*	10.84	2B	08LM045	Upstream of CSAH 6, 5 mi. W of Stewartville	MTS	MTS	-	MTS	-	-	-	--	EX	FS	NS

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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Robinson Creek Watershed Unit.

Stream habitat

Table 59: Minnesota Stream Habitat Assessment (MSHA) for the Robinson Creek 11 HUC

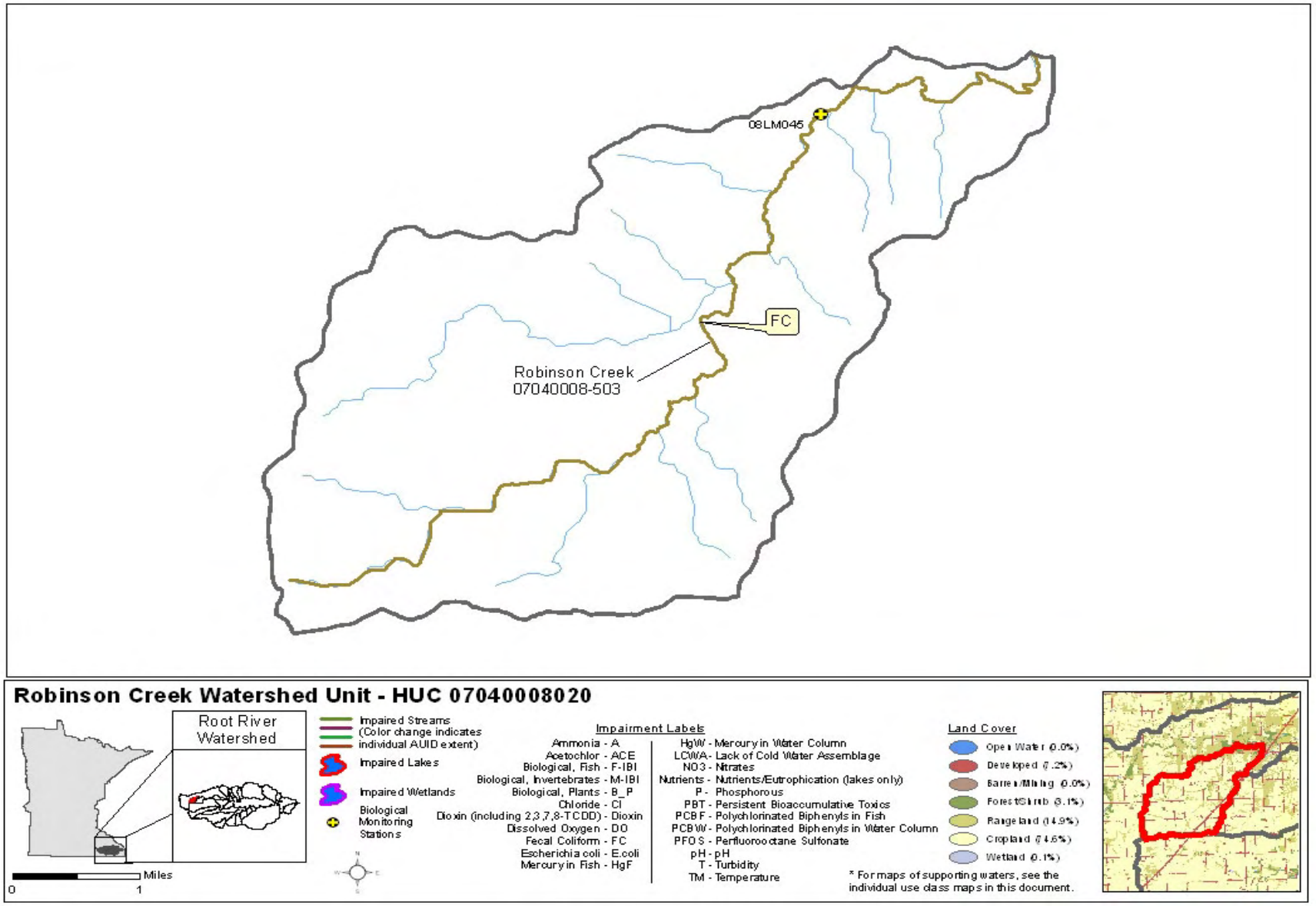
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM045	Robinson Creek	1	1.5	8	16.2	11	18	54.7	Fair
Average Habitat Results: *Robinson Creek 11- HUC Watershed*			1.5	8	16.2	11	18	54.7	

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)

Robinson Creek Watershed Unit summary

The Robinson Creek watershed data confirmed an existing aquatic recreation impairment for bacteria. Fish and invertebrate communities both met their expectations. The habitat evaluation performed on Robinson Creek showed a "fair" rating.

Figure 29: Currently listed impaired waters by parameter in the Robinson Creek Watershed Unit



Carey Creek Watershed Unit HUC 0704008030

Watershed description

The Carey Creek watershed is located in the northwestern portion of the Root River watershed. The watershed has a drainage area of 18.3 square miles consisting of mainly cropland (73.4 percent) and rangeland (17.7 percent), and is 1 percent of the entire Root River watershed. Carey Creek starts in the in northeast Mower County in the townships of Pleasant Valley and Racine. Carey Creek flows in a northeasterly direction before joining the North Branch Root River just outside of the city of Stewartville. Biological station 08LM022 represents the outlet for this watershed.

Stream water chemistry assessment results

Water quality data was available on a very short reach (0.6 mile) of this tributary. Transparency tube data indicated a possible stressor on aquatic life, but it did not warrant an impairment decision.

Stream biological and use assessment results

Table 60: Aquatic life and recreation assessments on assessed AUIDs in the Carey Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-696, *Carey Creek, Unnamed cr to Unnamed cr*	0.63	2B	08LM022	Upstream of Mower/Olmsted Rd, 1.5 mi. SW of Stewartville	MTS	MTS	-	MTS	-	-	-	--	--	FS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Carey Creek Watershed Unit.

Stream habitat

Table 61: Minnesota Stream Habitat Assessment (MSHA) for the Carey Creek 11 HUC

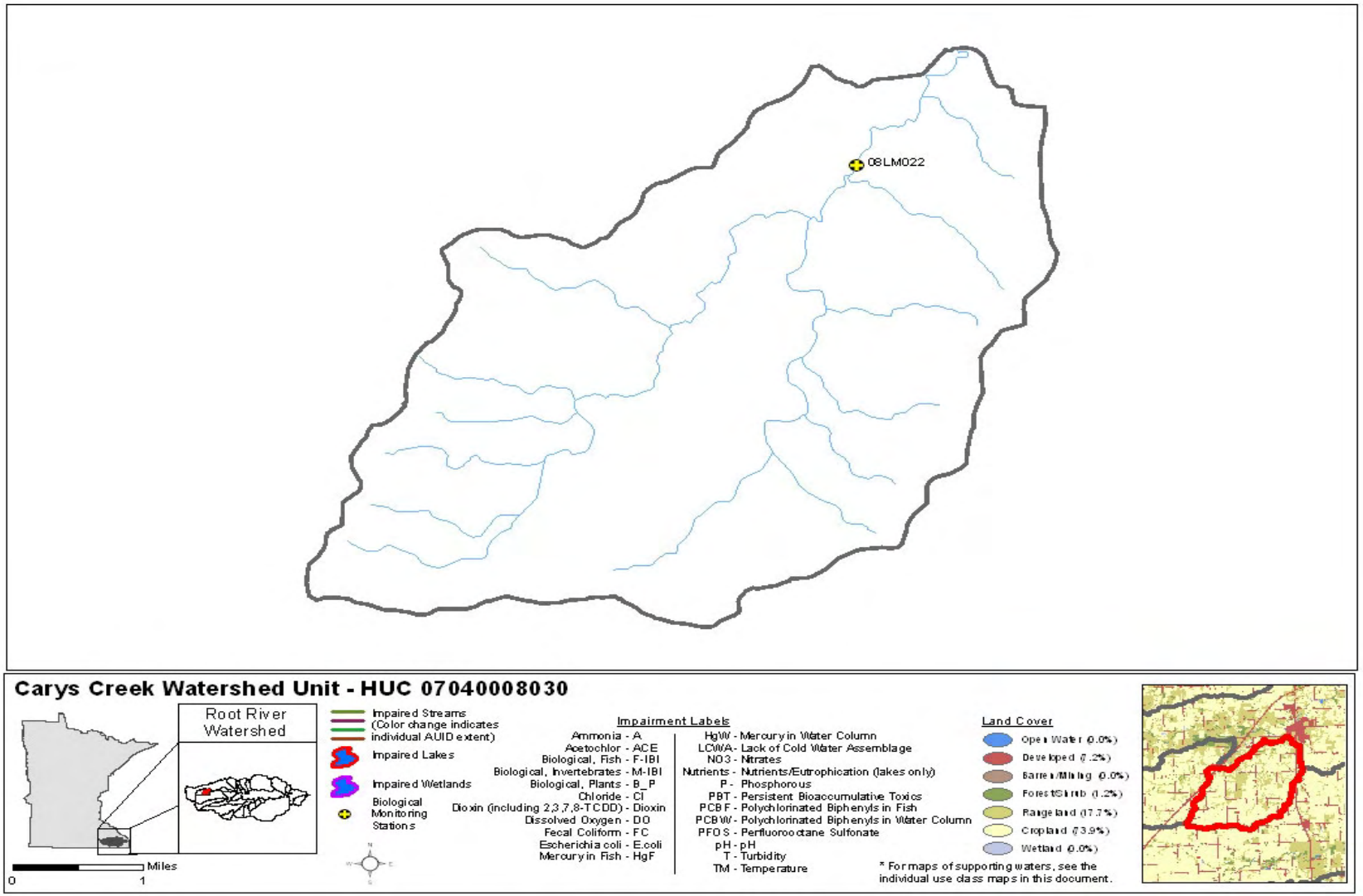
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM022	Carey Creek	1	0	8.5	17.9	7	20	53.4	Fair
Average Habitat Results: *Carey Creek 11- HUC Watershed*			0	8.5	17.9	7	20	53.4	

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)

Carey Creek Watershed Unit summary

The Carey Creek watershed had no impairments. Both fish and invertebrate communities met their expectations. The habitat evaluation performed on Carey Creek showed a “fair” rating.

Figure 30: Currently listed impaired waters by parameter in the Carey Creek Watershed Unit



Lost Creek Watershed Unit HUC 07040008050

Watershed description

The Lost Creek watershed is located in the north central portion of the Root River watershed. The watershed has a drainage area of 18.8 square miles and is 1 percent of the entire Root River watershed. The landscape consists of cropland (47.4 percent), rangeland (32.7 percent), and forests (14.8 percent). Upper Bear Creek is the main waterbody in the watershed and it begins in the townships of Sumner and Jordan located in northwestern Fillmore County. Upper Bear Creek flows in an easterly direction before flowing into the Middle Branch Root River about two miles south of the city of Chatfield. Biological station 08LM027 represents the outlet for this watershed. There were no water chemistry data available for this watershed.

Stream biological and use assessment results

Table 62: Aquatic life and recreation assessments on assessed AUIDs in the Lost Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	**Aquatic Life Indicators:**								**Bacteria**	**Aquatic Life**	**Aquatic Rec.**
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-540*, Upper Bear Creek, T104 R11W S18, west line to M Br Root R*	1.1	2A	08LM027	Downstream of CSAH 5, 2 mi. S of Chatfield	EXP	EXS	-	-	-	-	MTS	-	-	NS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Lost Creek Watershed Unit.

Stream habitat

Table 63: Minnesota Stream Habitat Assessment (MSHA) for the Lost Creek 11 HUC

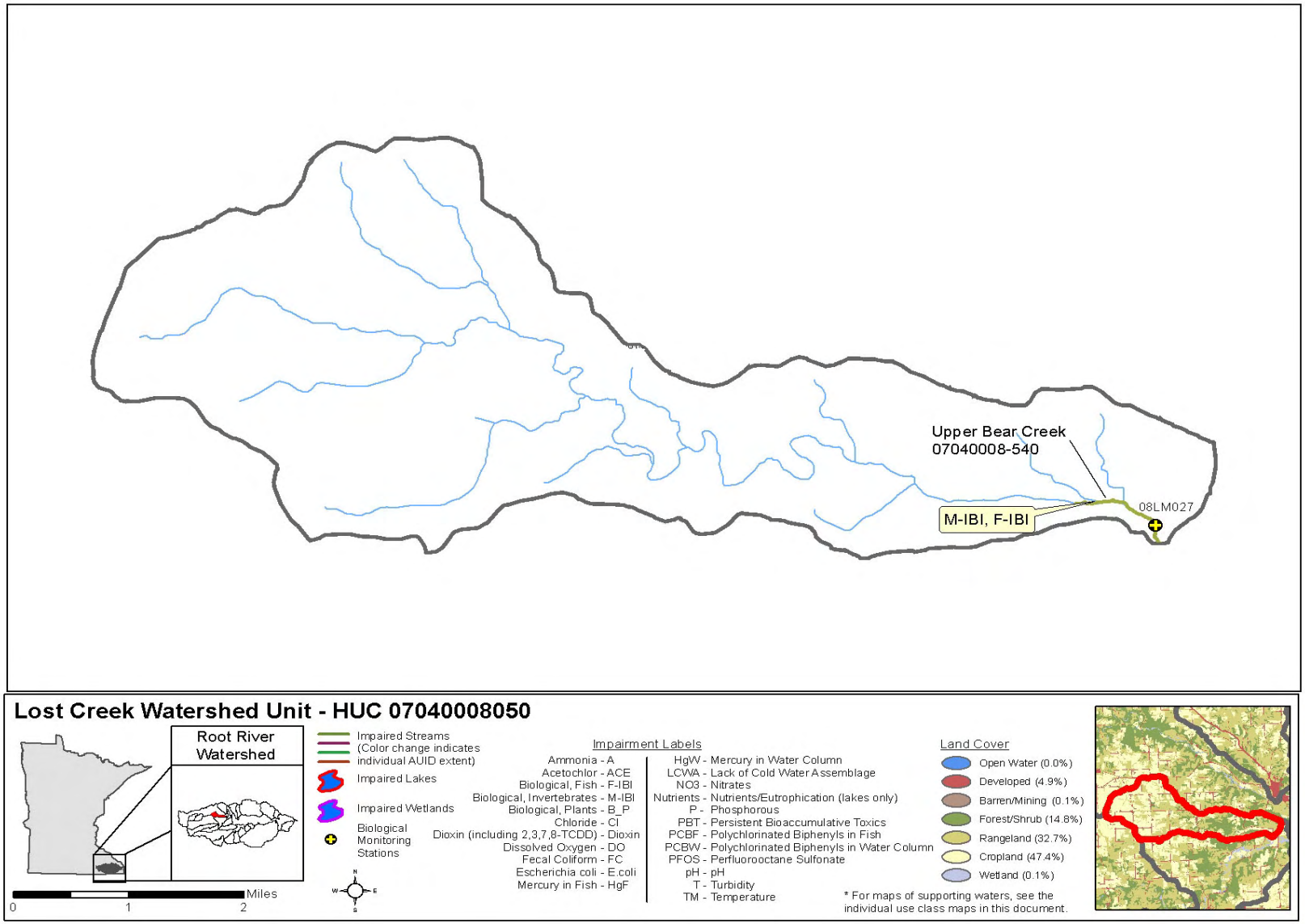
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM027	Upper Bear Creek	1	2.5	9	18.9	12	23	65.4	Fair
Average Habitat Results: *Lost Creek 11-HUC Watershed*			2.5	9	18.9	12	23	65.4	

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)

Lost Creek Watershed Unit summary

The Lost Creek watershed showed impairments for both fish and invertebrates. The habitat evaluation performed on Upper Bear Creek showed a "fair" rating.

Figure 31: Currently listed impaired waters by parameter in the Lost Creek Watershed Unit



Rice Creek Watershed Unit HUC 07040008110

Watershed description

The Rice Creek watershed is located in the central portion of the Root River watershed. The watershed has a drainage area of 24.2 square miles consisting of mainly cropland (44.4 percent) and rangeland (37.1 percent), and is 1 percent of the entire Root River watershed. Rice Creek and its main tributary, Sugar Creek, start in central Fillmore County in the townships of Fillmore and Fountain and flow in a northeasterly direction before joining the Middle Branch Root River approximately 4 miles southeast of the city of Chatfield. Biological station 08LM031 represents the outlet for this watershed.

Stream biological and use assessment results

Table 64: Aquatic life and recreation assessments on assessed AUIDs in the Rice Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-581, *Rice Creek, T104 R11W S23, west line to M Br Root R*	3.23	2A	08LM031	Downstream of 308th St, 5 mi. SE of Chatfield	EXP	EXS	-	-	-	-	MTS	-	-	NS	NA
07040008-G86, *Sugar Creek, T103 R11W S8, west line to Rice Cr*	3.23	2B	08LM083	Upstream of CSAH 8, 1.5 mi. W of Fountain	MTS	MTS	-	-	-	-	-	-	-	FS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Rice Creek Watershed Unit.

Stream habitat

Table 65: Minnesota Stream Habitat Assessment (MSHA) for the Rice Creek 11 HUC

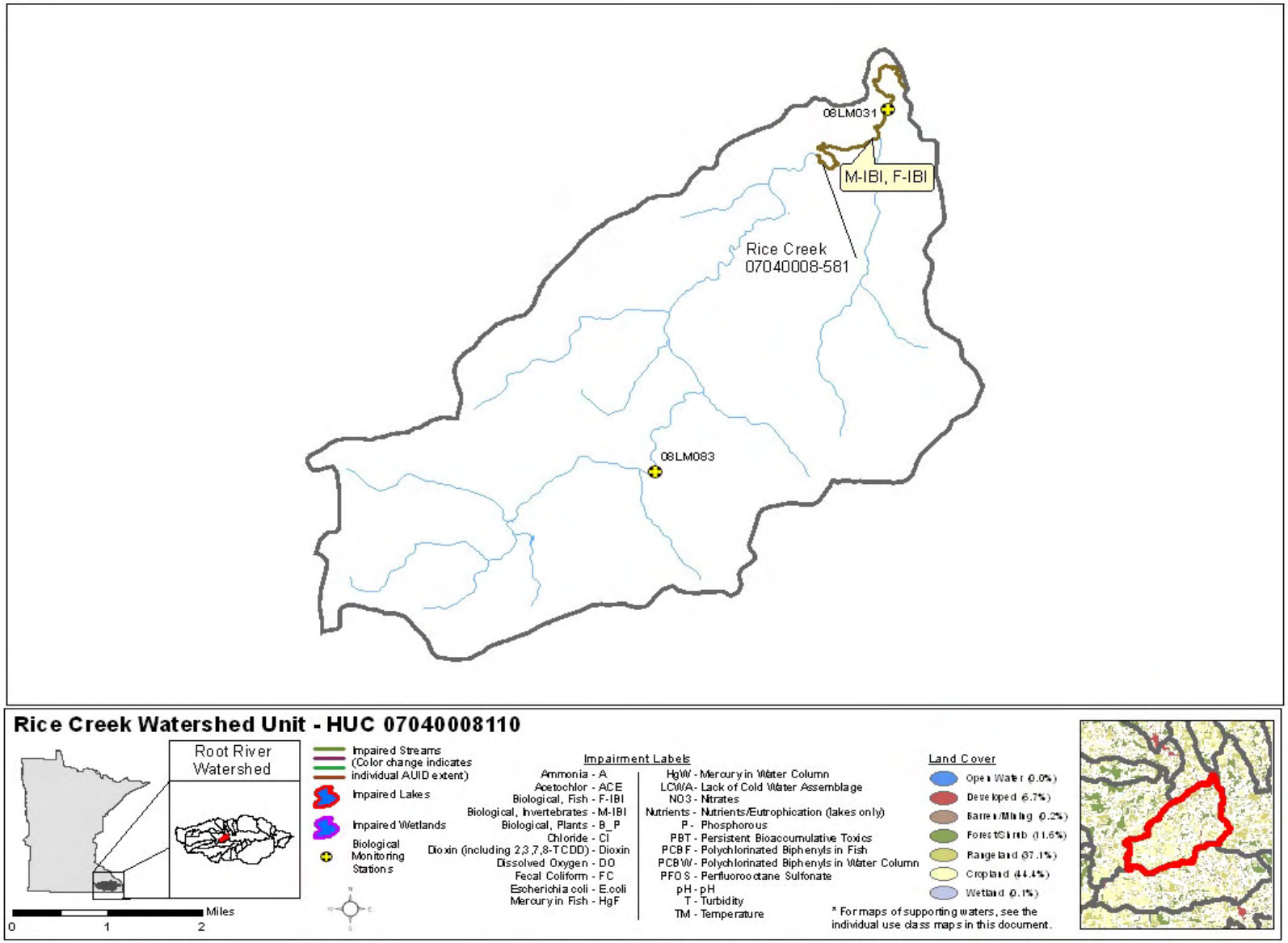
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM031	Rice Creek	1	2	4.5	19.5	11	22	59	Fair
08LM083	Sugar Creek	1	2.5	14	17.8	5	22	61.3	Fair
Average Habitat Results: *Rice Creek 11-HUC Watershed*			2.3	9.3	18.7	8	22	60.2	

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)

Rice Creek Watershed Unit summary

The Rice Creek watershed showed an invertebrate impairment on the most downstream AUID. Fish communities met expectations throughout the watershed. The habitat evaluation performed on both Rice Creek and Sugar Creek showed a "fair" rating. The presence of eroding banks, as well as high nitrate levels during the fish sampling visit, represent potential stressors to the Rice Creek system.

Figure 32: Currently listed impaired waters by parameter in the Rice Creek Watershed Unit



Lynch Creek Watershed Unit HUC 07040008120

Watershed description

The Lynch Creek watershed is located in the north central portion of the Root River watershed. The watershed has a drainage area of 12.6 square miles consisting of mainly rangeland (49 percent) and cropland (37.6 percent), and is 1 percent of the entire Root River watershed. Lynch Creek starts in the southeast corner of Mower County in the township of Chatfield. Lynch Creek flows in a southerly direction before joining the Middle Branch Root River about four miles southeast of the city of Chatfield. Biological station 08LM049 represents the outlet for this watershed. There was no water chemistry information for this watershed.

Stream biological and use assessment results

Table 65: Minnesota Stream Habitat Assessment (MSHA) for the Lynch Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	**Aquatic Life Indicators:**								**Bacteria**	**Aquatic Life**	**Aquatic Rec.**
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-533*, Lynch Creek, T104 R11W S2, north line to M Br Root R*	4.97	2A	08LM049	Upstream of CSAH 40, 3.5 mi. E of Chatfield	NA	NA	-	-	-	-	-	-	-	NA	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Lynch Creek Watershed Unit.

Stream habitat

Table 66: Minnesota Stream Habitat Assessment (MSHA) for the Lynch Creek 11 HUC

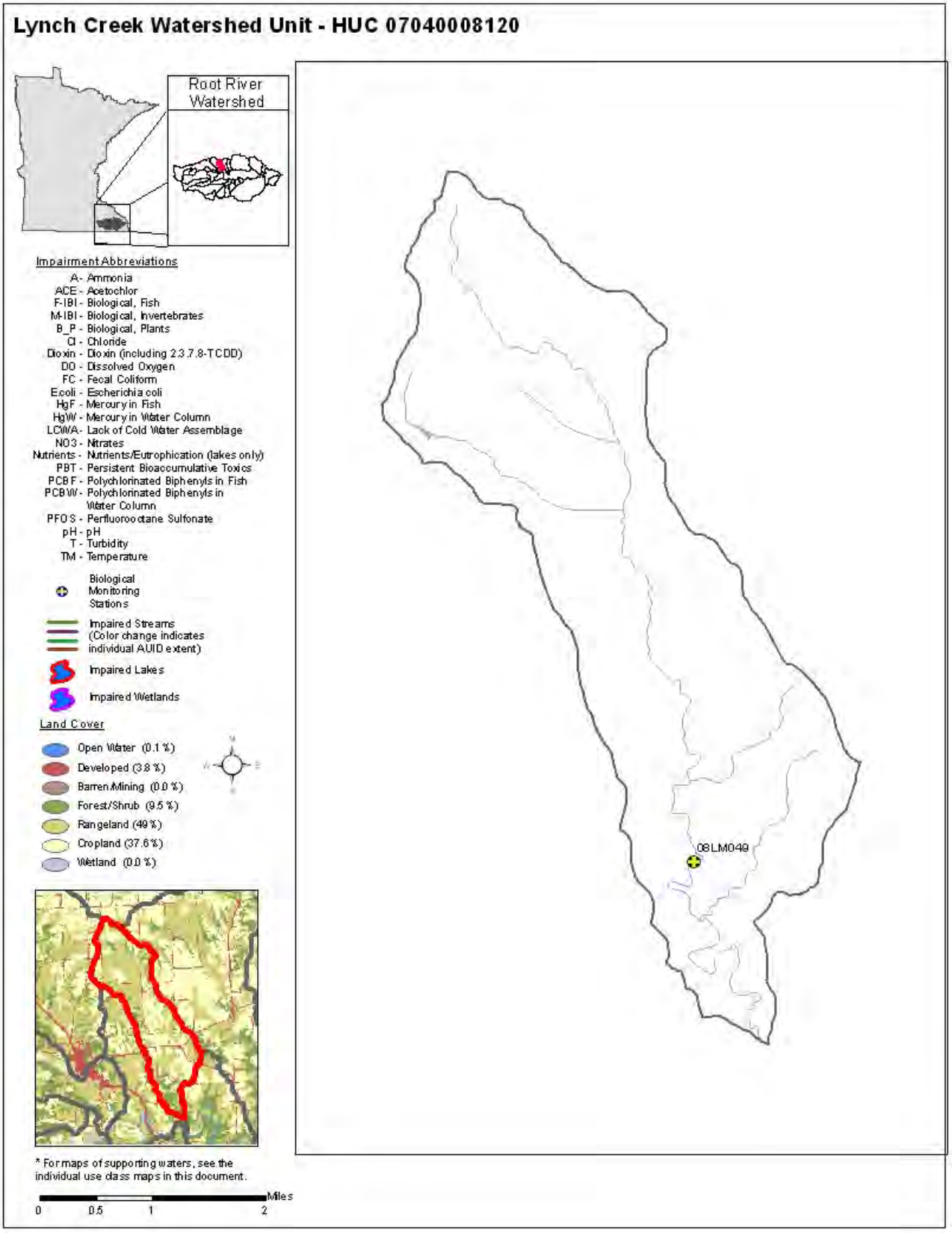
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM049	Lynch Creek	1	0	11.5	11.9	7	19	49.4	Fair
Average Habitat Results: *Lynch Creek 11-HUC Watershed*			0	11.5	11.9	7	19	49.4	

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)

Lynch Creek Watershed Unit summary

One site was sampled for biology in the Lynch Creek watershed. However, the AUID was not assessed because the site location was determined not to be an accurate representation of the watershed condition due to lack of flow. Periods of intermittent flow are common at sampling location. More research needs to be done within the watershed to determine the actual condition. The habitat evaluation performed on Lynch Creek showed a "fair" rating.

Figure 33: Currently listed impaired waters by parameter in the Lynch Creek Watershed Unit



Dyer Valley Watershed Unit

Watershed description

The Dyer Valley watershed is located in the north central portion of the Root River watershed. The watershed has a drainage area of 20.3 square miles. The landscape consists mainly of cropland (56.1 percent), rangeland (29.2 percent) and forests (9.7 percent). Money Creek is the main waterbody within this watershed and it begins in Saratoga Township located in southwest Winona County. Money Creek flows in a southerly direction before joining the Middle Branch Root River approximately 5 miles northwest of the city of Lanesboro. Biological station 08LM051 represents the outlet for this watershed. There were no water chemistry data for this watershed.

Stream biological and use assessment results

Table 67: Aquatic life and recreation assessments on assessed AUIDs in the Dyer Valley 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-F48*, Money Creek, Unnamed cr to M Br Root R*	5.42	2B	08LM051	Upstream of Harrow Rd, 5 mi. NW of Lanesboro	MTS	EXP	-	-	-	-	-	-	-	NS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Dyer Valley Watershed Unit.

Stream habitat

Table 68: Minnesota Stream Habitat Assessment (MSHA) for the Dyer Valley 11 HUC

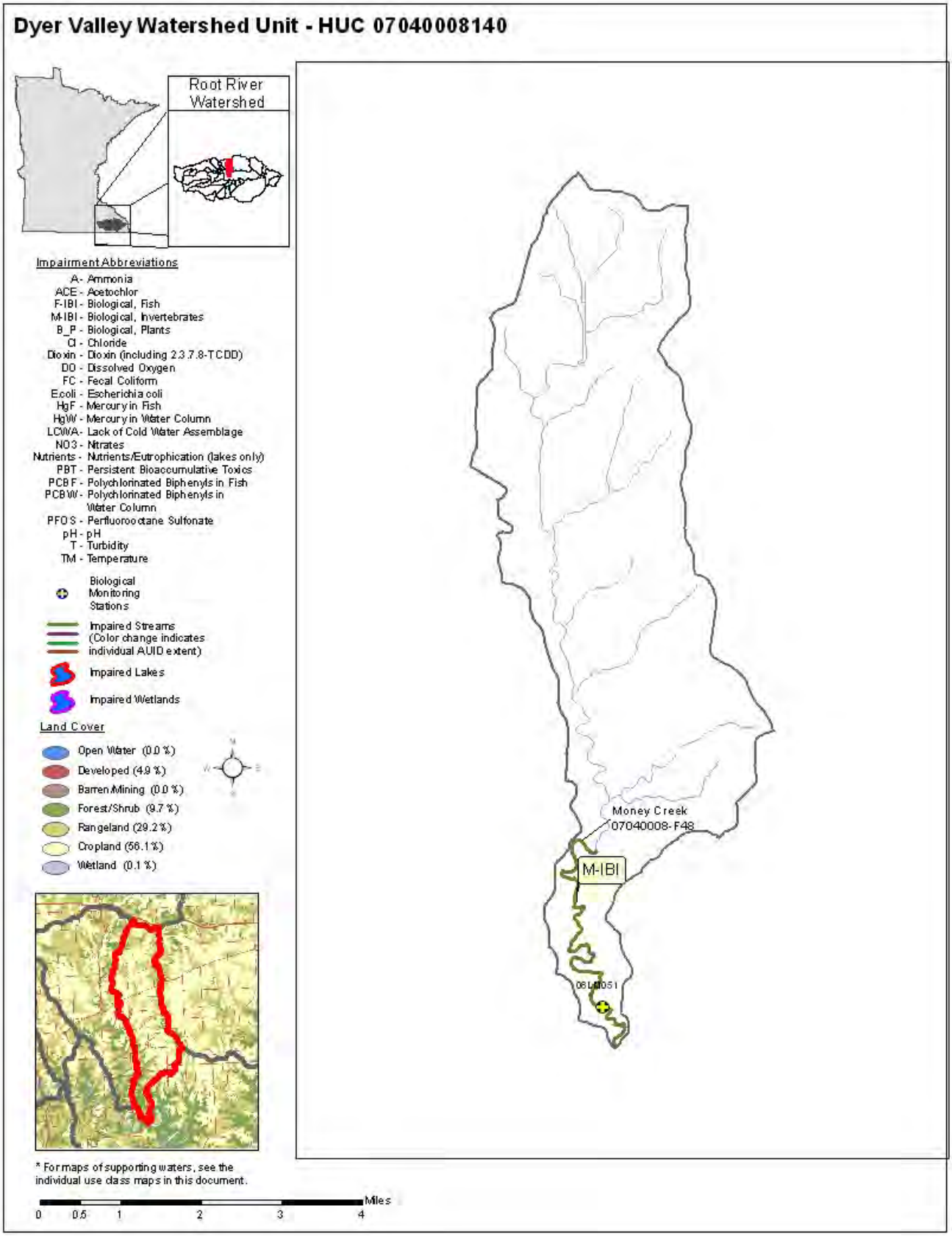
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM051	Money Creek	1	2.5	6.5	19.2	9	25	62.2	Fair
Average Habitat Results: *Dyer Valley 11-HUC Watershed*			2.5	6.5	19.2	9	25	62.2	

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)

Dyer Valley Watershed Unit summary

The Dyer Valley watershed showed an impairment for invertebrates on Money Creek. Fish communities met expectations in the watershed. The habitat evaluation performed on Money Creek showed a "fair" rating.

Figure 34: Currently listed impaired waters by parameter in the Dyer Valley Watershed Unit



Canfield Creek Watershed Unit HUC07040008150

Watershed description

The Canfield Creek watershed is located in the south central portion of the Root River watershed. The watershed has a drainage area of 28.8 square miles consisting of mainly cropland (63.2 percent) and rangeland (20.9 percent), and is 2 percent of the entire Root River watershed. Canfield Creek starts in the in southeastern Fillmore County in the townships of Beaver and York. Canfield Creek flows in a northeasterly direction before joining the South Branch Root River near the small village of Forestville. Biological station 04LM108 represents the outlet for this watershed.

Stream water chemistry assessment results

Water quality data was available on the lower 2 miles of the creek upstream of the South Branch Root River. Elevated nitrates were detected and as a result the reach is impaired for drinking water use. Insufficient data was available to determine recreation or aquatic life use support.

Stream biological and use assessment results

Table 69: Aquatic life and recreation assessments on assessed AUIDs in the Canfield Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-557*, Canfield Creek, T102 R12W S25, west line to S Br Root R*	2.11	2A	04LM108	Just upstream of southern boundary of Forestville Mystery Cave State Park. Two miles south of Forestville.	MTS	MTS	-	IF	-	-	MTS	-	IF	FS	IF

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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Canfield Creek Watershed Unit.

Stream habitat

Table 70: Minnesota Stream Habitat Assessment (MSHA) for the Canfield Creek 11 HUC

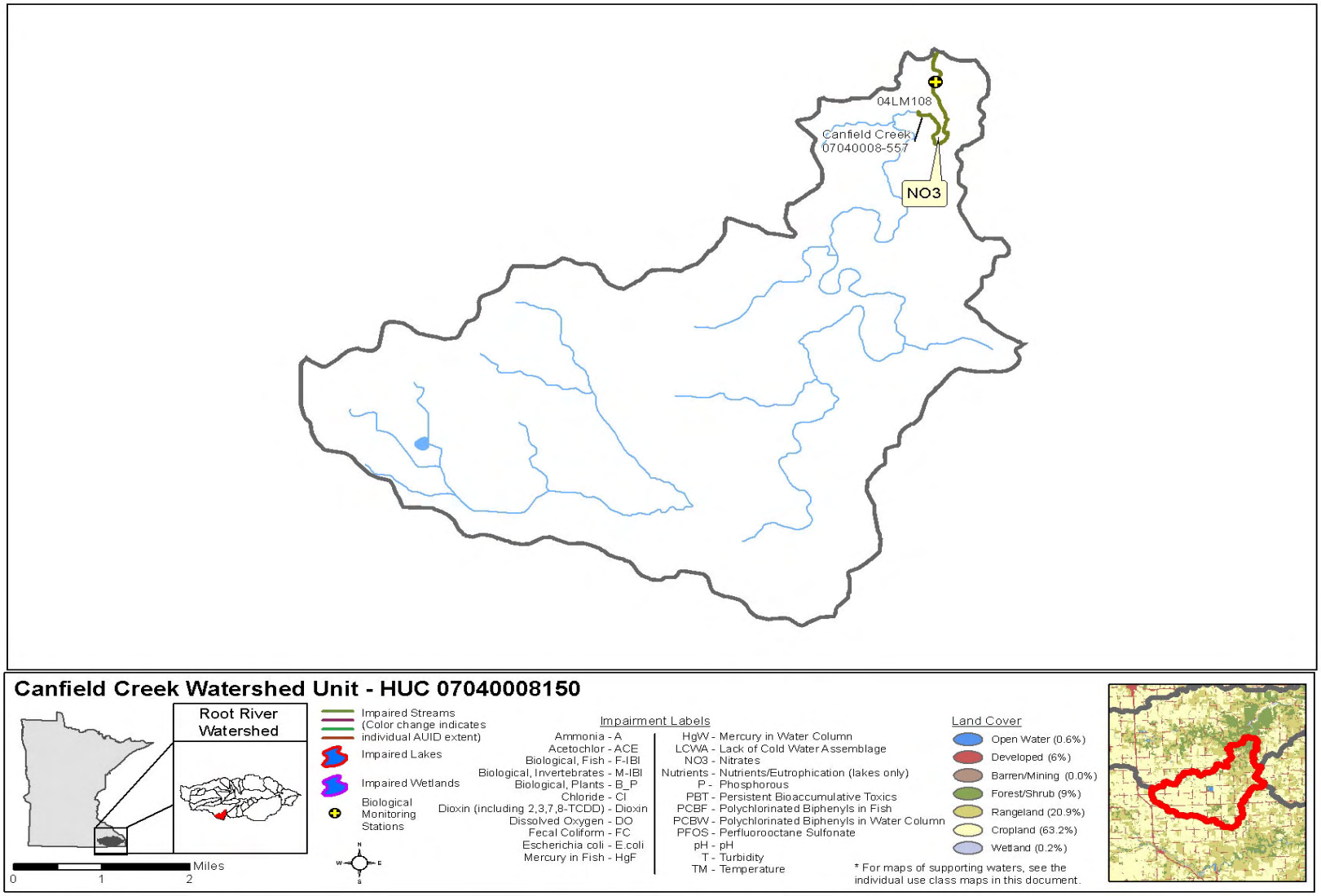
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM108	Canfield Creek	1	5	12.5	21.8	13	34	86.3	Good
Average Habitat Results: *Canfield Creek 11- HUC Watershed*			5	12.5	21.8	13	34	86.3	

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

Canfield Creek Watershed Unit summary

The Canfield Creek watershed has a drinking water impairment due to elevated nitrite/nitrate levels. Both fish and invertebrate communities met expectations in the watershed. The habitat evaluation performed on Canfield Creek showed a “good” rating.

Figure 35: Currently listed impaired waters by parameter in the Canfield Creek Watershed Unit



Gribben Creek Watershed Unit HUC 07040008210

Watershed description

The Gribben Creek watershed is located in the central portion of the Root River watershed. The watershed has a drainage area of 13 square miles. The land use consists of forests (35.9 percent), rangeland (32.6 percent), and cropland (27.4 percent). Gribben Creek starts in east central Fillmore County in the townships of Amherst and Holt. Gribben Creek flows north before entering the Root River near the small village of Whalan. Biological station 08LM044 represents the outlet for this watershed. There was no water chemistry information for this watershed.

Stream biological and use assessment results

Table 71: Aquatic life and recreation assessments on assessed AUIDs in the Gribben Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:									Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria		
07040008-589, *Gribben Creek, Unnamed cr to Unnamed cr*	1.77	2A	04LM114 08LM044	Along CR 23, 3 miles E. of Lanesboro Upstream of CSAH 23, 1.5 mi. SE of Whalan	MTS	MTS	-	IF	-	-	-	-	-	FS	NA
07040008-591, *Gribben Creek, Unnamed cr to Root R*	0.99	2A	-	-	-	-	-	-	-	-	MTS	-	-	IF	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Gribben Creek Watershed Unit.

Stream habitat

Table 72: Minnesota Stream Habitat Assessment (MSHA) for the Gribben Creek 11 HUC

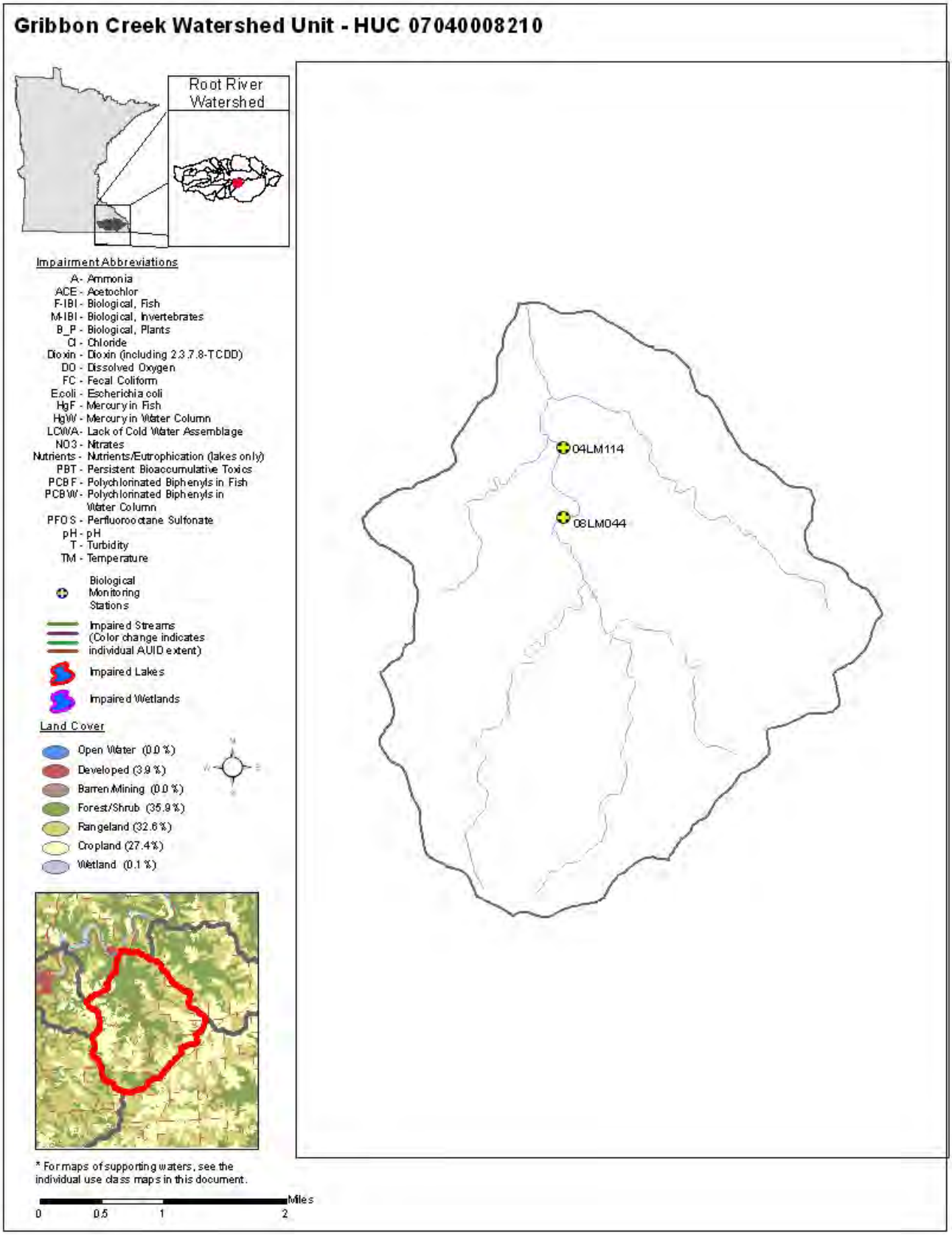
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM114	Gribben Creek	1	5	11.5	22	11	29	78.5	Good
08LM044	Gribben Creek	2	5	13.8	19.8	15.5	32	86.1	Good
Average Habitat Results: *Gribben Creek 11- HUC Watershed*			5	12.6	20.9	13.3	30.5	82.3	

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

Gribben Creek Watershed Unit summary

The Gribben Creek watershed met biological expectations throughout the watershed. The habitat evaluations performed on Gribben Creek both showed a “good” rating.

Figure 36: Currently listed impaired waters by parameter in the Gribben Creek Watershed Unit



Diamond Creek Watershed Unit HUC 07040008220

Watershed description

The Diamond Creek watershed is located in the central portion of the Root River watershed. The watershed has a drainage area of 10.8 square miles. Land use consists mainly of rangeland (36.1 percent), cropland (32.4 percent), and forest/shrubland (28.9 percent). Diamond Creek starts in east central Fillmore County in the townships of Norway and Holt. Diamond Creek flows in a northwesterly direction before entering the Root River approximately two miles northeast of the small village of Whalan. Biological station 08LM052 represents the outlet for this watershed. There were no water chemistry results for this watershed.

Stream biological and use assessment results

Table 73: Aquatic life and recreation assessments on assessed AUIDs in the Diamond Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-620, *Diamond Creek, Unnamed cr to T103 R9W S10, north line*	3.52	2A	04LM115 08LM052	1 mile upstream of CR 107 crossing, 4.5 miles E of Lanesboro Upstream of CR 107, 2 mi. E of Whalan	MTS	MTS	-	-	-	-	-	-	-	FS	NA
07040008-621, *Diamond Creek, T103 R9W S3, south line to Root R*	0.49	2B	-	-	-	-	-	-	-	-	MTS	-	-	NA	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Diamond Creek Watershed Unit.

Stream habitat

Table 74: Minnesota Stream Habitat Assessment (MSHA) for the Diamond Creek 11 HUC

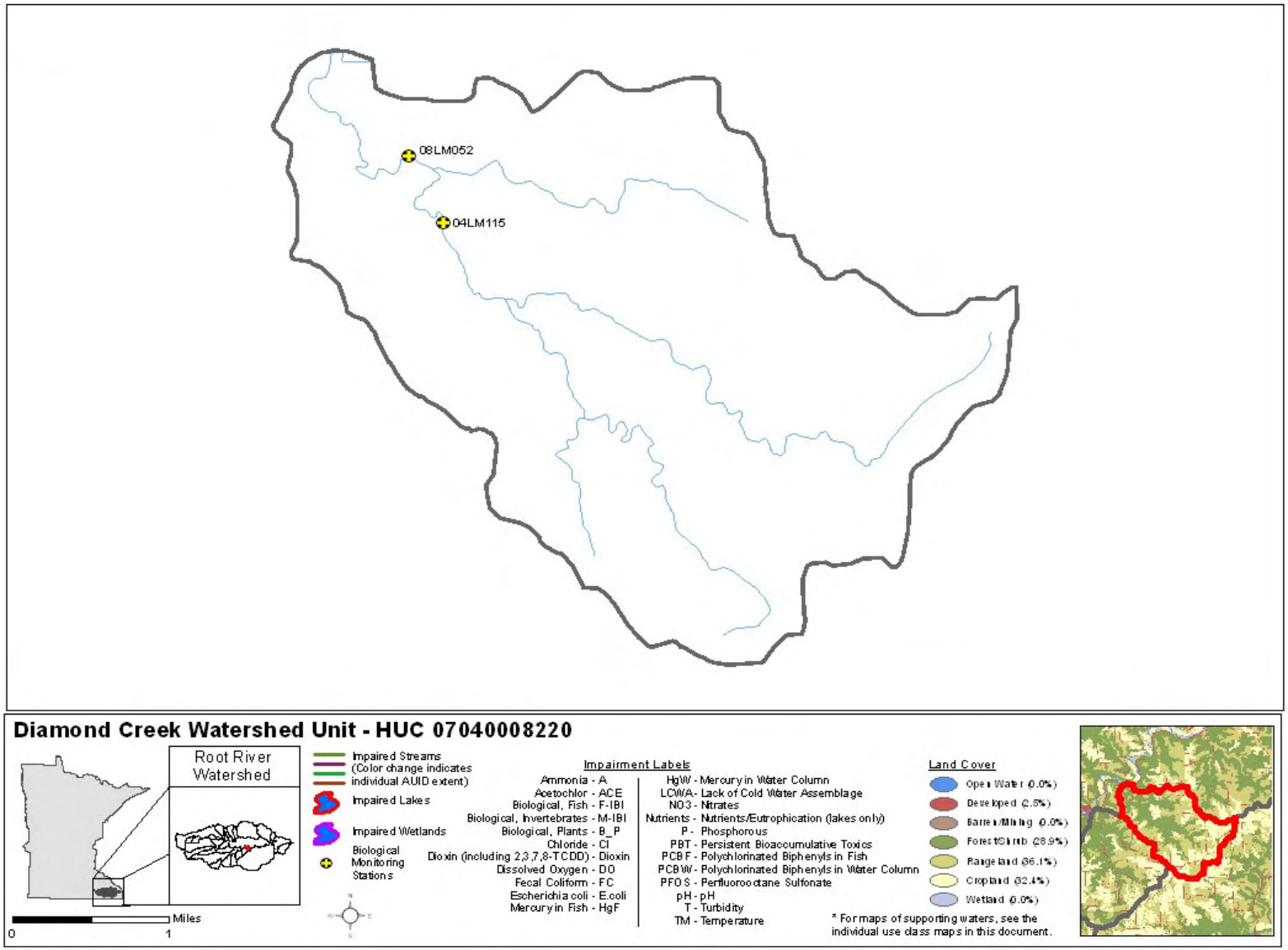
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
04LM115	Diamond Creek	1	5	14	18.3	7	31	75.3	Good
08LM052	Diamond Creek	1	5	13	17.6	12	28	75.6	Good
Average Habitat Results: *Diamond Creek 11- HUC Watershed*			5	13.5	17.9	9.5	29.5	75.4	

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)

Diamond Creek Watershed Unit summary

The Diamond Creek watershed met biological expectations for both fish and invertebrates. The habitat evaluations performed on Diamond Creek at both sites showed a “good” rating.

Figure 37: Currently listed impaired waters by parameter in the Diamond Creek Watershed Unit



Loony Creek Watershed Unit HUC 07040008260

Watershed description

The Loony Creek watershed is located in the northeastern portion of the Root River watershed. The watershed has a drainage area of 16.8 square miles and is 1 percent of the entire Root River watershed. The landscape consists mostly of forests (54.3 percent) and rangeland (35.1 percent). Silver Creek and its main tributary, Loony Creek, start in southeast Winona County in the township of Pleasant Hill. Silver Creek flows in a southerly direction before entering the Root River four miles east of the city of Houston. Biological station 08LM060 represents the outlet for this watershed. There were no water chemistry data for this watershed.

Stream biological and use assessment results

Table 75: Aquatic life and recreation assessments on assessed AUIDs in the Loony Creek 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-640, *Silver Creek, T105 R6W S35, north line to T104 R6W S14, south line*	5.12	2A	08LM060	Upstream of CSAH 9, 4.5 mi. NE of Houston	EXP	EXS	-	-	-	-	-	-	-	NS	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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Loony Creek Watershed Unit.

Stream habitat

Table 76: Minnesota Stream Habitat Assessment (MSHA) for the Loony Creek 11 HUC

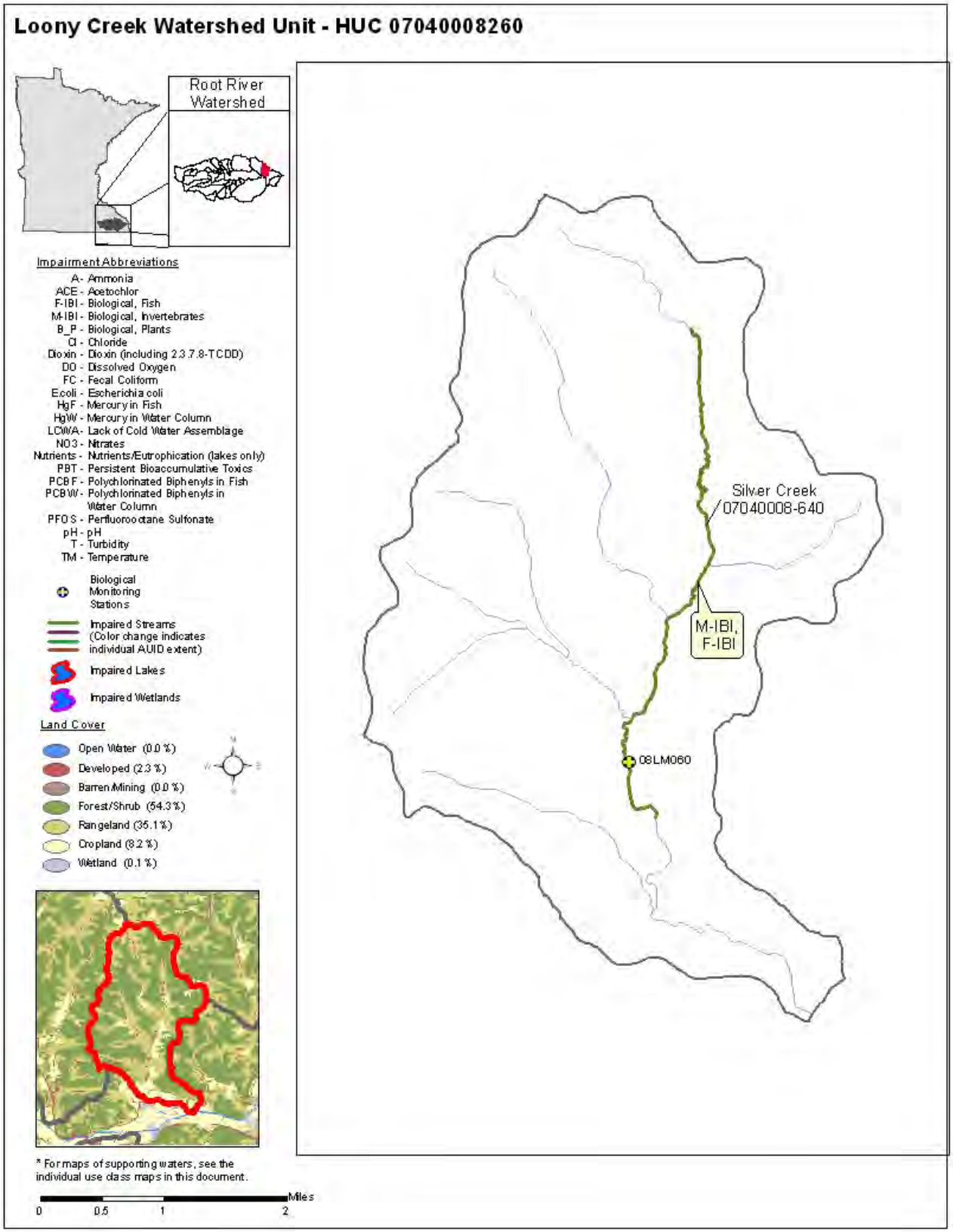
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM060	Silver Creek	1	0	2	17	6	8	33	Poor
Average Habitat Results: *Loony Creek 11-HUC Watershed*			0	2	17	6	8	33	

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)

Loony Creek Watershed Unit summary

Silver Creek in the Loony Creek watershed showed impairments of both fish and invertebrate communities. The monitored section on Silver Creek appears to have been impacted by the significant flood event that took place in August of 2007. The habitat evaluations performed on Silver Creek showed a "poor" rating primarily due to the lack of fish habitat, minimal riparian buffer, heavily pastured land use and poor bank stability.

Figure 38: Currently listed impaired waters by parameter in the Loony Creek Watershed Unit



Chatfield Watershed Unit HUC 07040008060

Watershed description

The Chatfield Watershed Unit is a flow through system located in the north central part of the Root River watershed. The watershed has a drainage area of 9.6 square miles and comprises 1 percent of the entire Root River watershed. The landscape consists mostly of rangeland (48.6 percent), cropland (28.4 percent), and forests (15.1 percent). The Root River extends just over 6 miles within the watershed and is the main water body flowing through the system. This area is located approximately 2.5 miles southeast of the city of Chatfield. This watershed is represented by two sites, 04LM006 and 08LM050. There were no water chemistry data for this watershed.

Stream biological and use assessment results

Table 77: Aquatic life and recreation assessments on assessed AUIDs in the Chatfield 11 HUC

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:								Bacteria	Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides			
07040008-534, *Root River, Middle Branch, N Br Root R to Lynch Cr*	6.09	2B	08LM050 04LM006	Upstream of Hwy 52, 3 mi. SE of Chatfield Upstream of Hwy 52, 1 mi. SE of Chatfield	MTS	EXP	-	-	-	-	-	-	EX	NS	NS

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: = previous impairment listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Biological sampling of channelized stream reaches

There were no channelized biological stations in the Chatfield Watershed Unit.

Stream habitat

Table 78: Minnesota Stream Habitat Assessment (MSHA) for the Chatfield 11 HUC

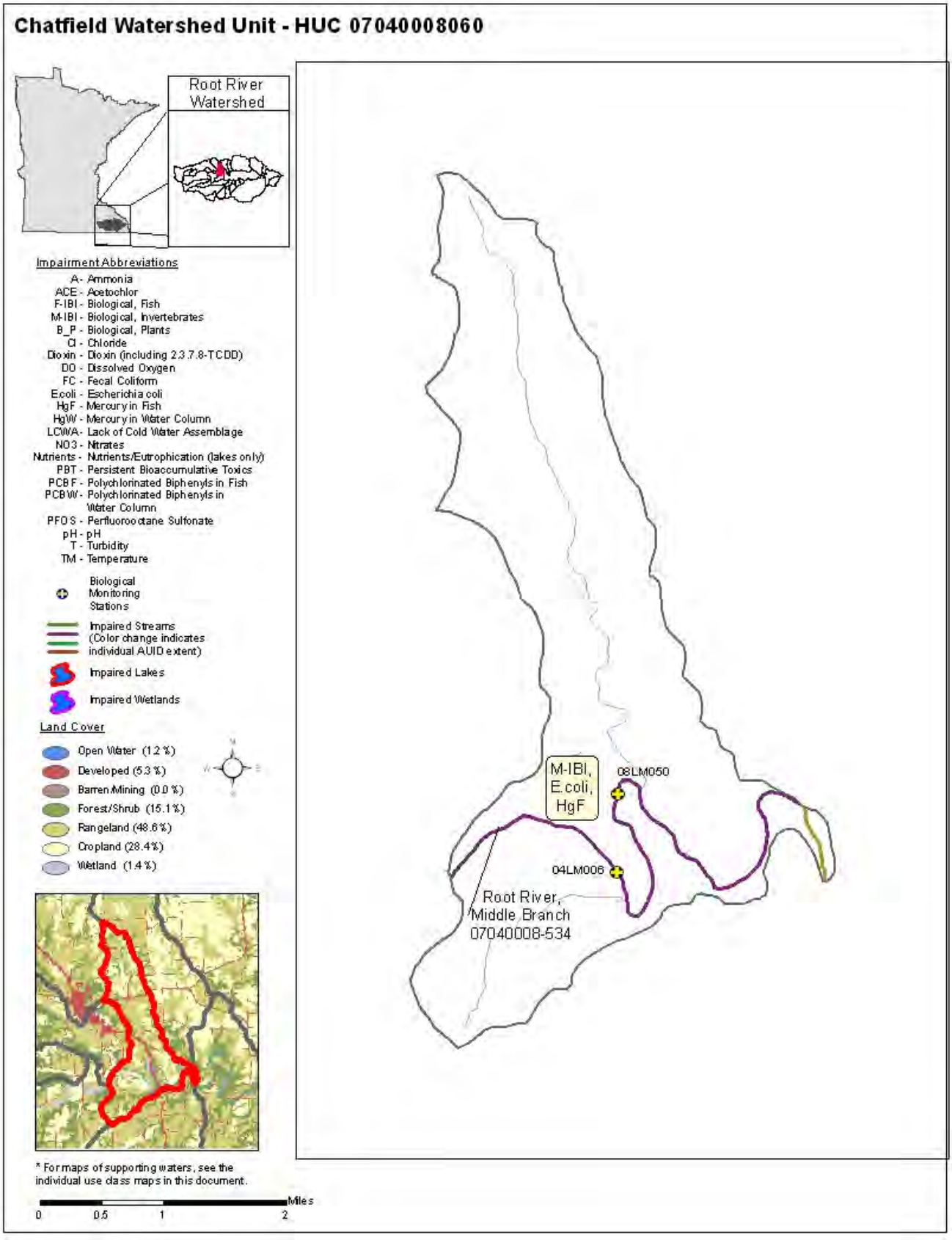
Site ID	Stream Name	Visits	Landuse (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph (0-36)	MSHA Score (0-100)	MSHA RATING
08LM050	Root River	1	1	9.5	20	12	24	66.5	Good
04LM006	Root River	1	0	6	20.6	7	17	50.6	Fair
Average Habitat Results: *Chatfield 11-HUC Watershed*			0.5	7.75	20.3	9.5	20.5	58.55	

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)

Chatfield Watershed Unit summary

The Root River in the Chatfield Watershed Unit showed a new impairment for invertebrates to go along with the existing impairment for E. coli. Fish community data met their expectations in this watershed. In-stream habitat at these sampling locations had one “good” and one “fair” rating.

Figure 39: Currently listed impaired waters by parameter in the Chatfield Watershed Unit



VII. Watershed-Wide Results and Discussion

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

Pollutant load monitoring

Annual FWMCs were calculated and compared for years 2009-2010 (Fig. 12-15) and compared to the RNR standards (only TP and TSS draft standards are available for the Central RNR). It should be noted that while a FWMC exceeding a given water quality standard is generally an indicator, the water body is out of compliance with the RNR standard, the rule does not always hold true. Waters of the state are listed as impaired based on the percentage of individual samples exceeding the numeric standard, generally 10 percent and greater (MPCA 2010a), over the most recent 10 year period and not based on comparisons with FWMCs. A river with a FWMC above a water quality standard, for example, would not be listed as impaired if less than 10 percent of the individual samples collected over the assessment period were above the standard.

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

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

Figure 40: Hydrograph, sampling regime and annual runoff for the Root River near Mound Prairie 2009-2010

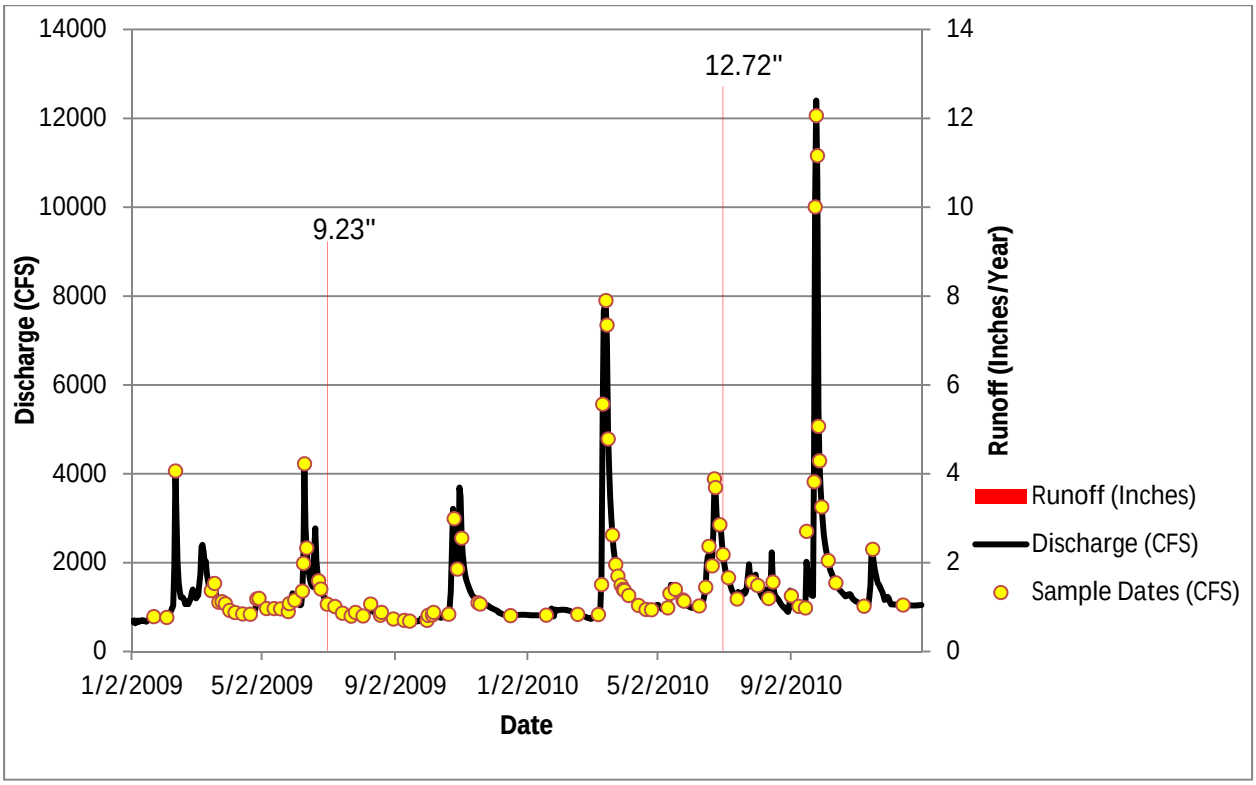


Figure 41: TSS flow weighted mean concentrations in the Root River

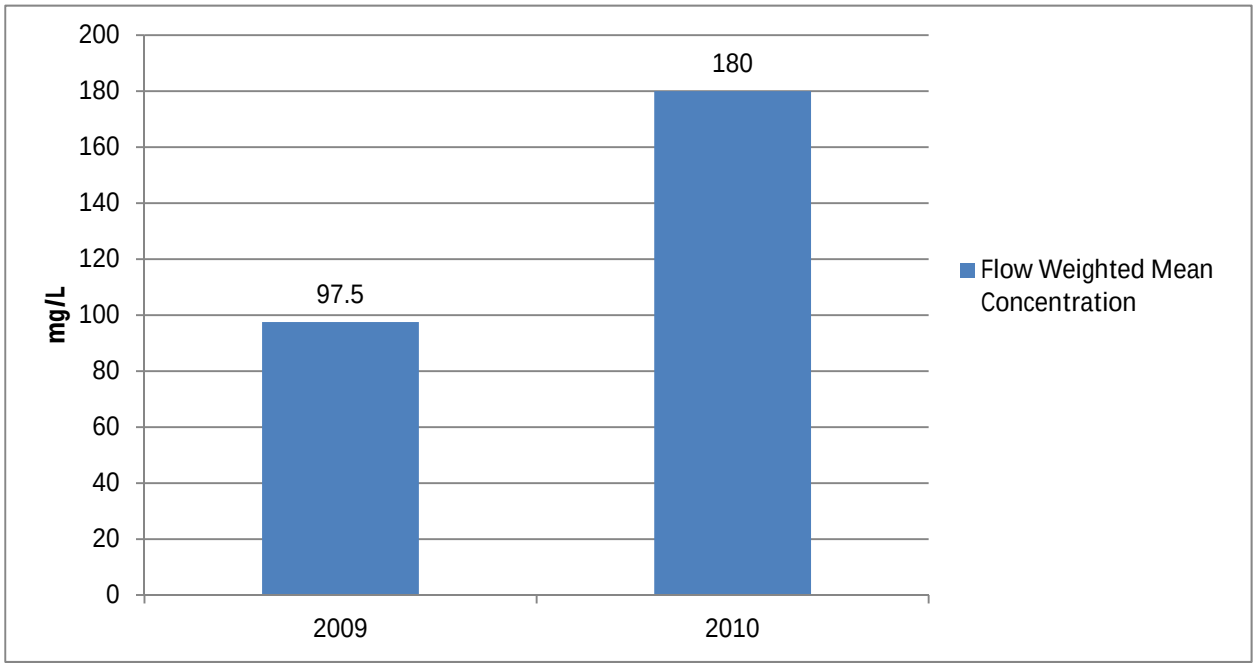


Figure 42: TP flow weighted mean concentrations for the Root River.

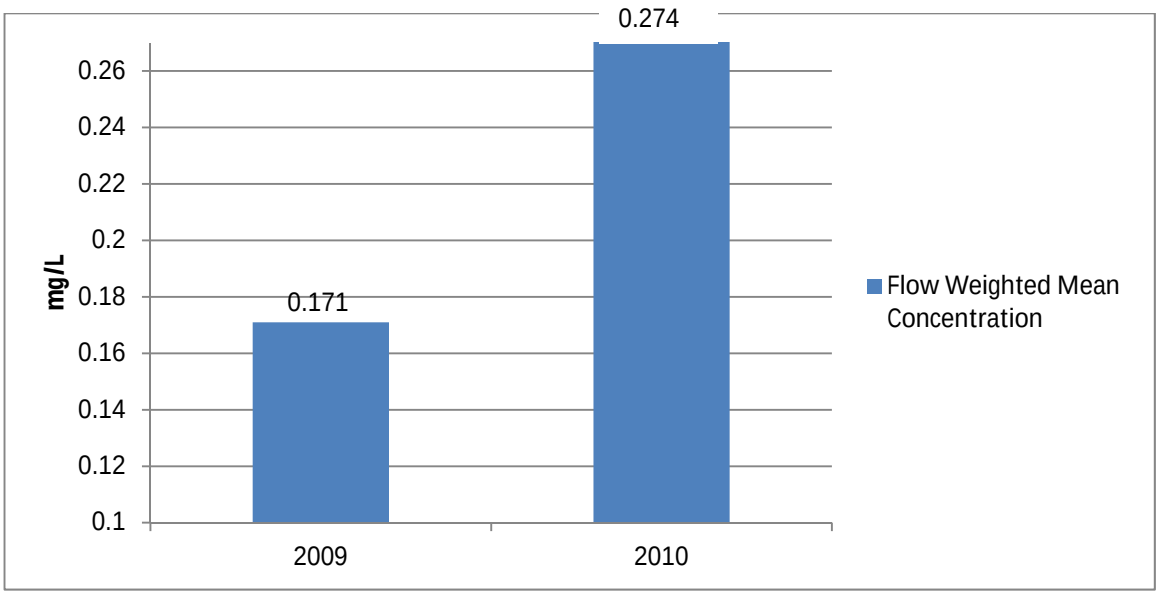


Figure 43: DOP flow weighted mean concentrations for the Root River

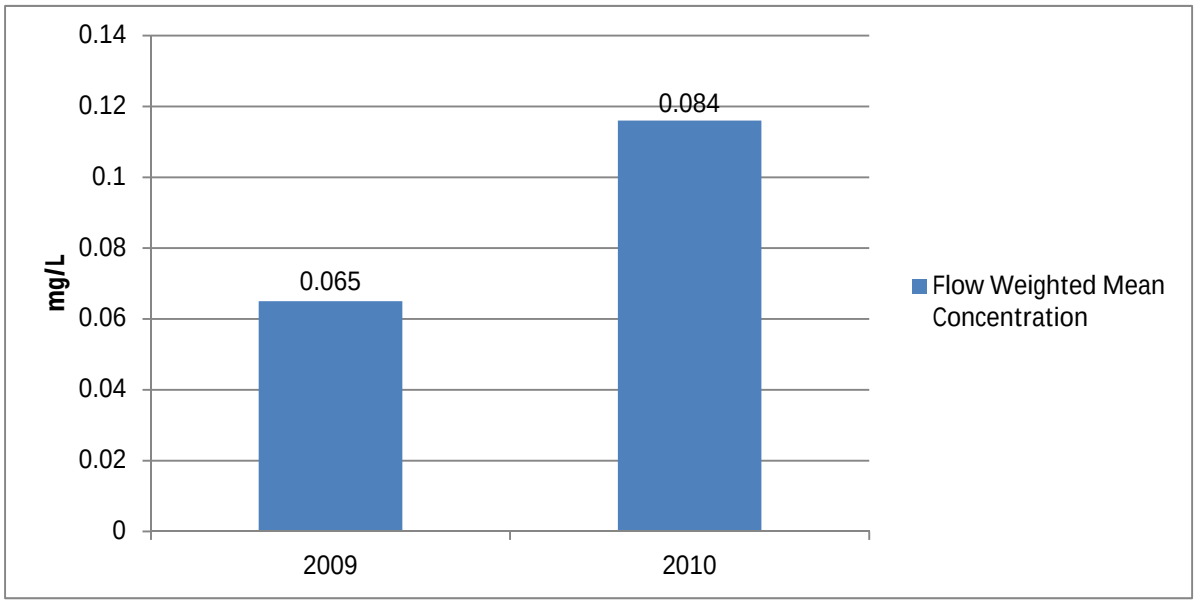


Figure 44: Nitrate-N flow weighted mean concentrations for the Root River

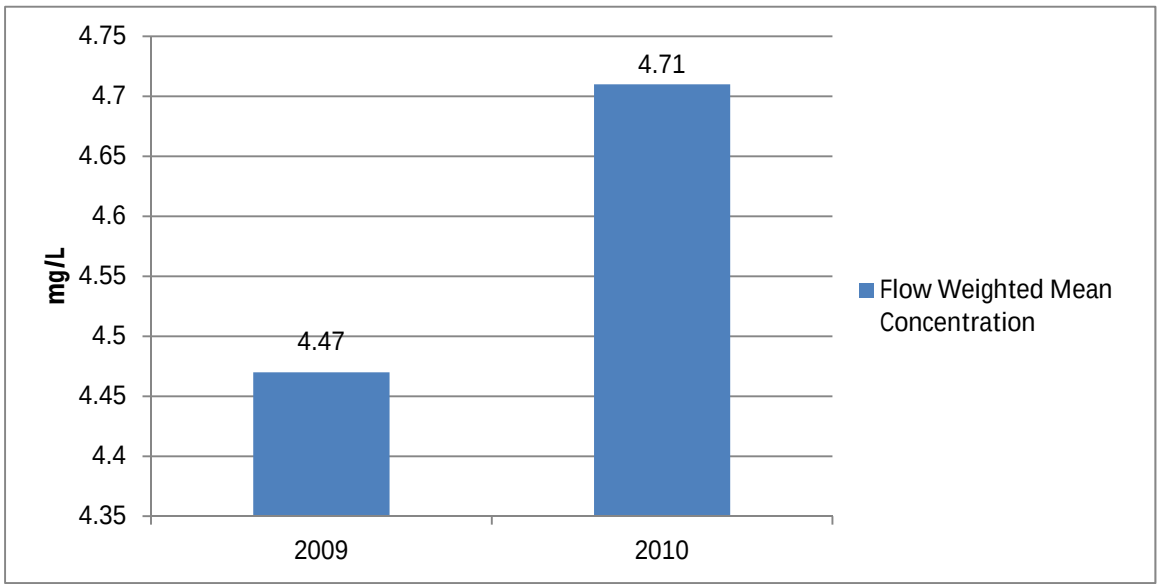


Table 79: Annual pollutant loads by parameter calculated for the Root River

	2009	2010
Parameter	**Mass (kg)**	**Mass (kg)**
Total Suspended Solids	94165485	238992310
Total Phosphorus	164870	362004
Ortho Phosphorus	63638	154562
Nitrate + Nitrite Nitrogen	4320674	6261684

Total suspended solids

Water clarity refers to the transparency of water. Turbidity is a measure of the lack of transparency or "cloudiness" of water due to the presence of suspended and colloidal materials such as clay, silt, finely divided organic and inorganic matter, and plankton or other microscopic organisms. By definition, turbidity is caused primarily by suspension of particles that are smaller than one micron in diameter in the water column.

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

Currently, the state of Minnesota's TSS standards is moving from the "development phase" into the "approval phase" and must be considered to be draft standards until approval. Within the Central RNR, the TSS draft standard is 30 mg/L (MPCA 2010c); when greater than 10 percent of the individual samples exceed the draft standard, the river is out of compliance. Sample data from 2009 and 2010 show 39 and 54 percent of the individual TSS samples exceeded the 30 mg/L draft standard, respectively. In addition, the computed FWMCs for the three sample years all drastically exceeded the 30 mg/L draft standard (97.5, and 180mg/L, respectively) (Fig. 41). In 2009, the highest sampled TSS concentration (1600 mg/L) was collected during a February thaw event. This event was relatively short in duration (nine days) yet accounted for approximately 24 percent of the annual TSS load. The second highest concentration of 735 mg/L was on the rising limb of a June high intensity rain event. During 2010, the highest measured TSS concentrations coincided with the rising limb of a spring snowmelt runoff event and two high intensity rain events when concentrations reached 930, 2200, and 1100 mg/L respectively. Although the data may not reflect long-term trends, both TSS FWMCs and annual loads showed an increase from 2009 to 2010 (Fig. 41 and Table 79). Because of the strong correlation that often exists between pollutant loads and annual runoff volume, the increase may be due strictly to differences in annual runoff volume (Fig. 40).

Total phosphorus

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

Total phosphorus standards for Minnesota's rivers are also in the final approval phase and must be considered draft standards until approved. Within the Central RNR, the TP draft standard is 100 ug/L as a summer average. Summer average violations of one or more "response" variables (pH, biological oxygen demand (BOD), dissolved oxygen flux, chlorophyll-a) must also occur along with the numeric TP violation for the water to be listed. Concentrations from 2009 and 2010 show that 65 and 59 percent of the individual TP samples exceeded the 100 ug/L draft standard, respectively. Observation of Figure 42 shows that the FWMCs from 2009 and 2010 are considerably higher than the draft standard at 171, and 274 ug/L, respectively. Like TSS, Table 79 shows a consistent increase in annual TP loads in 2009 and 2010.

Dissolved orthophosphate

Dissolved orthophosphate (DOP) is a water soluble form of phosphorus that is readily available to algae (bioavailable) (MPCA and MSUM 2009). While orthophosphates occur naturally in the environment, river and stream concentrations may become elevated with additional inputs from waste water treatment plants, noncompliant septic systems, and fertilizers in urban and agricultural runoff. The 2009 and 2010 FWMC ratio of DOP to TP shows that 38 to 42 percent of TP is in the orthophosphate form. Table 78 indicates an increase in DOP loads, similar to TSS and TP over the two year monitoring period.

Nitrate plus nitrite - nitrogen

Nitrate and nitrite-nitrogen are inorganic forms of nitrogen present within the environment that are formed through the oxidation of ammonia-nitrogen by nitrifying bacteria (nitrification). Ammonia-nitrogen is found in fertilizers, septic systems, and animal waste. Once converted from ammonia-nitrogen to nitrate and nitrite-nitrogen, they too, like phosphorus, can stimulate excessive levels of some algae species in streams (MPCA 2010b). Because nitrate and nitrite-nitrogen are water soluble, transport to surface waters is enhanced through agricultural drainage. The ability of nitrite-nitrogen to be readily converted to nitrate-nitrogen is the basis for the combined laboratory analysis of nitrate plus nitrite-nitrogen, with nitrite-nitrogen typically making up a small proportion of the combined total concentration. These and other forms of nitrogen exist naturally in aquatic environments; however concentrations can vary drastically depending on season, biological activity, and anthropogenic inputs. Environmentally, studies have shown that the elevated nitrate-nitrogen levels in the Minnesota River Basin contribute to hypoxia (low levels of dissolved oxygen) in the Gulf of Mexico. This occurs by nitrate-nitrogen stimulating the growth of algae which, through death and biological decomposition, consume large amounts of dissolved oxygen and thereby threaten aquatic life (MPCA and MSUM 2009).

Nitrate-nitrogen can also be a toxicant to aquatic organisms in Minnesota's surface waters with invertebrates appearing to be the most sensitive to nitrate toxicity. Draft nitrate-nitrogen standards have been proposed (2012) for the protection of aquatic life in lakes and streams. The draft acute value (maximum standard) for all Class 2 surface waters is 41 mg/L nitrate-nitrogen for a 1-day duration, and the draft chronic value for Class 2B (warm water) surface waters is 4.9 mg/L nitrate-nitrogen for a 4-day duration. In addition, a draft chronic value of 3.1 mg/L nitrate- nitrogen (4-day duration) was determined for protection of Class 2A (cold water) surface waters (MPCA, Aquatic Life Water Quality Standards Technical Support Document for Nitrate, Nov 2010).

Nitrate-nitrogen FWMCs in 2009 and 2010 for the Root River Watershed were 4.47, and 4.71 mg/L, respectively (Fig. 44) which is slightly lower than proposed standards. Calculations of the Root River's annual nitrate-nitrogen loads show an increase over the two year sampling period (Table 79), similar to TSS,TP and OP.

Stream water quality

Of the 110 assessed stream AUIDs, 43 were considered to be fully supporting of aquatic life and none for aquatic recreation. One AUID was not assessed due to its classification as a limited resource water. Nine AUIDs were not assessed for aquatic biology because greater than 50 percent of the AUID has been channelized or the biological station fell on a channelized stream reach on the AUID.

Throughout the watersheds 52 AUIDs are non-supporting of aquatic life and/or recreation. Of those AUIDs, 43 are non-supporting of aquatic life and 18 are non-supporting of aquatic recreation. Aquatic biological impairments were scattered across the watershed.

Designated coldwater streams had relatively the same amount of impaired AUIDs as warmwater streams. Only one coldwater stream AUID was impaired only for fish, 12 were impaired for invertebrates only, and six were impaired for both fish and invertebrates. In warmwater stream AUIDs, 20 were impaired for invertebrates, while no AUIDs were found to be impaired for fish.

A large portion of the biological impairments was focused on the larger bodies of water within the watershed. These include the main stem Root River, as well as the South Fork, Middle, and South Branches of the Root River. Often times, turbidity levels were above standards in these larger rivers indicating that this parameter is a major stressor to the fish and especially invertebrate communities.

Aquatic recreation impairments are present at each 11-HUC watershed outlet with enough data to be evaluated. These impairments are due to the elevated levels of E. coli present throughout the entire Root River watershed.

Table 80: Stream AUID assessment results for the Root River watershed

				Supporting			Non-support			
	Area (acres)	# AUIDs Sampled	# Assessed AUIDs	# Aquatic Life	# Aquatic Recreation	#LUW	# Aquatic Life	# Aquatic Recreation	# LUW	Insufficient Data
Root River HUC 8 totals	**1,061,124**	**111**	**88**	**43**	**0**	**0**	**43**	**18**	**1**	**19**
North Branch Root River	104,941	7	6	2	0	0	4	1	0	0
Robinson Creek	11,190	1	1	1	0	0	0	1	0	0
Carey Creek	11,676	1	1	1	0	0	0	0	0	0
Mill Creek	20,652	2	1	0	0	0	0	1	0	0
Lost Creek	12,045	2	1	0	0	0	1	0	0	1
Chatfield	6,225	1	1	0	0	0	1	1	0	0
Deer Creek	37,602	3	2	2	0	0	0	1	0	0
Bear Creek	63,555	4	3	2	0	0	1	1	0	0
Spring Valley Creek	19,234	1	1	0	0	0	1	1	0	0
Middle Branch Root River	21,524	5	3	1	0	0	2	1	0	2
Rice Creek	15,525	2	2	1	0	0	1	0	0	0
Lynch Creek	8,036	1	0	0	0	0	0	0	0	0
Trout Run Creek	20,462	3	2	1	0	0	1	1	0	1

				Supporting			Non-support			
	Area (acres)	# AUIDs Sampled	# Assessed AUIDs	# Aquatic Life	# Aquatic Recreation	#LUW	# Aquatic Life	# Aquatic Recreation	# LUW	Insufficient Data
Dyer Valley	12,981	1	1	0	0	0	1	0	0	0
Canfield Creek	18,398	1	1	1	0	0	0	0	0	1
East Willow Creek	23,078	2	1	0	0	0	1	1	0	1
Camp Creek	16,975	2	2	1	0	0	1	0	0	0
Watson Creek	21,711	1	1	0	0	0	1	1	0	0
Duschee Creek	14,606	1	0	0	0	0	0	0	0	1
South Branch Root River	88,781	12	10	5	0	0	5	2	0	2
Gribben Creek	8,316	2	1	1	0	0	0	0	0	1
Diamond Creek	6,891	2	1	1	0	0	0	0	0	0
Rush-Pine Creek	86,855	7	7	3	0	0	3	1	0	1
Money Creek	48,976	6	3	1	0	0	2	1	0	2
South Fork Root River	184,597	22	19	10	0	1	9	1		1
Loony Creek	10,729	1	1	0	0	0	1	0	0	0
Thompson Valley	23,538	4	4	4	0	0	0	1	0	0
Root River	142,025	14	12	5	0	0	7	1	0	2

Fish contaminants results

All 19 AUIDs of the Root River, including the Middle Branch and the South Fork, are listed as impaired for mercury in fish tissue. Fish were not sampled in all AUIDS but fish are assumed to have access to all AUIDs because there are no fish barriers (dams or reservoirs). A summary of descriptive statistics for mercury and PCBs (Table 81) indicates mercury exceeded the threshold of 0.2 mg/Kg in the 90th percentile of golden redhorse and smallmouth bass. The threshold was also exceeded in common carp but there were only two fish of that species to assess. None of the fish species were impaired for PCBs.

The Minnesota Department of Health has fish consumption advice for the river. Consumption advice can be based on one fish. Advice for the sensitive population (women who are or may become pregnant and children under age 15) is one meal per week for brown trout, carp, redhorse sucker and white sucker, and one meal per month for smallmouth bass.

Table 81: Descriptive statistics of mercury and PCB concentrations by fish species in the Root River

Waterway	AUID	EPA Category	Species	Year	N	Length (in)			Mercury (mg/kg)				PCBs (mg/kg)			
						Mean	Min	Max	Mean	Min	Max	90th Pctl	N	Mean	Min	Max
Root River	07040008 -501, 502, 520, 522, 527	4A*	Brown trout	2004, 2008	24	12.3	8.7	18.3	0.087	0.029	0.194	0.154	5	0.054	<0.010	0.140
			Common carp	1999	2	20.3	19.4	21.2	0.205	0.190	0.220	0.220	2	0.089	0.082	0.096
Root River, Middle Branch	07040008 -545, -B95, -B96, -506, -534, 532, -530, -528		Golden redhorse	2008	5	14.5	12.5	16.5	0.151	0.072	0.264	0.264	2	<0.025	<0.025	<0.025
			Redhorse, unknown sp.	2004	1	14.6	14.6	14.6	0.251	0.251	0.251	NA	1	<0.010	<0.010	<0.010
			Smallmouth bass	2008	6	14.5	12.7	18.2	0.284	0.194	0.446	0.433	2	0.033	<0.025	0.040
Root River, South Fork	07040008 -573, -511, -510, -572, -509, -508		Shorthead redhorse	2008	4	15.7	12.7	17.1	0.151	0.124	0.160	0.160	2	0.085	0.080	0.090
			White sucker	1999	1	14.1			0.140			NA	1	0.016		

NA - not available

*All AUIDs are included in the Minnesota Statewide Mercury TMDL; 4 AUIDs are listed as 5B because other TMDLs are needed

Groundwater monitoring

Monitoring wells from the MDNR Observation Well Network track the elevation of groundwater across the state. Data available at:
http://www.dnr.state.mn.us/waters/groundwater_section/obwell/waterleveldata.html

Water levels are recorded from wells at two locations in the Root River watershed. These hydrographs show water levels recorded in the past 10 to 20 years. Levels in the Prairie du Chien aquifer have remained steady (See Fig. 45) while levels in the much deeper and much older Mt. Simon aquifer appear to have dropped for a period of time then recovered and stabilized (See Fig. 46).

Figure 45: Prairie du Chien water levels

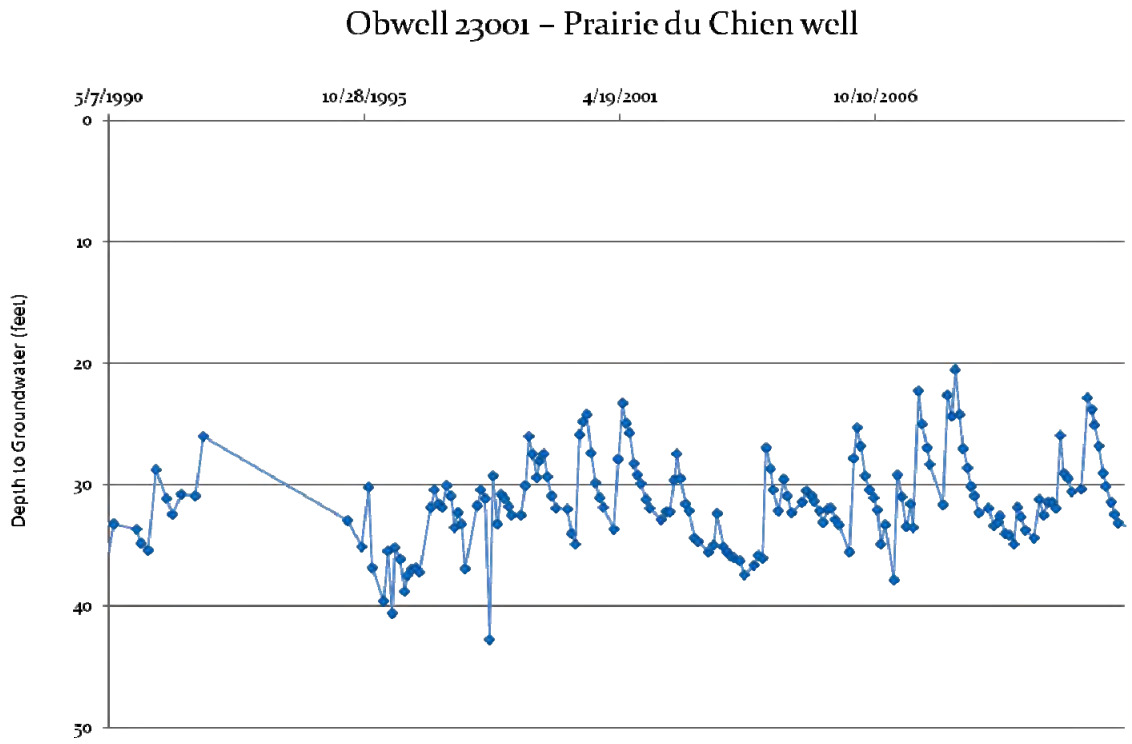
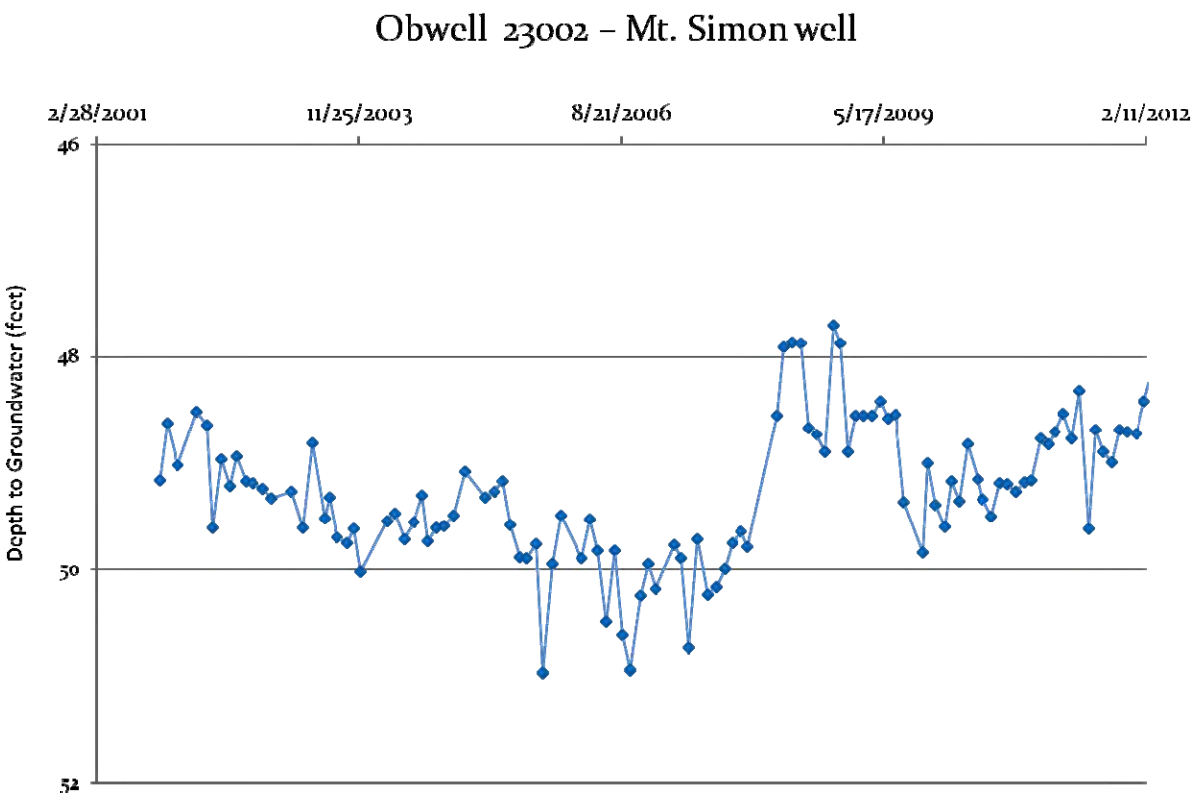


Figure 46 Mt. Simon water levels



Considering all the data analyzed in the groundwater review, it has been determined that there is no trend in regional precipitation. Also, groundwater levels in bedrock aquifers in the region show no significant trend. No trend in groundwater quality was identified, though groundwater in this region is vulnerable due to the unique geology of southeast Minnesota. At this time, the Root River watershed is not a priority for further groundwater investigation. However, the vulnerability of groundwater in the watershed is a reason for a sustained awareness and emphasis on pollution prevention.

Water chemistry trends

Pollutant trends for the Root River

	Total Suspended Solids	Total Phosphorus	Nitrite/Nitrate	Ammonia	Biochemical Oxygen Demand	Chloride
At Br on MN-26, 3 Mi E of Hokah (RT-3) (period of record 1958 - 2008)						
overall trend	**decrease**	**decrease**	**increase**	**decrease**	**decrease**	**increase**
average annual change	-1.3%	-2.4%	3.7%	-1.0%	-4.1%	1.4%
total change	-41%	-70%	355%	-34%	-88%	76%
1995 - 2009 trend	**decrease**	**no trend**	**increase**	**no trend**	**no trend**	little data
average annual change	-8.2%		2.2%			
total change	-61%		39%			
median concentrations first 10 years	120	0.3	1	0.15	3.5	7
median concentrations most recent 10 years	58	0.1	4	<.05	1.1	13

(Analysis was performed using the Seasonal Kendall Test for Trends. Trends shown are significant at the 90 percent confidence level. Percentage changes are statistical estimates based on the available data. Actual changes could be higher or lower. A designation of "no trend" means that a statistically significant trend has not been found; this may simply be the result of insufficient data.)

(Concentrations are median summer (Jun-Aug) values, except for chlorides, which are median year-round values. All concentrations are in mg/L.)

Figure 47: Map of identified impaired waters for the Root River watershed

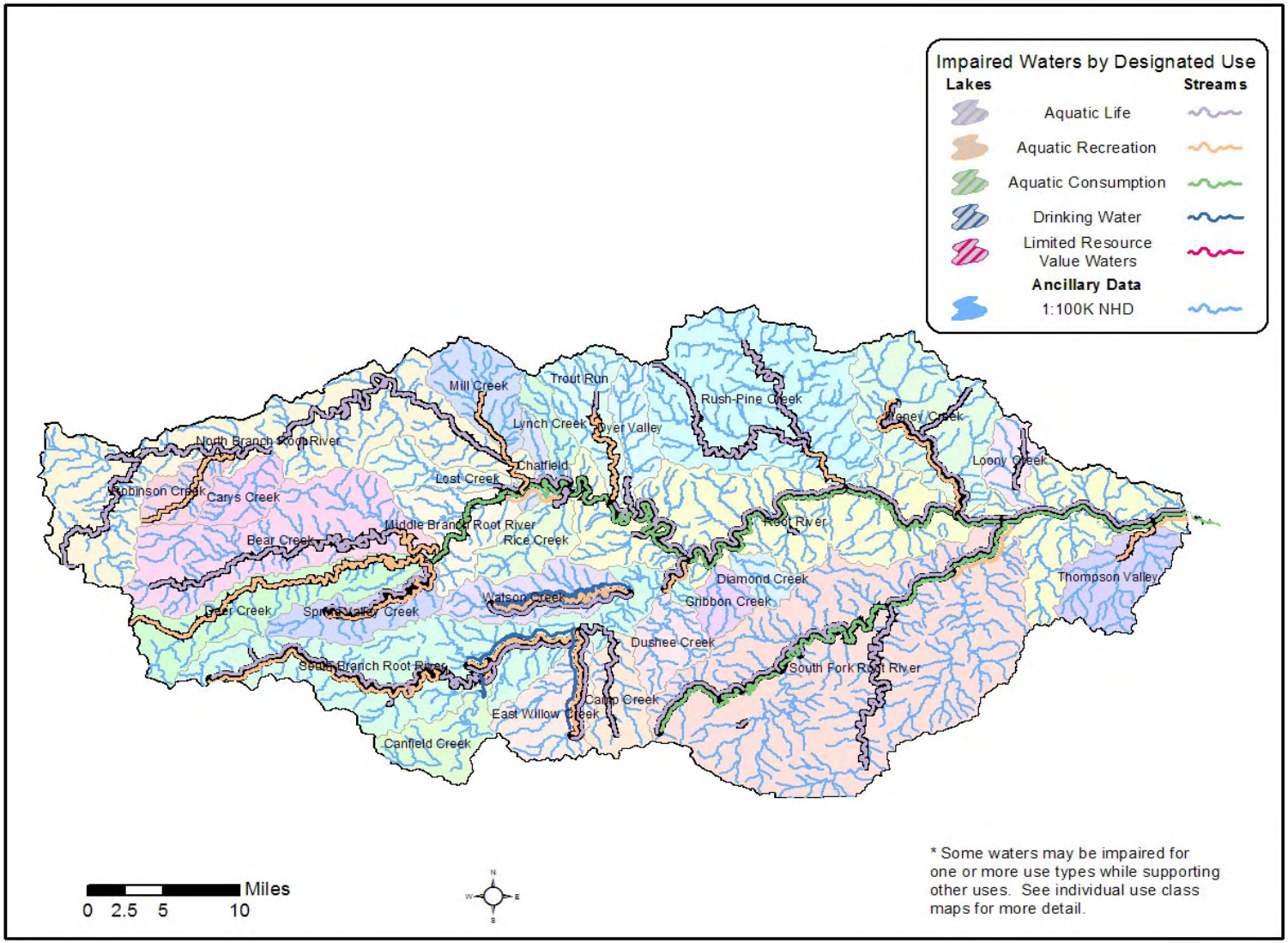


Figure 48: Map of all supporting waters in the Root River watershed

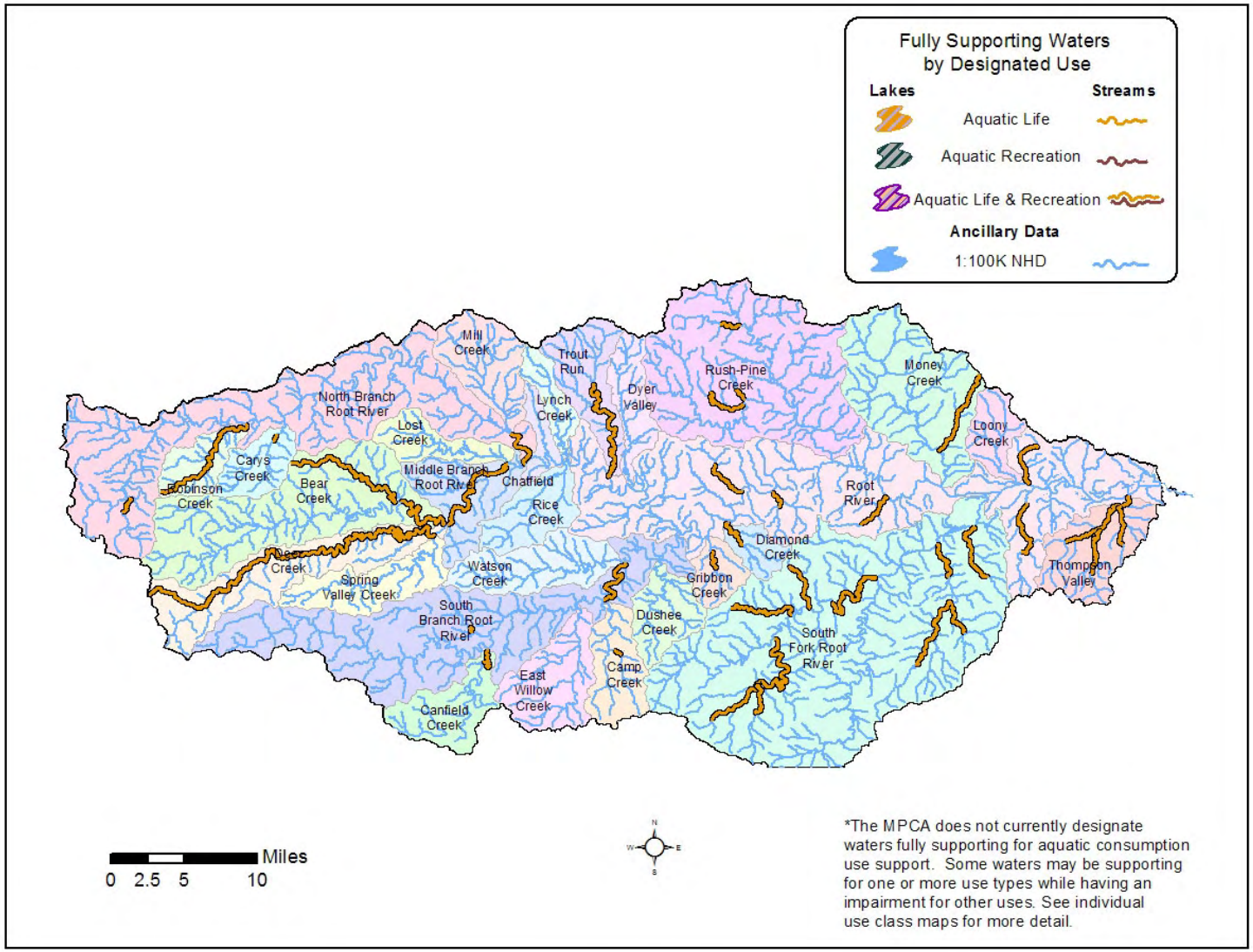


Figure 49: Aquatic consumption support map for the Root River watershed

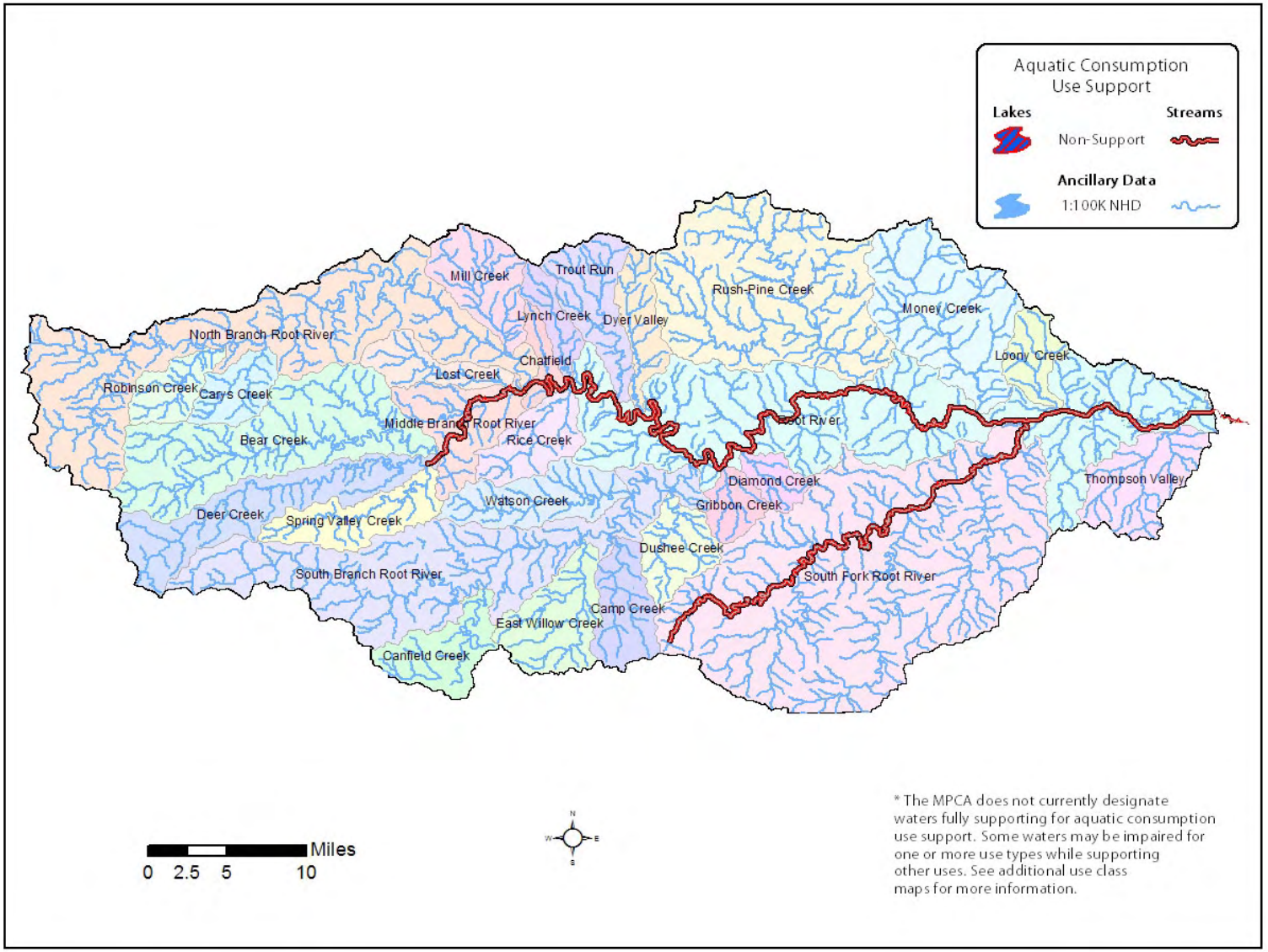


Figure 50: Aquatic life support map for the Root River watershed

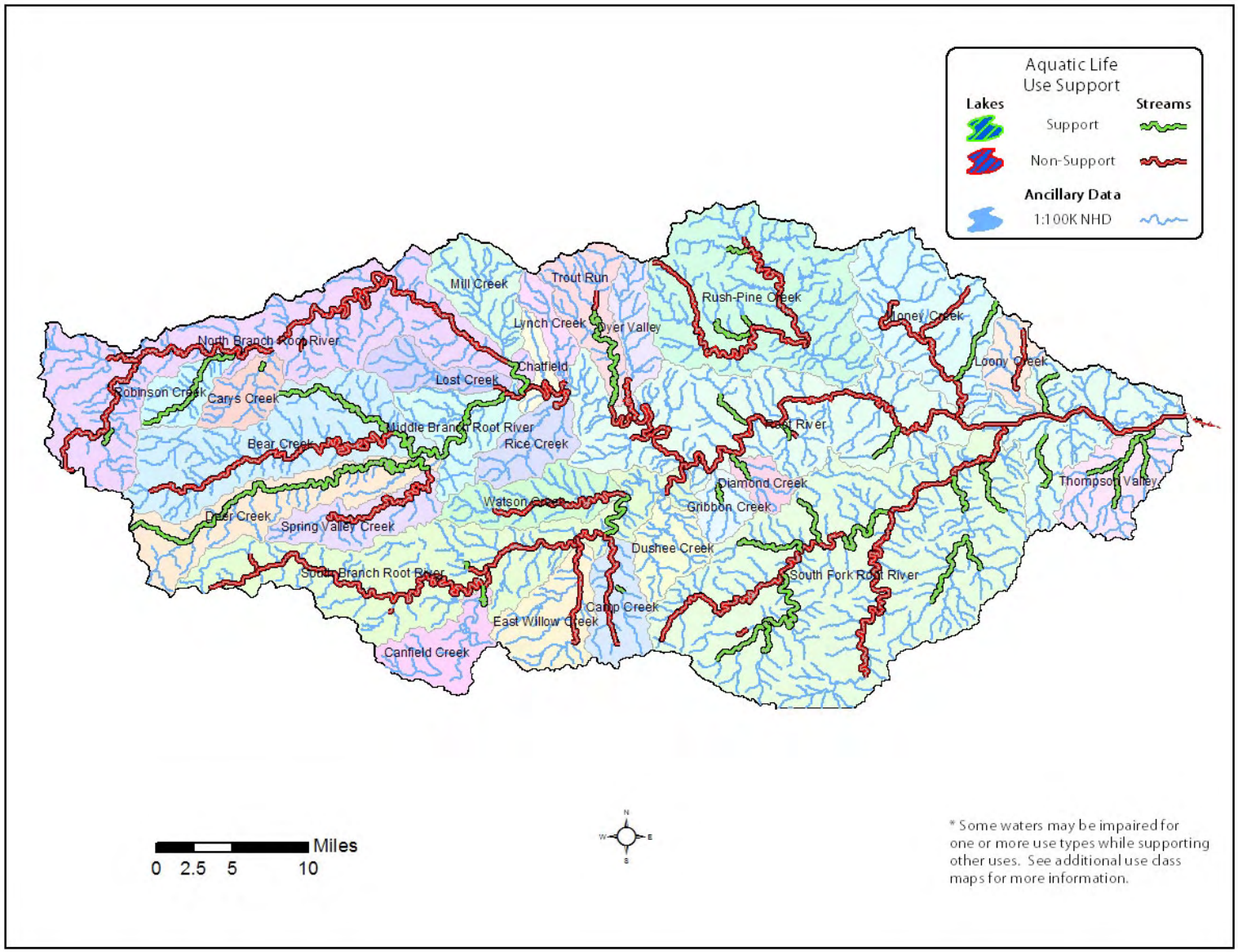
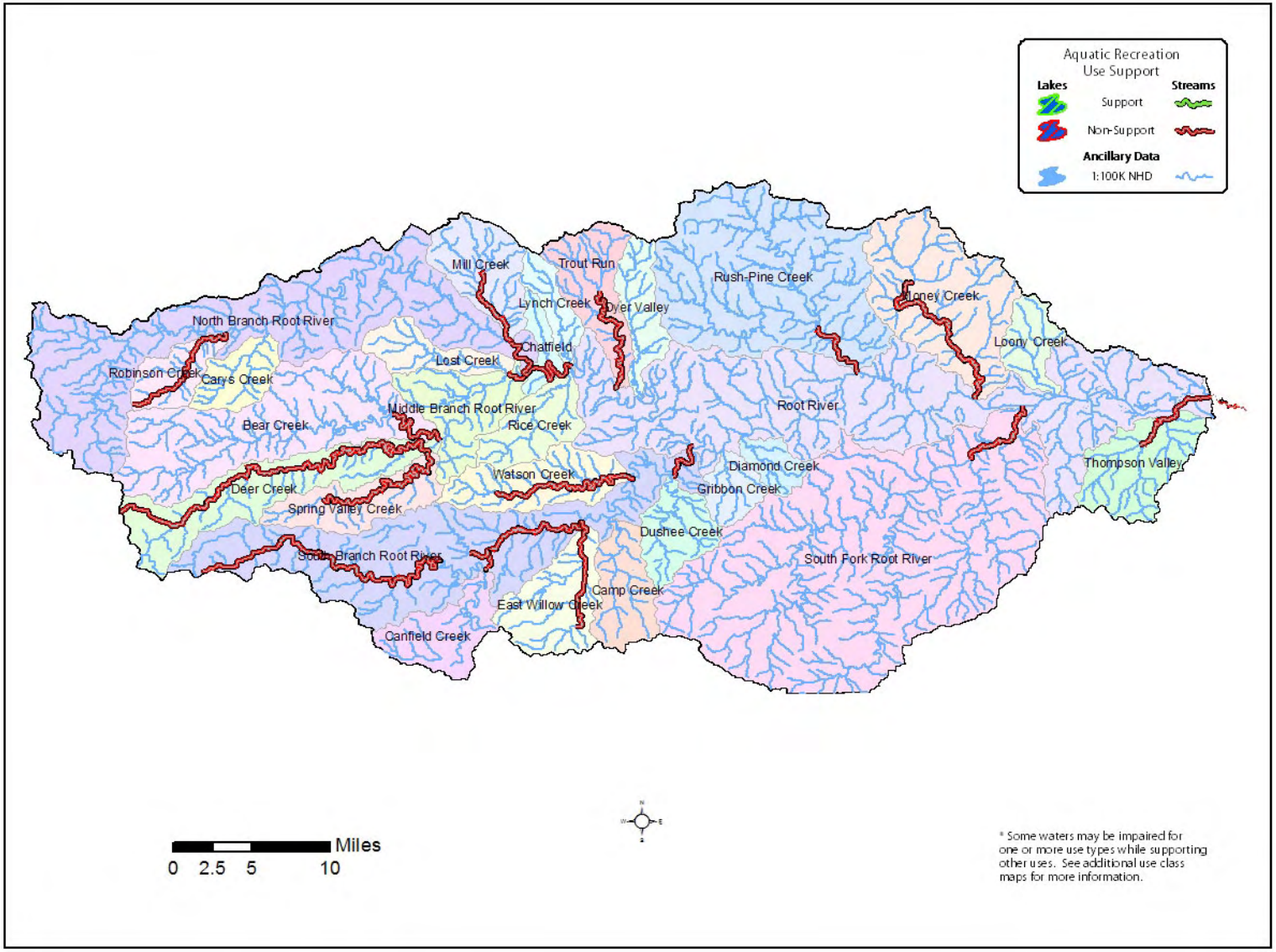


Figure 51: Aquatic recreation use support map for the Root River watershed



Summary and Recommendations

The Root River watershed is a very unique watershed with its abundance of both cold and warm water streams. These different use designations require different chemical and biological standards. Correctly applying these standards to their appropriate water is a challenge in the watershed. In addition, the watershed is unique in that it has no natural lakes, due primarily to the karst topography found in this region of Minnesota.

Approximately 50 percent of the AUIDs were impaired for aquatic life. Impaired AUIDs were generally found in larger watersheds located throughout the watershed with no observable regional patterns. Invertebrate impairments significantly outnumbered fish impairments. Turbidity problems were often noted at impaired sites. Long term water chemistry stations indicate that phosphorus and turbidity levels are decreasing while nitrates are increasing. Habitat evaluations were fair or good with only an occasional poor site indicating that habitat is not generally a problem.

Aquatic recreation impairment from E. coli was prevalent at all AUIDs that were sampled. The Root River watershed is included in a regional bacteria TMDL under implementation. Best management practices (BMPs) may not yet be comprehensive enough to reduce levels below impairment concentrations.

Fish mercury levels exceeded impairment thresholds but at levels below those found in northern Minnesota. Concentrations are likely due to general atmospheric deposition and not likely due to specific point sources.

To help address impairments and improve the water quality in the watershed, efforts must be made to control the affects of non-point sources of pollution. This includes targeting BMPs along feedlots, row crops, and stormwater. The Mississippi River Basin Initiative (MRBI) has taken some initial steps to make improvements within the watershed by targeting watersheds for intensive agricultural BMP installation. These watersheds include Watson Creek, Rush-Pine Creek, the Upper South Fork Root River, and the Lower Root River.

The extensive sampling in the Root River watershed done mainly during 2004 and 2008 has shown that there are many impairments for both aquatic life and aquatic recreation. Extensive flooding has occurred in the watershed during the late summer of 2007 and spring of 2008. These floods have caused widespread damage to the landscape, especially to the stream banks. Fish communities, for the most part, were able to recover more quickly from the extreme hydrologic events than the invertebrate communities. Additional fish monitoring was performed in 2011 in areas lacking enough data to make an accurate assessment. Invertebrate monitoring also took place in these areas as well as on the main stem of the Root River. The results of these latest sampling efforts are still pending.

Continued biological and water chemistry monitoring will help to better understand the landscape and effects of the recent major flooding events, as well as the relationships with the karst topography. Special attention needs to be paid to the impaired and vulnerable areas, but also to the least disturbed areas to protect these valuable resources. Reducing the amount of bacteria throughout the watershed, as well as identifying and stabilizing erodible banks should be immediate priorities in the watershed.

References

McCollor, S., and S. Heiskary. 1993. Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions. Addendum to Fandrei, G., S. Heiskary, and S. McCollor. 1988. Descriptive Characteristics of the Seven Ecoregions in Minnesota. Division of Water Quality, Program Development Section, Minnesota Pollution Control Agency, St. Paul, Minnesota. 140 p.

MPCA. 2008a. Watershed Approach to Condition Monitoring and Assessment. Appendix 7 *in* Biennial Report of the Clean Water Council. Minnesota Pollution Control Agency, St. Paul, Minnesota.

(http://www.pca.state.mn.us/publications/wq-s1-27.pdf

MPCA. 2007a. Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List. Environmental Outcomes Division, Minnesota Pollution Control Agency, St. Paul, Minnesota.

http://www.pca.state.mn.us/index.php/view-document.html?gid=8601

Minnesota Rules Chapter 7050. 2008. Standards for the Protection of the Quality and Purity of the Waters of the State. Revisor of Statutes and Minnesota Pollution Control Agency, St. Paul, Minnesota.

Minnesota Pollution Control Agency (2010c). Aquatic Life Water Quality Standards Draft Technical Support Document for Total Suspended Solids (Turbidity). http://www.pca.state.mn.us/index.php/view-document.html?gid=14922

Minnesota Pollution Control Agency (MPCA) and Minnesota State University of Mankato (MSUM). 2009. State of the Minnesota River, Summary of Surface Water Quality Monitoring 2000-2008. http://mrbdc.mnsu.edu/sites/mrbdc.mnsu.edu/files/public/reports/basin/state_08/2008_fullreport1109.pdf

University of Missouri Extension. 1999. Agricultural Phosphorus and Water Quality. Pub. G9181. http://extension.missouri.edu/publications/DisplayPub.aspx?P=G9181

USDA-NRCS, 2009, Rapid Watershed Assessment, Resource Profile, Root (MN) HUC: 07040008, United States Department of Agriculture, Natural Resources Conservation Service.

Minnesota Pollution Control Agency (2011). Karst in Minnesota .

http://www.pca.state.mn.us/index.php/water/water-types-and-programs/groundwater/about-groundwater/karst-in-minnesota.html

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

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

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

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

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

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

Total suspended solids (TSS) – TSS and turbidity are highly correlated. Turbidity is a measure of the lack of transparency or "cloudiness" of water due to the presence of suspended and colloidal materials such as clay, silt, finely divided organic and inorganic matter and plankton or other microscopic organisms. The greater the level of TSS, the murkier the water appears and the higher the measured turbidity. Higher turbidity results in less light penetration which may harm beneficial aquatic species and may favor undesirable algae species. An overabundance of algae can lead to increases in turbidity, further compounding the problem.

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

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

Appendix 2: Biological monitoring stations in the Root River watershed

Field Number	Stream Name	Location Description	Drainage Area (Mi^2)
02LM011	Root River	upstream of Hwy 16 bridge 0.5 miles NW of Hokah	1614.55
04LM006	Root River	Upstream of Hwy 52, 1 mi. SE of Chatfield	474.08
04LM011	Trib. to Forestville Creek	1 mi. W of Forestville	14.62
04LM016	Money Creek	Downstream of Hwy 76, 1 mi. N of Houston	70.76
04LM021	Willow Creek	Downstream of Hwy 15, 1 mi. SW of Preston	34.35
04LM025	Root River, North Branch	Upstream of Hwy 30, 4 mi. NW of Chatfield	182.07
04LM032	Rush Creek	Downstream of Hwy 29, 2 mi. S of Lewiston	21.25
04LM057	Watson Creek	downstream of U.S. Route 52, ~2 miles NW of Preston	21.61
04LM058	Spring Valley Creek	along County Route 8, Spring Valley Township, ~5.4 mi SW of Fillmore.	18.57
04LM060	Riceford Creek	upstream of CR 4, 6.8 miles NNW of Spring Grove	55.68
04LM069	Root River, South Fork	~7.6 mi. NE of Harmony	24.87
04LM072	Root River, Middle Branch	SE1/4, Sec 35,1.5 miles NNE out of Fillmore	197.82
04LM074	Trib. to Willow Creek	just upstream of CR 22, ~ 4 mi. S of Preston	0.81
04LM095	Pine Creek	Upstream of Hwy 2, ~3 miles NW of Rushford	49.41
04LM096	Coolridge Creek	upstream of CR 2 crossing, ~ 7 miles NW of Rushford	1.75
04LM097	Pine Creek	Fremont Township, just upstream of mouth of Hemingway Creek, ~ 6 miles NW of Rushford.	33.66
04LM098	Trout Run	Upstream of CR 10, ~6 miles NE of Chatfield.	8.92
04LM107	Deer Creek	Just upstream of County Route 1 crossing, ~2.5 miles N of Spring Valley	46.64
04LM108	Canfield Creek	Just upstream of southern boundary of Forestville Mystery Cave State Park. Two miles south of Forestville.	28.57
04LM110	Root River, South Branch	Downstream of C.R. 118 in Forestville State Park	116.35
04LM111	Root River, South Branch	just upstream of CR 114, ~ 1 mile N. of Etna	53.21
04LM112	Riceford Creek	upstream of Hwy 44 in Mabel	12.61
04LM113	Root River, South Fork	downstream of CR 18, ~5 miles NE of Harmony	18.27
04LM114	Gribben Creek	Along CR 23, 3 miles E. of Lanesboro	8.40
04LM115	Diamond Creek	~1 mile upstream of CR 107 crossing, ~4.5 miles E of Lanesboro	7.84
04LM116	Root River, South Fork	1 Mile Downstream of county road 15, 1.5 Miles SW of Yucatan	116.44
04LM117	Riceford Creek	2 mi N of Riceford	32.91
04LM118	Root River	just north of Houston	1246.76
04LM129	Mill Creek	Just upstream of Hwy 30 crossing, just W of Chatfield.	31.31
04LM130	Root River, North Branch	Upstream of CR 19, 4 miles NW of Cummingsville.	167.22
04LM200	Hemingway Creek	100 m. upstream of confluence with Pine Creek	7.80

Field Number	Stream Name	Location Description	Drainage Area (Mi^2)
07LM023	Trib. to Root River, North Branch	Downstream of CR 2, 2 mi. NW of Dexter	2.50
08LM001	Root River	Downstream of Hwy 26, 3 mi. NE of Hokah	1663.75
08LM002	Root River, South Branch	Downstream of CSAH 8, in Lanesboro	284.67
08LM003	Rush Creek	Downstream of Hwy 43, in Rushford	134.12
08LM004	Watson Creek	Downstream of CSAH 17, 4 mi. NE of Preston	33.82
08LM005	Willow Creek	Downstream of CSAH 12, 1 mi. S of Preston	33.54
08LM006	Spring Valley Creek	Downstream of Orchard Rd, 2.5 mi. W of Wykoff	25.26
08LM007	Root River, Middle Branch	Downstream of CSAH 7, 3 mi. S of Chatfield	236.24
08LM008	Trout Run Creek	Upstream of CSAH 43, 5.5 mi. E of Chatfield	24.20
08LM009	Root River, South Fork	Upstream of Swede Bottom Rd, 1 mi. E of Houston	291.11
08LM010	Thompson Creek	Downstream of Butterfield Valley Rd, in Hokah	26.70
08LM011	Money Creek	Upstream of Hwy 76, 3 mi. NW of Houston	73.58
08LM012	Root River, North Branch	Upstream of Lost Loop, 2 mi. SE of Chatfield	231.00
08LM013	Deer Creek	Downstream of CSAH 8, 3 mi. NW of Wykoff	88.52
08LM014	Bear Creek	Downstream of Nature Rd, 3 mi. N of Wykoff	99.51
08LM015	Curtis Creek	Downstream of CSAH 5, 2 mi. N of Wykoff	4.11
08LM016	Root River, South Fork	Downstream of Deer Rd, 8.5 mi. NE of Harmony	29.21
08LM017	Root River, North Branch	Upstream of CSAH 19, 6 mi. SW of Eyota	167.22
08LM018	Corey Creek	Downstream of CSAH 17, 3.5 mi. NW of Money Creek	11.69
08LM019	Root River, South Branch	Upstream of 151st Ave, 7 mi. SW of Wykoff	44.40
08LM020	Forestville Creek	Adjacent to CR 118, 5 mi. S of Wykoff	16.89
08LM022	Carey Creek	Upstream of Mower/Olmstead Rd, 1.5 mi. SW of Stewartville	16.20
08LM024	Wadden Valley Creek	Adjacent to Hobbit Ln, 4 mi. NW of Lanesboro	9.60
08LM025	Shattuck Creek	Upstream of 401st Ave, 7 mi. SE of Lanesboro	6.40
08LM026	Etna Creek	Downstream of 153rd Ave, 8 mi. SW of Wykoff	4.46
08LM027	Upper Bear Creek	Downstream of CSAH 5, 2 mi. S of Chatfield	18.71
08LM028	Trib. to Rush Creek	Upstream of CSAH 29, 3 mi. S of Lewiston	11.15
08LM029	Root River, South Branch	Downstream of Maple Rd, 6 mi. S of Wykoff	69.13
08LM030	Wisel Creek	Downstream of CSAH 18, 5.5 mi. NW of Mabel	40.33
08LM031	Rice Creek	Downstream of 308th St, 5 mi. SE of Chatfield	24.00
08LM032	Root River, North Branch	Upstream of 15th Ave NE, 1.5 mi. NE of Stewartville	124.74
08LM033	Trib. to Root River, South Fork	Upstream of Hwy 43, 9 mi. SE of Lanesboro	6.69
08LM034	Judicial Ditch 1	Downstream of 200 St, 4.5 mi. SE of Grand Meadow	8.69
08LM035	Trib. to Willow Creek	Downstream of CSAH 15, 3 mi. SW of Preston	10.40
08LM036	Partridge Creek	Downstream of CSAH 16, 4 mi. SE of Preston	7.62
08LM037	Root River, South Branch	Downstream of Hwy 52, 1 mi. E of Preston	211.54
08LM038	Willow Creek	Downstream of Jumper Rd, 5 mi. NW of Harmony	16.06
08LM039	Root River, North Branch	Upstream of CR 115, 5 mi. W of Stewartville	66.64

Field Number	Stream Name	Location Description	Drainage Area (Mi^2)
08LM041	Trib. to Root River, North Branch	Upstream of Hwy 30, 1 mi. E of Stewartville	5.30
08LM043	Mill Creek	Downstream of CR 137, 4.5 mi. NW of Chatfield	10.92
08LM044	Gribben Creek	Upstream of CSAH 23, 1.5 mi. SE of Whalan	7.87
08LM045	Robinson Creek	Upstream of CSAH 6, 5 mi. W of Stewartville	15.79
08LM046	Camp Creek	Upstream of Cottage Grove Rd, 1 mi. SE of Preston	24.25
08LM047	Trib. to Root River, North Branch	Downstream of CSAH 7, 3 mi. NW of Dexter	9.58
08LM048	Duschee Creek	Downstream of Grosbeak Rd, 1 mi. SW of Lanesboro	22.68
08LM049	Lynch Creek	Upstream of CSAH 40, 3.5 mi. E of Chatfield	10.15
08LM050	Root River	Upstream of Hwy 52, 3 mi. SE of Chatfield	475.95
08LM051	Money Creek	Upstream of Harrow Rd, 5 mi. NW of Lanesboro	20.19
08LM052	Diamond Creek	Upstream of CR 107, 2 mi. E of Whalan	9.84
08LM053	Root River, South Branch	Downstream of CSAH 12, 4 mi. W of Preston	133.91
08LM054	Root River, North Branch	Upstream of 680th Ave, 8.5 mi. SE of Hayfield	35.54
08LM055	Bear Creek, North Fork	Upstream of CSAH 8, 2 mi. N of Grand Meadow	13.84
08LM056	Rush Creek	Downstream of Enterprise Valley Dr, 3.5 mi. S of Lewiston	30.29
08LM057	Root River	Upstream of Hwy 76, 0.5 mi. N of Houston	1249.43
08LM058	Bear Creek, South Fork	Downstream of CSAH 2, 2 mi. NE of Grand Meadow	19.88
08LM059	Deer Creek	Downstream of CSAH 8, 1 mi. S of Grand Meadow	20.76
08LM060	Silver Creek	Upstream of CSAH 9, 4.5 mi. NE of Houston	13.01
08LM061	Money Creek	Adjacent to Cone Dale Dr, 3 mi. NW of Money Creek	36.80
08LM062	Root River, South Fork	Downstream of CSAH 15, 8 mi NW of Spring Grove	128.40
08LM063	Pine Creek	Upstream of Dendal Dr, 7 mi. NW of Rushford	29.95
08LM064	Root River	Upstream of Hwy 16, 2 mi. NE of Peterson	980.61
08LM065	Root River	Adjacent to Hwy 16, 3.5 mi. SE of Rushford	1142.81
08LM066	Daley Creek	Downstream of Chisholm Rd, 5 mi. SE of Rushford	4.56
08LM067	Kedron Creek	Upstream of CSAH 4, 6 mi. NW of Wykoff	21.69
08LM068	Jordan Creek	Downstream of 181st Ave, 5 mi. N of Wykoff	4.05
08LM069	Root River	Upstream of CSAH 21, 5 mi. NW of Lanesboro	565.46
08LM070	Root River	Adjacent to Goodview Dr, 3.5 mi. NW of Lanesboro	612.40
08LM071	Root River	Adjacent to Hwy 16, 1 mi. NE of Whalan	923.48
08LM073	Big Springs Creek	Adjacent to CR 105, 6 mi. NE of Lanesboro	5.57
08LM074	Rush Creek	Upstream of CSAH 25, 4 mi. NW of Rushford	55.60
08LM075	Camp Creek	Downstream of CSAH 16, 4 mi. S of Preston	10.96
08LM077	Deer Creek	Upstream of CR 5, 3.5 mi. SW of Grand Meadow	5.58
08LM078	Trib. to Deer Creek	Upstream of CR 5, 4 mi. SW of Grand Meadow	6.76
08LM079	Bear Creek	Downstream of Twp 422, 6 mi. NW of Wykoff	69.02
08LM080	Deer Creek	Upstream of CSAH 38, 4.5 mi. NW of Wykoff	50.20
08LM083	Sugar Creek	Upstream of CSAH 8, 1.5 mi. W of Fountain	8.61
08LM084	Root River, North Branch	Downstream of CSAH 2, 0.5 mi. W of Chatfield	195.90

Field Number	Stream Name	Location Description	Drainage Area (Mi^2)
08LM085	Trib. to Root River	Downstream of CSAH 25, 1.5 mi. S of Peterson	10.15
08LM087	Sorenson Creek	Downstream of Diamond Dr, 4 mi. NE of Canton	5.30
08LM088	Wisel Creek	Upstream of CSAH 24, 4 mi. NE of Canton	10.09
08LM089	Crystal Creek	Downstream of Sanden Rd, 4 mi. E of Houston	13.31
08LM090	Sullivan Creek	Upstream of CSAH 20, 4 mi. SW of Hokah	11.77
08LM091	Butterfield Creek	Upstream of Butterfield Valley Rd, 1 mi. S of Hokah	5.99
08LM092	Thompson Creek	Downstream of Loomis Rd, 4 mi. SW of Hokah	9.85
08LM093	Root River	At CSAH 25, 6 mi. NE of Houston	1591.73
08LM095	Storer Creek	Adjacent to Storer Valley Rd, 4.5 mi. NE of Houston	6.44
08LM096	Trib. to Wisel Creek	Upstream of CSAH 24, 5 mi. NE of Canton	8.97
08LM097	Root River, North Branch	Upstream of CSAH 7, 4 mi. NW of Dexter	10.24
08LM098	Pine Creek	Downstream of Grover Dr., 8 mi. SE of St. Charles	18.13
08LM100	Riceford Creek	Downstream of Creamery Dr, 8.5 mi. NW of Spring Grove	64.40
08LM101	Unnamed creek	Upstream of 680th Ave, 8 mi. SE of Hayfield	20.41
08LM102	Root River, South Fork	Downstream of Hwy 43, 9 mi. N of Mabel	95.98
08LM103	Bridge Creek	Downstream of John Deere Dr, 6.5 mi. SW of Houston	7.34
08LM104	Root River, South Fork	Downstream of East Twin Ridge Rd, 4 mi. SW of Houston	214.34
08LM105	Beaver Creek	Upstream of CSAH 10, 4 mi. SW of Houston	52.37
08LM106	Beaver Creek, East Fork	Upstream of CSAH 1, 3.5 mi. W of Caledonia	7.55
08LM107	Beaver Creek	Downstream of CSAH 12, 4.5 mi. W of Caledonia	22.07
08LM108	Badger Creek	Adjacent to Hwy 76, 3.5 mi. S of Houston	9.58
08LM109	Campbell Creek	Upstream of CSAH 26, 1 mi. E of Money Creek	8.15
08LM110	Riceford Creek	Upstream of CSAH 28, in Mabel	8.77
08LM111	Riceford Creek	Downstream of Mapleleaf Rd, 3 mi. E of Mabel	22.56
08LM140	Riceford Creek	Upstream of Elm Dr, 4 mi. NE of Mabel	32.22
08LM141	Trib. to Root River	Upstream of CSAH 25, 1.5 mi. S of Peterson	5.40
08LM142	Trib. to Root River	Upstream of Hatchery Rd. on W side of CSAH 25, 1.5 mi. S of Peterson	4.72
09LM001	Root River, South Branch	Upstream of 770 St, 4.5 mi. SE of Grand Meadow	15.38
10EM015	Spring Valley Creek	Upstream and downstream of Hwy 63, in Spring Valley	14.00
10EM079	Root River	Adjacent to Hwy 16, 2 mi. NE of Whalan	927.20
10EM123	Root River, North Branch	0.75 mi. downstream of CSAH 2, 1 mi. S of Chatfield	228.10
10EM143	Willow Creek	0.75 mi. upstream of CSAH 15, 3 mi. SW of Preston	31.95
10EM146	Root River, South Fork	Upstream of Hwy 43, 9 mi. N of Mabel	95.22
10EM187	Unnamed creek	1 mi. upstream of Hwy 52, 3 mi. N of Chatfield	0.36

Appendix 3: Intensive watershed monitoring stations in the Root River watershed

Biological Station ID	STORET ID	Stream Name	Location Description	11-Digit HUC
04LM129	S004-828	Mill Creek	Downstream of Hwy 30, in Chatfield	7040008040
08LM001	S000-065	Root River	Downstream of Hwy 26, 3 mi. NE of Hokah	7040008280
08LM002	S004-829	Root River, South Branch	Downstream of CSAH 8, in Lanesboro	7040008200
08LM003	S001-689	Rush Creek	Downstream of Hwy 43, in Rushford	7040008230
08LM004	S003-388	Watson Creek	Downstream of CSAH 17, 4 mi. NE of Preston	7040008180
08LM005	S004-948	Willow Creek	Downstream of CSAH 15, 3 mi. S of Preston	7040008160
08LM006	S000-769	Spring Valley Creek	Downstream of Orchard Rd, 2.5 mi. W of Wykoff	7040008090
08LM007	S004-821	Root River, Middle Branch	Downstream of CSAH 7, 3 mi. S of Chatfield	7040008100
08LM008	S004-822	Trout Run Creek	Upstream of CSAH 43, 5.5 mi. E of Chatfield	7040008130
08LM009	S004-830	Root River, South Fork	Upstream of Swede Bottom Rd, 1 mi. E of Houston	7040008255
08LM010	S004-823	Thompson Creek	Downstream of Butterfield Valley Rd, in Hokah	7040008270
08LM011	S004-824	Money Creek	Upstream of Hwy 76, 3 mi. NW of Houston	7040008240
08LM012	S004-825	Root River, North Branch	Upstream of Lost Loop, 2 mi. SE of Chatfield	7040008010
08LM013	S004-826	Deer Creek	Downstream of CSAH 8, 3 mi. NW of Wykoff	7040008070
08LM014	S004-827	Bear Creek	Downstream of Nature Rd, 3 mi. N of Wykoff	7040008080

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

AUID	Stream Name	Location Description	AUID Length	Use Class	Aquatic Life	Aquatic Recreation	Limited Use Water	Drinking Water		Fish IBI	Invert IBI	Chloride	E_coli	DO	pH	Unionized Ammonia	Turbidity
HUC-11: 07040008010 (North Branch Root River)																	
07040008-535	Root River, North Branch	Mill Cr to M Br Root R	3.69	2B	FS	NS				MTS	MTS	MT	EX		MTS	MT	EXP
07040008-706	Unnamed creek	Unnamed cr to N Br Root R	3.7	2B	NS	NA				MTS	EXP						
07040008-716	Root River, North Branch	Unnamed cr to Mill Cr	33.58	2B	NS	NA				MTS	EXP				MTS		EXP
07040008-717	Root River, North Branch	Headwaters to Carey Cr	33.14	2B	NS	NA				MTS	EXP						EXS
07040008-F41	Unnamed creek	Unnamed cr to Unnamed cr	1.86	2B	FS	NA				EXP	EXP						
07040008-F43	Unnamed creek	Unnamed cr to Unnamed cr	2.71	2B	NA	NA											
07040008-F46	Unnamed creek	Unnamed cr to Unnamed cr	1.18	2B	NS	NA				EXP	EXS						
HUC-11: 07040008020 (Robinson Creek)																	
07040008-503	Robinson Creek	Headwaters to N Br Root R	10.84	2B	FS	NS				MTS	MTS		EX				MTS
HUC-11: 07040008030 (Carey Creek)																	
07040008-696	Carey Creek	Unnamed cr to Unnamed cr	0.63	2B	FS	NA				MTS	MTS						MTS
HUC-11: 07040008040 (Mill Creek)																	
07040008-536	Mill Creek	T105 R12W S14, north line to N Br Root R	8.07	2A	NA	NS		MTS		NA	NA	MT	EX		MTS	MT	MTS
07040008-F67	Unnamed creek	Headwaters to Mill Cr	2.34	2B	NA	NA											

AUID	Stream Name	Location Description	AUID Length	Use Class	Aquatic Life	Aquatic Recreation	Limited Use Water	Drinking Water		Fish IBI	Invert IBI	Chloride	E_coli	DO	pH	Unionized Ammonia	Turbidity
HUC-11: 07040008050 (Lost Creek)																	
07040008-540	Upper Bear Creek	T104 R11W S18, west line to M Br Root R	1.1	2A	NS	NA				EXP	EXS					MT	
07040008-A18	Bear Creek (Lost Creek)	Unnamed cr to T104 R12W S10, east line	5.57	2A	IF	NA											IF
HUC-11: 07040008060 (Chatfield)																	
07040008-534	Root River, Middle Branch	N Br Root R to Lynch Cr	6.09	2B	NS	NS				MTS	EXP		EX				
HUC-11: 07040008070 (Deer Creek)																	
07040008-545	Root River, Middle Branch (Deer Creek)	Spring Valley Cr to Bear Cr	1.25	2A	FS	NA				MTS	MTS						
07040008-546	Deer Creek	Headwaters to M Br Root R	37.89	2B	FS	NS				MTS	MTS	MT	EX		MTS	MT	MTS
07040008-F44	County Ditch 8	Unnamed cr to Deer Cr	2.24	2B	NA	NA											
HUC-11: 07040008080 (Bear Creek)																	
07040008-542	Bear Creek	Kedron Cr to M Br Root R	7.2	2B	FS	NS				MTS	MTS	MT	EX		MTS	MT	MTS
07040008-544	Bear Creek	Headwaters to Kedron Cr	31.21	2B	NS	NA				MTS	EXP						
07040008-584	Kedron Creek	Headwaters to T104 R13W S35, east line	12.35	2B	FS	NA				MTS							
07040008-F45	Bear Creek, North Fork	Unnamed cr to Unnamed cr	1.31	2B	NA	NA											
HUC-11: 07040008090 (Spring Valley Creek)																	
07040008-548	Spring Valley Creek	T103 R13W S29, west line to Deer Cr	17.32	2A	NS	NS		IF		EXS	EXS	MT	EX		MTS	MT	MTS

AUID	Stream Name	Location Description	AUID Length	Use Class	Aquatic Life	Aquatic Recreation	Limited Use Water	Drinking Water		Fish IBI	Invert IBI	Chloride	E_coli	DO	pH	Unionized Ammonia	Turbidity
HUC-11: 07040008100 (Middle Branch Root River)																	
07040008-506	Root River, Middle Branch	Upper Bear Cr to N Br Root R	1.59	2B	NS	NS				MTS	EXP	MT	EX			MT	IF
07040008-541	Curtis Creek	Headwaters to M Br Root R	3.24	2A													
07040008-595	Carson Creek (Little Jordan Creek)	Unnamed cr to M Br Root R	1.07	2A	IF	NA										MT	
07040008-713	Jordan Creek	Unnamed cr to Unnamed cr	0.57	2B	IF	NA				MTS	MTS						
07040008-B96	Root River, Middle Branch	T103 R12W S4, south line to Upper Bear Cr	9.76	2B	FS	NA				MTS	MTS						
HUC-11: 07040008110 (Rice Creek)																	
07040008-581	Rice Creek	T104 R11W S23, west line to M Br Root R	3.23	2A	NS	NA				EXP	EXS					MT	
07040008-G86	Sugar Creek	T103 R11W S8, west line to Rice Cr	3.23	2A	FS	NA				MTS	MTS						
HUC-11: 07040008120 (Lynch Creek)																	
07040008-533	Lynch Creek	T104 R11W S2, north line to M Br Root R	4.97	2A	NA	NA				NA	NA						
HUC-11: 07040008130 (Trout Run Creek)																	
07040008-G88	Trout Run Creek	Unnamed cr to M Br Root R	11.91	2A	FS	NS				MTS	EXP	MTS	EX		MTS	MTS	EXP
07040008-G87	Trout Run Creek	T105 R10W S18, north line to Unnamed cr	1.72	2A	NS	NA				MTS	EXS						
07040008-690	Unnamed creek	Headwaters to Unnamed cr	2.78	2B	IF	IF						MT	IF				
HUC-11: 07040008140 (Dyer Valley)																	
07040008-F48	Money Creek	Unnamed cr to M Br Root R	5.42	2B	NS	NA				MTS	EXP						
HUC-11: 07040008150 (Canfield Creek)																	
07040008-557	Canfield Creek	T102 R12W S25, west line to S Br Root R	2.11	2A	FS	IF				MTS	MTS		IF			MT	IF

AUID	Stream Name	Location Description	AUID Length	Use Class	Aquatic Life	Aquatic Recreation	Limited Use Water	Drinking Water		Fish IBI	Invert IBI	Chloride	E_coli	DO	pH	Unionized Ammonia	Turbidity
HUC-11: 07040008160 (East Willow Creek)																	
07040008-558	Willow Creek	T101 R11W S12, west line to S Br Root R	9.92	2A	NS	NS		EX		MTS	EXP	MT	EX		MTS	MT	IF
07040008-F08	Unnamed creek	T102 R11W S24, west line to Willow Cr	0.81	2A	IF	NA				EXS	EXP						
HUC-11: 07040008170 (Camp Creek)																	
07040008-559	Camp Creek	Headwaters to S Br Root R	11.73	2A	NS	NA				EXS	EXS					MT	
07040008-678	Partridge Creek	Unnamed cr to T102 R10W S21, west line	0.75	2B	FS	NA				MTS	MTS						
HUC-11: 07040008180 (Watson Creek)																	
07040008-552	Watson Creek	T103 R11W S30, west line to S Br Root R	16.94	2A	NS	NS		EX		EXS	EXS	MT	EX		MTS	MT	IF
HUC-11: 07040008190 (Duschee Creek)																	
07040008-560	Duschee Creek	T102 R10W S1, east line to S Br Root R	8.04	2A	IF	NA				EXP	EXP						IF
HUC-11: 07040008200 (South Branch Root River)																	
07040008-550	Root River, South Branch	Duschee Cr to M Br Root R	3.56	2A	NS	NS		MTS		MTS	EXP	MT	EX		MTS	MT	IF
07040008-551	Root River, South Branch	Watson Cr to Duschee Cr	6.08	2A	IF	NA											IF
07040008-553	Root River, South Branch	Camp Cr to Watson Cr	5.35	2A	FS	NA				MTS	MTS						
07040008-554	Root River, South Branch	Willow Cr to Camp Cr	3.01	2A	NS	NA											EXP
07040008-555	Root River, South Branch	Canfield Cr to Willow Cr	12.03	2A	FS	NS		EX		MTS	MTS	MT	EX	IF	MTS	MT	IF
07040008-556	Root River, South Branch,	T102 R12W S21, north line to Canfield Cr	8.11	2A	NS	NA				MTS	EXP						IF
07040008-561	Judicial Ditch 1	Unnamed cr to S Br Root R	1.31	2B	NS	NA											EXP
07040008-562	Etna Creek	Unnamed cr to S Br Root R	0.69	2A	IF	NA											IF
07040008-563	Forestville Creek	Unnamed cr to S Br Root R	1.9	2A	FS	NA		EX		MTS	MTS				MTS	MT	EXP

AUID	Stream Name	Location Description	AUID Length	Use Class	Aquatic Life	Aquatic Recreation	Limited Use Water	Drinking Water		Fish IBI	Invert IBI	Chloride	E_coli	DO	pH	Unionized Ammonia	Turbidity
07040008-586	Root River, South Branch	Headwaters to T102 R12W S16, south line	26.32	2B	FS	NA				MTS	MTS	MT			MTS		EXP
07040008-597	Etna Creek	T102 R13W S36, west line to Unnamed cr	0.57	2A	NS	NA				MTS	EXP						
07040008-599	Unnamed creek	T102 R12W S15, north line to Forestville Cr	0.72	2A	FS	NA				MTS	MTS						
HUC-11: 07040008210 (Gribben Creek)																	
07040008-589	Gribben Creek	Unnamed cr to Unnamed cr	1.77	2A	FS	NA				MTS	MTS						IF
07040008-591	Gribben Creek	Unnamed cr to Root R	0.99	2A	IF	NA										MT	
HUC-11: 07040008220 (Diamond Creek)																	
07040008-620	Diamond Creek	Unnamed cr to T103 R9W S10, north line	3.52	2A	FS	NA				MTS	MTS						
07040008-621	Diamond Creek	T103 R9W S3, south line to Root R	0.49	2B	NA	NA										MT	
HUC-11: 07040008230 (Rush-Pine Creek)																	
07040008-523	Rush Creek	Pine Cr to Root R	5.53	2A	IF	NS		MTS				MT	EX		MTS	MT	MTS
07040008-524	Rush Creek	Unnamed cr to Pine Cr	16.38	2A	NS	NA				MTS	EXS						MTS
07040008-526	Pine Creek	T104 R9W S4, north line to Rush Cr	14.53	2A	NS	NA				MTS	EXP						
07040008-576	Pine Creek	Headwaters to T105 R9W S32, south line	9.25	2B	NS	NA				MTS	EXS						
07040008-608	Hemmingway Creek	T105 R9W S28, north line to Pine Cr	4.55	2A	FS	NA				MTS	MTS						
07040008-609	Unnamed creek (Coolridge Creek)	Unnamed cr to Pine Cr	1.13	2A	FS	NA				MTS	MTS						MTS
07040008-685	Unnamed creek	T106 R9W S34, west line to Rush Cr	1.93	2A	FS	NA				MTS	MTS						

AUID	Stream Name	Location Description	AUID Length	Use Class	Aquatic Life	Aquatic Recreation	Limited Use Water	Drinking Water		Fish IBI	Invert IBI	Chloride	E_coli	DO	pH	Unionized Ammonia	Turbidity
HUC-11: 07040008240 (Money Creek)																	
07040008-521	Money Creek	T105 R7W S21, north line to Root R	18.72	2B	NS	NS				MTS	MTS	MT	EX		MTS	MT	EXP
07040008-564	Unnamed creek	Unnamed cr to Money Cr	2.55	2A	IF	NA											IF
07040008-575	Money Creek	T105 R7W S3, north line to T105 R7W S16, south line	5.26	2A	NA	NA											MTS
07040008-631	Corey Creek	T105 R6W S18, east line to Money Cr	5.79	2A	NS	NA		MTS		EXS	MTS						IF
07040008-636	Campbell Creek	Headwaters to Money Cr	7.63	2A	FS	NA				MTS	MTS						
07040008-B02	Unnamed creek	Unnamed cr to T105 R7W S15, west line	0.88	2B	IF	NA											MTS
HUC-11: 07040008255 (South Fork Root River)																	
07040008-508	Root River, South Fork	Beaver Cr to Root R	8.48	2B	NS	NS				MTS	EXP	MT	EX		MTS	MT	EXP
07040008-509	Root River, South Fork	Riceford Cr to Beaver Cr	6.67	2B	NS	NA				MTS	EXP						IF
07040008-510	Root River, South Fork	Wisel Cr to T102 R8W S2, east line	10.06	2A	NS	NA		MTS		MTS	EXP						
07040008-511	Root River, South Fork	T102 R9W S26, west line to Wisel Cr	6.58	2A	NS	NA				MTS	MTS					MT	EXP
07040008-512	Wisel Creek	T102 R8W S31, west line to S Fk Root R	8.99	2A	FS	NA				MTS	MTS					MT	
07040008-513	Wisel Creek	Headwaters to T102 R9W S36, east line	6.73	2B	FS	NA				MTS	MTS						
07040008-515	Riceford Creek	Headwaters to T101 R8W S17, east line	4.26	2B	IF	NA				MTS	EXS						
07040008-516	Riceford Creek	T101 R8W S26, west line to T101 R8W S25, east line	3.42	7													
07040008-517	Riceford Creek	T101 R7W S30, west line to north line	0.38	2B	NA	NA										MT	
07040008-518	Riceford Creek	T101 R7W S19, south line to T102 R7W S30, north line	13.52	2A	NS	NA				MTS	EXS						
07040008-519	Riceford Creek	T102 R7W S19, south line to S Fk Root R	10.48	2B	NS	NA				MTS	EXP						
07040008-568	Beaver Creek West	T102 R7W S26, south line to E Beaver Cr	7.47	2A	FS	NA				MTS	MTS						

AUID	Stream Name	Location Description	AUID Length	Use Class	Aquatic Life	Aquatic Recreation	Limited Use Water	Drinking Water		Fish IBI	Invert IBI	Chloride	E_coli	DO	pH	Unionized Ammonia	Turbidity
07040008-570	Beaver Creek	T103 R6W S30, south line to S Fk Root R	4.14	2A	FS	NA				MTS	MTS						
07040008-572	Root River, South Fork	T102 R8W S1, west line to Riceford Cr	9.16	2B	FS	NA				MTS	MTS						MTS
07040008-573	Root River, South Fork	Headwaters to T102 R9W S27, east line	11.46	2B	NS	NA				EXP	EXS				MTS		EXP
07040008-616	Shattuck Creek	T102 R9W S2, west line to S Fk Root R	6.7	2A	FS	NA				MTS	MTS					MT	
07040008-617	Unnamed creek	T103 R8W S28, west line to T102 R8W S3, south line	4.19	2A	FS	NA				MTS	MTS					MT	
07040008-632	Beaver Creek East	T102 R6W S17, east line to Beaver Cr	3.15	2A	FS	NA				MTS	MTS						
07040008-633	Badger Creek	Unnamed cr to S Fk Root R	6.4	2A	FS	NA				MTS	MTS						
07040008-F49	Donaldson Creek	Unnamed cr to Wisel Cr	3.26	2B	FS	NA				MTS							
07040008-F52	Sorenson Creek	Unnamed cr to Unnamed cr	0.98	2B	NS	NA				MTS	EXP						
07040008-F54	Bridge Creek	Unnamed cr to Unnamed cr	6.71	2B	NS	NA				MTS	EXS						
HUC-11: 07040008260 (Loony Creek)																	
07040008-640	Silver Creek	T105 R6W S35, north line to T104 R6W S14, south line	5.12	2A	NS	NA				EXP	EXS						
HUC-11: 07040008270 (Thompson Valley)																	
07040008-507	Thompson Creek	T103 R5W S12, south line to Root R	5.15	2A	FS	NS		MTS		EXP	MTS	MT	EX			MT	IF
07040008-571	Thompson Creek	Unnamed cr to T103 R5W S13, north line	2.75	2A	FS	NA				MTS	MTS						
07040008-653	Butterfield Creek	T103 R4W S18, east line to Thompson Cr	3.83	2A	FS	NA				MTS	MTS						
07040008-655	Sullivan Creek	T103 R5W S26, south line to Thompson Cr	5.29	2A	FS	NA				MTS	MTS						
HUC-11: 07040008280 (Root River)																	
07040008-501	Root River	Thompson Cr to Mississippi R	5.65	2B	NS	NS				MTS	EXP	MT	EX	MTS	MTS	MT	EXS
07040008-502	Root River	S Fk Root R to Thompson Cr	11.1	2B	NS	NA				MTS	EXS	MT		IF	MTS	MT	EXP
07040008-520	Root River	Money Cr to S Fk Root R	3.44	2B	NS	NA				MTS	EXP	MT		IF	MTS	MT	IF
07040008-527	Root River	M Br Root R to Rush Cr	20.3	2B	NS	NA				MTS	EXS						EXP
07040008-528	Root River, Middle Branch	Trout Run Cr to S Br Root R	16.31	2B	NS	IF				MTS	EXP		IF		MTS		IF

AUID	Stream Name	Location Description	AUID Length	Use Class	Aquatic Life	Aquatic Recreation	Limited Use Water	Drinking Water		Fish IBI	Invert IBI	Chloride	E_coli	DO	pH	Unionized Ammonia	Turbidity
07040008-530	Root River, Middle Branch	Rice Cr to Trout Run Cr	6.65	2B	IF	IF							IF				MTS
07040008-605	Unnamed creek	Unnamed cr to M Br Root R	1.2	2B	NS	NA				MTS	EXP						
07040008-607	Torkelson Creek	T104 R10W S25, north line to M Br Root R	2.02	2A	IF	NA										MT	
07040008-623	Big Springs Creek	Unnamed cr to Root R	4.1	2A	FS	NA				MTS	MTS						
07040008-638	Daley Creek	R103 R7W S8, west line to Root R	3.45	2A	FS	NA				MTS	MTS						
07040008-643	Storer Creek	T104 R5W S17, north line to Root R	4.23	2A	FS	NA				MTS	MTS						
07040008-650	Crystal Creek	T103 R5W S19, west line to T103 R5W S6, north line	6.02	2A	FS	NA				EXP	MTS						
07040008-658	Unnamed creek	Unnamed cr to T104 R8W S31, north line	1.31	2A	FS	NA				MTS	MTS						
07040008-659	Unnamed creek	T104 R8W S32, east line to Unnamed cr	0.68	2A	NS	NA				MTS	EXP						

Appendix 5: Minnesota statewide IBI thresholds and confidence limits

Class #	Class Name	Use Class	Threshold	Confidence Limit	Upper	Lower
Fish						
1	Southern Rivers	2B	39	±11	50	28
2	Southern Streams	2B	45	±9	54	36
3	Southern Headwaters	2B	51	±7	58	44
4	Northern Rivers	2B	35	±9	44	26
5	Northern Streams	2B	50	±9	59	41
6	Northern Headwaters	2B	40	±16	56	24
7	Low Gradient	2B	40	±10	50	30
10	Southern Coldwater	2A	45	13	58	32
11	Northern Coldwater	2A	37	10	47	27
Invertebrates						
1	Northern Forest Rivers	2B	51.3	±10.8	62.1	40.5
2	Prairie Forest Rivers	2B	30.7	±10.8	41.5	19.9
3	Northern Forest Streams RR	2B	50.3	±12.6	62.9	37.7
4	Northern Forest Streams GP	2B	52.4	±13.6	66	38.8
5	Southern Streams RR	2B	35.9	±12.6	48.5	23.3
6	Southern Forest Streams GP	2B	46.8	±13.6	60.4	33.2
7	Prairie Streams GP	2B	38.3	±13.6	51.9	24.7
8	Northern Coldwater	2A	26	±12.4	38.4	13.6
9	Southern Coldwater	2A	46.1	±13.8	59.9	32.3

Appendix 1: Biological monitoring results-fish IBI

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Fish Class	Threshold	FIBI	Visit Date
HUC-11: 07040008010 (North Branch Root River)							
07040008-535	10EM123	Root River, North Branch	228.10	2	45	67	09-Jun-10
07040008-535	08LM012	Root River, North Branch	231.00	2	45	86	21-Aug-08
07040008-706	08LM101	Unnamed creek	20.41	3	51	79	24-Jul-08
07040008-716	08LM084	Root River, North Branch	195.90	2	45	79	08-Jul-08
07040008-716	08LM084	Root River, North Branch	195.90	2	45	88	18-Aug-08
07040008-716	04LM130	Root River, North Branch	167.22	2	45	84	09-Aug-04
07040008-716	08LM032	Root River, North Branch	124.74	2	45	69	21-Jul-08
07040008-716	08LM017	Root River, North Branch	167.22	2	45	82	24-Jul-08
07040008-716	04LM025	Root River, North Branch	182.07	2	45	73	10-Aug-04
07040008-717	08LM039	Root River, North Branch	66.64	2	45	77	06-Aug-08
07040008-717	08LM054	Root River, North Branch	35.54	2	45	56	21-Jul-08
07040008-717	08LM097	Root River, North Branch	10.24	3	51	54	13-Aug-08
07040008-F41	08LM047	Trib. to Root River, North Branch	9.58	3	51	55	13-Aug-08
07040008-F43	07LM023	Trib. to Root River, North Branch	2.50	3	51	41	14-Aug-07
07040008-F46	08LM041	Trib. to Root River, North Branch	5.30	3	51	52	22-Jul-08
HUC-11: 07040008020 (Robinson Creek)							
07040008-503	08LM045	Robinson Creek	15.79	3	51	79	19-Aug-08
HUC-11: 07040008030 (Carey Creek)							
07040008-696	08LM022	Carey Creek	16.20	3	51	83	21-Jul-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Fish Class	Threshold	FIBI	Visit Date
HUC-11: 07040008040 (Mill Creek)							
07040008-536	04LM129	Mill Creek	31.31	10	45	26	29-Jun-04
07040008-536	04LM129	Mill Creek	31.31	10	45	40	30-Jun-08
07040008-536	08LM043	Mill Creek	10.92	10	45	10	21-Jul-08
07040008-F67	10EM187	Unnamed creek	0.36	3	51	0	13-Jul-10
HUC-11: 07040008050 (Lost Creek)							
07040008-540	08LM027	Upper Bear Creek	18.71	10	45	37	22-Jul-08
HUC-11: 07040008060 (Chatfield)							
07040008-534	04LM006	Root River	474.08	1	39	78	17-Aug-04
07040008-534	08LM050	Root River	475.95	1	39	72	13-Aug-08
HUC-11: 07040008070 (Deer Creek)							
07040008-545	08LM013	Deer Creek	88.52	2	45	81	02-Jul-08
07040008-546	04LM107	Deer Creek	46.64	2	45	75	21-Jul-04
07040008-546	04LM107	Deer Creek	46.64	2	45	75	26-Aug-04
07040008-546	08LM080	Deer Creek	50.20	2	45	97	22-Jul-08
07040008-546	08LM077	Deer Creek	5.58	3	51	64	07-Aug-08
07040008-546	08LM059	Deer Creek	20.76	3	51	71	13-Aug-08
07040008-F44	08LM078	Trib. to Deer Creek	6.76	3	51	63	07-Aug-08
HUC-11: 07040008080 (Bear Creek)							
07040008-542	08LM014	Bear Creek	99.51	2	45	94	02-Jul-08
07040008-544	08LM079	Bear Creek	69.02	2	45	93	22-Jul-08
07040008-544	08LM058	Bear Creek, South Fork	19.88	3	51	79	06-Aug-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
07040008-584	08LM067	Kedron Creek	21.69	3	51	68	25-Jun-08
07040008-F45	08LM055	Bear Creek, North Fork	13.84	3	51	65	26-Jun-08
HUC-11: 07040008090 (Spring Valley Creek)							
07040008-548	04LM058	Spring Valley Creek	18.57	10	45	32	24-Jun-04
07040008-548	08LM006	Spring Valley Creek	25.26	10	45	26	03-Jul-08
07040008-548	10EM015	Spring Valley Creek	14.00	10	45	48	08-Jun-10
HUC-11: 07040008100 (Middle Branch Root River)							
07040008-506	08LM007	Root River, Middle Branch	236.24	2	45	75	20-Aug-08
07040008-541	08LM015	Curtis Creek	4.11	10	45	63	14-Aug-08
07040008-541	08LM015	Curtis Creek	4.11	10	45	63	22-Jul-08
07040008-713	08LM068	Jordan Creek	4.05	3	51	59	25-Jun-08
07040008-B96	04LM072	Root River, Middle Branch	197.82	2	45	85	09-Sep-04
HUC-11: 07040008110 (Rice Creek)							
07040008-581	08LM031	Rice Creek	24.00	10	45	36	30-Jul-08
07040008-G86	08LM083	Sugar Creek	8.61	3	51	56	25-Jun-08
HUC-11: 07040008120 (Lynch Creek)							
07040008-533	08LM049	Lynch Creek	10.15	10	45	22	24-Jun-08
HUC-11: 07040008130 (Trout Run Creek)							
07040008-G87	04LM098	Trout Run Creek	8.92	10	45	49	29-Jun-04
07040008-G87	04LM098	Trout Run Creek	8.92	10	45	68	24-Aug-04
07040008-G88	08LM008	Trout Run Creek	24.20	10	45	63	08-Jul-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
HUC-11: 07040008140 (Dyer Valley)							
07040008-F48	08LM051	Money Creek	20.19	3	51	82	24-Jun-08
HUC-11: 07040008150 (Canfield Creek)							
07040008-557	04LM108	Canfield Creek	28.57	10	45	82	29-Jun-04
HUC-11: 07040008160 (East Willow Creek)							
07040008-558	04LM021	Willow Creek	34.35	10	45	79	01-Sep-04
07040008-558	08LM005	Willow Creek	33.54	10	45	63	01-Jul-08
07040008-558	08LM038	Willow Creek	16.06	10	45	49	24-Jun-08
07040008-558	08LM038	Willow Creek	16.06	10	45	57	04-Aug-08
07040008-558	08LM038	Willow Creek	16.06	10	45	60	19-Jul-10
07040008-558	10EM143	Willow Creek	31.95	10	45	63	19-Jul-10
07040008-602	04LM074	Trib. to Willow Creek	0.81	10	45	0	21-Jun-04
07040008-F08	08LM035	Trib. to Willow Creek	10.40	10	45	28	23-Jun-08
07040008-F08	08LM035	Trib. to Willow Creek	10.40	10	45	46	20-Jul-10
HUC-11: 07040008170 (Camp Creek)							
07040008-559	08LM046	Camp Creek	24.25	10	45	45	09-Jul-08
07040008-559	08LM075	Camp Creek	10.96	10	45	10	24-Jun-08
07040008-678	08LM036	Partridge Creek	7.62	3	51	64	22-Jul-08
HUC-11: 07040008180 (Watson Creek)							
07040008-552	08LM004	Watson Creek	33.82	10	45	41	01-Jul-08
07040008-552	04LM057	Watson Creek	21.61	10	45	29	23-Jun-04

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
HUC-11: 07040008190 (Duschee Creek)							
07040008-560	08LM048	Duschee Creek	22.68	10	45	43	01-Jul-08
HUC-11: 07040008200 (South Branch Root River)							
07040008-550	08LM002	Root River, South Branch	284.67	10	45	69	04-Sep-08
07040008-553	08LM037	Root River, South Branch	211.54	10	45	80	29-Jul-08
07040008-555	04LM110	Root River, South Branch	116.35	10	45	80	11-Aug-04
07040008-555	08LM053	Root River, South Branch	133.91	10	45	85	23-Jul-08
07040008-555	08LM053	Root River, South Branch	133.91	10	45	77	20-Aug-08
07040008-556	08LM029	Root River, South Branch	69.13	10	45	74	29-Jul-08
07040008-561	08LM034	Judicial Ditch 1	8.69	3	51	48	24-Jul-08
07040008-561	08LM034	Judicial Ditch 1	8.69	3	51	77	20-Jul-09
07040008-563	08LM020	Forestville Creek	16.89	10	45	78	09-Jul-08
07040008-586	04LM111	Root River, South Branch	53.21	2	45	77	28-Jun-04
07040008-586	08LM019	Root River, South Branch	44.40	2	45	72	23-Jul-08
07040008-586	09LM001	Root River, South Branch	15.38	3	51	68	20-Jul-09
07040008-597	08LM026	Etna Creek	4.46	10	45	60	26-Jun-08
07040008-599	04LM011	Trib. to Forestville Creek	14.62	10	45	97	28-Jun-04
HUC-11: 07040008210 (Gribben Creek)							
07040008-589	04LM114	Gribben Creek	8.40	10	45	67	23-Jun-04
07040008-589	08LM044	Gribben Creek	7.87	10	45	66	25-Jun-08
07040008-589	08LM044	Gribben Creek	7.87	10	45	66	13-Aug-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
HUC-11: 07040008220 (Diamond Creek)							
07040008-620	04LM115	Diamond Creek	7.84	10	45	77	22-Jun-04
07040008-620	08LM052	Diamond Creek	9.84	10	45	55	24-Jun-08
HUC-11: 07040008230 (Rush-Pine Creek)							
07040008-523	08LM003	Rush Creek	134.12	10	45	60	19-Aug-08
07040008-523	08LM003	Rush Creek	134.12	10	45	50	09-Jul-08
07040008-524	04LM032	Rush Creek	21.25	10	45	83	16-Aug-04
07040008-524	08LM056	Rush Creek	30.29	10	45	87	28-Jul-08
07040008-524	08LM074	Rush Creek	55.60	10	45	87	05-Aug-08
07040008-526	04LM095	Pine Creek	49.41	10	45	68	23-Jun-04
07040008-526	04LM095	Pine Creek	49.41	10	45	75	23-Jun-08
07040008-526	04LM095	Pine Creek	49.41	10	45	74	11-Aug-08
07040008-526	04LM097	Pine Creek	33.66	10	45	83	01-Jul-04
07040008-526	08LM063	Pine Creek	29.95	10	45	75	05-Aug-08
07040008-576	08LM098	Pine Creek	18.13	3	51	85	28-Jul-08
07040008-608	04LM200	Hemingway Creek	7.80	10	45	94	01-Jul-04
07040008-609	04LM096	Coolridge Creek	1.75	10	45	84	24-Jun-04
07040008-685	08LM028	Trib. to Rush Creek	11.15	10	45	91	04-Aug-08
HUC-11: 07040008240 (Money Creek)							
07040008-521	04LM016	Money Creek	70.76	2	45	76	30-Jun-04
07040008-521	08LM011	Money Creek	73.58	2	45	68	31-Jul-08
07040008-521	08LM061	Money Creek	36.80	2	45	49	04-Sep-08
07040008-631	08LM018	Corey Creek	11.69	10	45	34	08-Jul-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
07040008-631	08LM018	Corey Creek	11.69	10	45	36	20-Jul-10
07040008-636	08LM109	Campbell Creek	8.15	10	45	76	23-Jul-08
HUC-11: 07040008255 (South Fork Root River)							
07040008-508	08LM009	Root River, South Fork	291.11	2	45	88	27-Aug-08
07040008-509	08LM104	Root River, South Fork	214.34	2	45	93	02-Sep-08
07040008-510	08LM102	Root River, South Fork	95.98	10	45	59	12-Aug-08
07040008-510	10EM146	Root River, South Fork	95.22	10	45	69	08-Jun-10
07040008-511	04LM069	Root River, South Fork	24.87	10	45	90	22-Jun-04
07040008-511	08LM016	Root River, South Fork	29.21	10	45	69	30-Jul-08
07040008-511	08LM016	Root River, South Fork	29.21	10	45	85	19-Aug-08
07040008-512	08LM030	Wisel Creek	40.33	10	45	77	10-Jul-08
07040008-512	08LM030	Wisel Creek	40.33	10	45	74	19-Aug-08
07040008-513	08LM088	Wisel Creek	10.09	3	51	74	10-Jul-08
07040008-515	08LM110	Riceford Creek	8.77	3	51	64	23-Jul-08
07040008-516	04LM112	Riceford Creek	12.61	3	51	0	22-Jun-04
07040008-516	04LM112	Riceford Creek	12.61	3	51	73	12-Aug-08
07040008-518	04LM117	Riceford Creek	32.91	10	45	49	12-Aug-04
07040008-518	08LM111	Riceford Creek	22.56	10	45	58	12-Aug-08
07040008-518	08LM140	Riceford Creek	32.22	10	45	72	15-Jul-08
07040008-519	04LM060	Riceford Creek	55.68	2	45	77	29-Jun-04
07040008-519	08LM100	Riceford Creek	64.40	2	45	72	16-Jul-08
07040008-568	08LM107	Beaver Creek	22.07	10	45	76	16-Jul-08
07040008-570	08LM105	Beaver Creek	52.37	10	45	66	16-Jul-08
07040008-572	04LM116	Root River, South Fork	116.44	2	45	79	12-Aug-04
07040008-572	08LM062	Root River, South Fork	128.40	2	45	86	30-Jul-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
07040008-573	04LM113	Root River, South Fork	18.27	3	51	10	22-Jun-04
07040008-573	04LM113	Root River, South Fork	18.27	3	51	60	24-Aug-11
07040008-616	08LM025	Shattuck Creek	6.40	10	45	70	25-Jun-08
07040008-617	08LM033	Trib. to Root River, South Fork	6.69	10	45	63	25-Jun-08
07040008-632	08LM106	Beaver Creek, East Fork	7.55	10	45	94	09-Jul-08
07040008-633	08LM108	Badger Creek	9.58	10	45	64	14-Jul-08
07040008-633	08LM108	Badger Creek	9.58	10	45	82	11-Aug-08
07040008-F49	08LM096	Trib. to Wisel Creek	8.97	3	51	66	10-Jul-08
07040008-F52	08LM087	Sorenson Creek	5.30	3	51	67	25-Jun-08
07040008-F54	08LM103	Bridge Creek	7.34	10	45	65	04-Aug-08
HUC-11: 07040008260 (Loony Creek)							
07040008-640	08LM060	Silver Creek	13.01	10	45	34	03-Sep-08
HUC-11: 07040008270 (Thompson Valley)							
07040008-507	08LM010	Thompson Creek	26.70	10	45	51	15-Jul-08
07040008-571	08LM092	Thompson Creek	9.85	10	45	78	12-Aug-08
07040008-653	08LM091	Butterfield Creek	5.99	10	45	66	14-Jul-08
07040008-655	08LM090	Sullivan Creek	11.77	10	45	77	15-Jul-08
HUC-11: 07040008280 (Root River)							
07040008-501	08LM001	Root River	1663.75	1	39	60	28-Aug-08
07040008-502	02LM011	Root River	1614.55	1	39	75	26-Aug-08
07040008-502	08LM093	Root River	1591.73	1	39	83	27-Aug-08
07040008-520	04LM118	Root River	1246.76	1	39	60	31-Aug-04
07040008-520	08LM057	Root River	1249.43	1	39	81	26-Aug-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Fish Class	Threshold	FIBI	Visit Date
07040008-522	08LM065	Root River	1142.81	1	39	69	03-Sep-08
07040008-527	08LM064	Root River	980.61	1	39	75	25-Aug-08
07040008-527	08LM071	Root River	923.48	1	39	71	03-Sep-08
07040008-527	10EM079	Root River	927.20	1	39	62	24-Aug-10
07040008-528	08LM069	Root River	565.46	1	39	83	11-Aug-08
07040008-528	08LM070	Root River	612.40	1	39	71	12-Aug-08
07040008-605	08LM024	Wadden Valley Creek	9.60	3	51	82	24-Jun-08
07040008-623	08LM073	Big Springs Creek	5.57	10	45	64	09-Jul-08
07040008-638	08LM066	Daley Creek	4.56	10	45	63	09-Jul-08
07040008-643	08LM095	Storer Creek	6.44	10	45	89	23-Jul-08
07040008-650	08LM089	Crystal Creek	13.31	10	45	46	14-Jul-08
07040008-658	08LM085	Trib. to Root River	10.15	10	45	93	07-Jul-08
07040008-658	08LM142	Trib. to Root River	4.72	10	45	92	28-Jul-08
07040008-659	08LM141	Trib. to Root River	5.40	10	45	58	28-Jul-08

Appendix 2: Biological monitoring results - macroinvertebrate IBI

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
HUC-11: 07040008010 (North Branch Root River)							
07040008-535	10EM123	Root River, North Branch	228.10	5	35.9	37.3	12-Aug-10
07040008-535	08LM012	Root River, North Branch	231.00	5	35.9	36.9	05-Aug-08
07040008-706	08LM101	Unnamed creek	20.41	6	46.8	41.7	23-Aug-08
07040008-716	08LM084	Root River, North Branch	195.90	5	35.9	35.6	04-Aug-08
07040008-716	04LM130	Root River, North Branch	167.22	5	35.9	61.5	23-Aug-04
07040008-716	04LM130	Root River, North Branch	167.22	5	35.9	62.5	08-Sep-08
07040008-716	08LM032	Root River, North Branch	124.74	6	46.8	38.5	05-Aug-08
07040008-716	08LM017	Root River, North Branch	167.22	5	35.9	61.3	19-Aug-08
07040008-716	04LM025	Root River, North Branch	182.07	5	35.9	53.1	31-Aug-04
07040008-717	08LM039	Root River, North Branch	66.64	5	35.9	25.0	04-Aug-08
07040008-717	08LM054	Root River, North Branch	35.54	5	35.9	30.4	04-Aug-08
07040008-717	08LM097	Root River, North Branch	10.24	6	46.8	33.7	04-Aug-08
07040008-F41	08LM047	Trib. to Root River, North Branch	9.58	5	35.9	40.0	04-Aug-08
07040008-F46	08LM041	Trib. to Root River, North Branch	5.30	6	46.8	31.7	04-Aug-08
HUC-11: 07040008020 (Robinson Creek)							
07040008-503	08LM045	Robinson Creek	15.79	5	35.9	37.4	05-Aug-08
HUC-11: 07040008030 (Carey Creek)							
07040008-696	08LM022	Carey Creek	16.20	5	35.9	35.0	05-Aug-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
HUC-11: 07040008040 (Mill Creek)							
07040008-536	04LM129	Mill Creek	31.31	9	46.1	6.5	04-Aug-08
07040008-536	04LM129	Mill Creek	31.31	9	46.1	8.9	19-Aug-08
07040008-536	04LM129	Mill Creek	31.31	9	46.1	42.4	23-Aug-04
07040008-536	08LM043	Mill Creek	10.92	9	46.1	5.9	04-Aug-08
07040008-536	08LM043	Mill Creek	10.92	9	46.1	15.1	19-Aug-08
07040008-F67	10EM187	Unnamed creek	0.36	6	46.8	47.8	16-Aug-10
HUC-11: 07040008050 (Lost Creek)							
07040008-540	08LM027	Upper Bear Creek	18.71	9	46.1	29.6	05-Aug-08
07040008-540	08LM027	Upper Bear Creek	18.71	9	46.1	35.0	20-Aug-08
HUC-11: 07040008060 (Chatfield)							
07040008-534	04LM006	Root River	474.08	5	35.9	32.7	08-Sep-04
07040008-534	08LM050	Root River	475.95	6	46.8	65.0	20-Aug-08
HUC-11: 07040008070 (Deer Creek)							
07040008-545	08LM013	Deer Creek	88.52	5	35.9	43.0	18-Aug-08
07040008-546	04LM107	Deer Creek	46.64	5	35.9	63.8	24-Aug-04
07040008-546	04LM107	Deer Creek	46.64	5	35.9	66.5	08-Sep-04
07040008-546	08LM080	Deer Creek	50.20	5	35.9	42.9	18-Aug-08
07040008-546	08LM077	Deer Creek	5.58	6	46.8	23.7	05-Aug-08
07040008-546	08LM059	Deer Creek	20.76	6	46.8	38.5	05-Aug-08
07040008-F44	08LM078	Trib. to Deer Creek	6.76	6	46.8	19.1	05-Aug-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
HUC-11: 07040008080 (Bear Creek)							
07040008-542	08LM014	Bear Creek	99.51	5	35.9	55.8	19-Aug-08
07040008-542	08LM014	Bear Creek	99.51	5	35.9	58.8	19-Aug-08
07040008-544	08LM079	Bear Creek	69.02	5	35.9	47.7	18-Aug-08
07040008-544	08LM058	Bear Creek, South Fork	19.88	5	35.9	29.1	05-Aug-08
07040008-584	08LM067	Kedron Creek	21.69				19-Aug-08
07040008-F45	08LM055	Bear Creek, North Fork	13.84	6	46.8	13.9	05-Aug-08
HUC-11: 07040008090 (Spring Valley Creek)							
07040008-548	04LM058	Spring Valley Creek	18.57	9	46.1	30.9	24-Aug-04
07040008-548	08LM006	Spring Valley Creek	25.26	9	46.1	6.5	18-Aug-08
07040008-548	10EM015	Spring Valley Creek	14.00	9	46.1	37.2	11-Aug-10
HUC-11: 07040008100 (Middle Branch Root River)							
07040008-506	08LM007	Root River, Middle Branch	236.24	5	35.9	24.0	05-Aug-08
07040008-541	08LM015	Curtis Creek	4.11	9	46.1	34.0	19-Aug-08
07040008-713	08LM068	Jordan Creek	4.05	5	35.9	33.3	19-Aug-08
07040008-B96	04LM072	Root River, Middle Branch	197.82	5	35.9	52.0	31-Aug-04
HUC-11: 07040008110 (Rice Creek)							
07040008-581	08LM031	Rice Creek	24.00	9	46.1	29.6	07-Aug-08
07040008-581	08LM031	Rice Creek	24.00	9	46.1	30.5	07-Aug-08
07040008-G86	08LM083	Sugar Creek	8.61	5	35.9	44.8	05-Aug-08
HUC-11: 07040008120 (Lynch Creek)							
07040008-533	08LM049	Lynch Creek	10.15	9	46.1	25.2	07-Aug-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
HUC-11: 07040008130 (Trout Run Creek)							
07040008-G87	04LM098	Trout Run Creek	8.92	9	46.1	14.0	17-Aug-04
07040008-G88	08LM008	Trout Run Creek	24.20	9	46.1	59.1	19-Aug-08
HUC-11: 07040008140 (Dyer Valley)							
07040008-F48	08LM051	Money Creek	20.19	5	35.9	30.9	6-Aug-08
07040008-F48	08LM051	Money Creek	20.19	5	35.9	31.2	20-Aug-08
HUC-11: 07040008150 (Canfield Creek)							
07040008-557	04LM108	Canfield Creek	28.57	9	46.1	64.0	24-Aug-04
07040008-557	04LM108	Canfield Creek	28.57	9	46.1	61.4	08-Sep-04
HUC-11: 07040008160 (East Willow Creek)							
07040008-558	04LM021	Willow Creek	34.35	9	46.1	27.3	23-Aug-04
07040008-558	08LM005	Willow Creek	33.54	9	46.1	41.7	6-Aug-08
07040008-558	08LM038	Willow Creek	16.06	9	46.1	63.7	6-Aug-08
07040008-558	08LM038	Willow Creek	16.06	9	46.1	60.3	17-Aug-08
07040008-558	10EM143	Willow Creek	31.95	9	46.1	28.4	17-Aug-10
07040008-F08	08LM035	Trib. to Willow Creek	10.40	9	46.1	45.9	06-Aug-08
07040008-F08	08LM035	Trib. to Willow Creek	10.40	9	46.1	31.0	17-Aug-10
HUC-11: 07040008170 (Camp Creek)							
07040008-559	08LM046	Camp Creek	24.25	9	46.1	66.1	07-Aug-08
07040008-559	08LM046	Camp Creek	24.25	9	46.1	61.3	07-Aug-08
07040008-559	08LM075	Camp Creek	10.96	9	46.1	30.1	06-Aug-08
07040008-678	08LM036	Partridge Creek	7.62	5	35.9	37.4	06-Aug-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
HUC-11: 07040008180 (Watson Creek)							
07040008-552	08LM004	Watson Creek	33.82	9	46.1	30.5	06-Aug-08
07040008-552	04LM057	Watson Creek	21.61	9	46.1	33.2	01-Sep-04
HUC-11: 07040008190 (Duschee Creek)							
07040008-560	08LM048	Duschee Creek	22.68	9	46.1	42.1	06-Aug-08
HUC-11: 07040008200 (South Branch Root River)							
07040008-550	08LM002	Root River, South Branch	284.67	9	46.1	42.7	05-Aug-08
07040008-553	08LM037	Root River, South Branch	211.54	9	46.1	64.3	07-Aug-08
07040008-555	04LM110	Root River, South Branch	116.35	9	46.1	48.1	24-Aug-04
07040008-555	08LM053	Root River, South Branch	133.91	9	46.1	64.7	07-Aug-08
07040008-556	08LM029	Root River, South Branch	69.13	9	46.1	35.0	07-Aug-08
07040008-561	08LM034	Judicial Ditch 1	8.69	6	46.8	18.4	06-Aug-08
07040008-561	08LM034	Judicial Ditch 1	8.69	6	46.8	27.3	17-Aug-09
07040008-563	08LM020	Forestville Creek	16.89	9	46.1	81.4	18-Aug-08
07040008-586	04LM111	Root River, South Branch	53.21	5	35.9	52.0	24-Aug-04
07040008-586	08LM019	Root River, South Branch	44.40	5	35.9	48.7	06-Aug-08
07040008-586	09LM001	Root River, South Branch	15.38	6	46.8	10.9	17-Aug-08
07040008-597	08LM026	Etna Creek	4.46	9	46.1	42.0	06-Aug-08
07040008-599	04LM011	Trib. to Forestville Creek	14.62	9	46.1	58.4	25-Aug-04
HUC-11: 07040008210 (Gribben Creek)							
07040008-589	04LM114	Gribben Creek	8.40	9	46.1	54.0	25-Aug-04
07040008-589	04LM114	Gribben Creek	8.40	9	46.1	45.6	08-Sep-04
07040008-589	08LM044	Gribben Creek	7.87	9	46.1	45.2	06-Aug-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
HUC-11: 07040008220 (Diamond Creek)							
07040008-620	04LM115	Diamond Creek	7.84	9	46.1	59.6	25-Aug-04
07040008-620	08LM052	Diamond Creek	9.84	9	46.1	67.5	06-Aug-08
HUC-11: 07040008230 (Rush-Pine Creek)							
07040008-523	08LM003	Rush Creek	134.12	9	46.1	38.5	07-Aug-08
07040008-524	04LM032	Rush Creek	21.25	9	46.1	23.1	01-Sep-04
07040008-524	08LM056	Rush Creek	30.29	9	46.1	23.5	25-Aug-08
07040008-524	08LM074	Rush Creek	55.60	9	46.1	37.7	25-Aug-08
07040008-526	04LM095	Pine Creek	49.41	9	46.1	45.4	01-Sep-04
07040008-526	04LM095	Pine Creek	49.41	9	46.1	45.8	26-Aug-08
07040008-526	04LM097	Pine Creek	33.66	9	46.1	24.2	18-Aug-04
07040008-526	08LM063	Pine Creek	29.95	9	46.1	51.2	26-Aug-08
07040008-576	08LM098	Pine Creek	18.13	5	35.9	23.1	25-Aug-08
07040008-608	04LM200	Hemingway Creek	7.80	9	46.1	54.3	18-Aug-04
07040008-609	04LM096	Coolridge Creek	1.75	9	46.1	67.8	18-Aug-04
07040008-609	04LM096	Coolridge Creek	1.75	9	46.1	56.8	09-Sep-04
07040008-685	08LM028	Trib. to Rush Creek	11.15	9	46.1	75.1	25-Aug-08
HUC-11: 07040008240 (Money Creek)							
07040008-521	04LM016	Money Creek	70.76	6	46.8	49.5	18-Aug-04
07040008-521	08LM011	Money Creek	73.58	6	46.8	48.8	05-Aug-08
07040008-521	08LM061	Money Creek	36.80	6	46.8	46.7	05-Aug-08
07040008-631	08LM018	Corey Creek	11.69	9	46.1	54.0	05-Aug-08
07040008-631	08LM018	Corey Creek	11.69	9	46.1	44.1	16-Aug-10
07040008-636	08LM109	Campbell Creek	8.15	9	46.1	64.1	05-Aug-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
HUC-11: 07040008255 (South Fork Root River)							
07040008-508	08LM009	Root River, South Fork	291.11	6	46.8	36.3	06-Aug-08
07040008-509	08LM104	Root River, South Fork	214.34	6	46.8	46.5	12-Aug-08
07040008-510	08LM102	Root River, South Fork	95.98	9	46.1	33.1	26-Aug-08
07040008-510	10EM146	Root River, South Fork	95.22	9	46.1	35.3	12-Aug-10
07040008-511	04LM069	Root River, South Fork	24.87	9	46.1	56.5	23-Aug-04
07040008-511	08LM016	Root River, South Fork	29.21	9	46.1	71.8	26-Aug-08
07040008-512	08LM030	Wisel Creek	40.33	9	46.1	62.5	20-Aug-08
07040008-513	08LM088	Wisel Creek	10.09	5	35.9	37.5	26-Aug-08
07040008-515	08LM110	Riceford Creek	8.77	6	46.8	18.0	21-Aug-08
07040008-516	04LM112	Riceford Creek	12.61	6	46.8	33.0	21-Aug-08
07040008-516	04LM112	Riceford Creek	12.61	6	46.8	11.6	25-Aug-04
07040008-518	04LM117	Riceford Creek	32.91	9	46.1	36.3	25-Aug-04
07040008-518	08LM111	Riceford Creek	22.56	9	46.1	29.5	21-Aug-08
07040008-518	08LM140	Riceford Creek	32.22	9	46.1	62.2	21-Aug-08
07040008-519	04LM060	Riceford Creek	55.68	6	46.8	46.9	25-Aug-04
07040008-519	08LM100	Riceford Creek	64.40	6	46.8	42.2	07-Aug-08
07040008-568	08LM107	Beaver Creek	22.07	9	46.1	78.6	07-Aug-08
07040008-568	08LM107	Beaver Creek	22.07	9	46.1	65.4	12-Aug-08
07040008-570	08LM105	Beaver Creek	52.37	9	46.1	52.4	06-Aug-08
07040008-572	04LM116	Root River, South Fork	116.44	5	35.9	38.0	25-Aug-04
07040008-572	08LM062	Root River, South Fork	128.40	6	46.8	54.6	12-Aug-08
07040008-573	04LM113	Root River, South Fork	18.27	6	46.8	5.8	23-Aug-04
07040008-616	08LM025	Shattuck Creek	6.40	9	46.1	60.4	26-Aug-08
07040008-617	08LM033	Trib. to Root River, South Fork	6.69	9	46.1	57.3	20-Aug-08
07040008-632	08LM106	Beaver Creek, East Fork	7.55	9	46.1	69.9	07-Aug-08
07040008-633	08LM108	Badger Creek	9.58	9	46.1	64.4	06-Aug-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
07040008-F52	08LM087	Sorenson Creek	5.30	6	46.8	39.9	21-Aug-08
07040008-F54	08LM103	Bridge Creek	7.34	9	46.1	5.7	07-Aug-08
HUC-11: 07040008260 (Loony Creek)							
07040008-640	08LM060	Silver Creek	13.01	9	46.1	17.9	05-Aug-08
HUC-11: 07040008270 (Thompson Valley)							
07040008-507	08LM010	Thompson Creek	26.70	9	46.1	65.7	06-Aug-08
07040008-571	08LM092	Thompson Creek	9.85	9	46.1	79.5	06-Aug-08
07040008-653	08LM091	Butterfield Creek	5.99	9	46.1	66.6	06-Aug-08
07040008-655	08LM090	Sullivan Creek	11.77	9	46.1	68.1	06-Aug-08
HUC-11: 07040008280 (Root River)							
07040008-501	08LM001	Root River	1663.75	2	30.7	19.0	12-Aug-08
07040008-502	02LM011	Root River	1614.55	2	30.7	20.1	05-Aug-08
07040008-502	08LM093	Root River	1591.73	2	30.7	18.6	12-Aug-08
07040008-520	04LM118	Root River	1246.76	2	30.7	17.6	18-Aug-04
07040008-520	08LM057	Root River	1249.43	2	30.7	37.5	11-Aug-08
07040008-522	08LM065	Root River	1142.81	2	30.7	21.4	11-Aug-08
07040008-527	08LM064	Root River	980.61	2	30.7	24.0	11-Aug-08
07040008-527	08LM071	Root River	923.48	2	30.7	17.8	06-Aug-08
07040008-527	08LM071	Root River	923.48	2	30.7	16.4	20-Aug-08
07040008-527	10EM079	Root River	927.20	2	30.7	38.3	12-Aug-10
07040008-528	08LM069	Root River	565.46	2	30.7	43.5	07-Aug-08
07040008-528	08LM070	Root River	612.40	2	30.7	15.3	07-Aug-08
07040008-605	08LM024	Wadden Valley Creek	9.60	5	35.9	28.7	05-Aug-08
07040008-623	08LM073	Big Springs Creek	5.57	9	46.1	74.5	26-Aug-08
07040008-638	08LM066	Daley Creek	4.56	9	46.1	65.6	07-Aug-08
07040008-643	08LM095	Storer Creek	6.44	9	46.1	44.0	05-Aug-08

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
07040008-650	08LM089	Crystal Creek	13.31	9	46.1	47.0	06-Aug-08
07040008-658	08LM085	Trib. to Root River	10.15	9	46.1	49.9	07-Aug-08
07040008-658	08LM085	Trib. to Root River	10.15	9	46.1	54.8	12-Aug-08
07040008-658	08LM142	Trib. to Root River	4.72	9	46.1	56.5	12-Aug-08
07040008-659	08LM141	Trib. to Root River	5.40	9	46.1	42.3	12-Aug-08

Ratings of "good" for channelized streams are based on Minnesota's general use threshold for aquatic life (Appendix 5). Stations with IBIs that score above this general use threshold would be given a rating of "good". The "fair" rating is calculated as a 15 point drop from the general use threshold. Stations with IBI scores below the general use threshold, but above the "fair" threshold would be given a rating of "fair". Stations scoring below the "fair" threshold would be considered "poor".

Appendix 8: Good/fair/poor thresholds for biological stations on non-assessed channelized AUIDs

Class #	Class Name	Good	Fair	Poor
Fish				
1	Southern Rivers	>38	38-24	<24
2	Southern Streams	>44	44-30	<30
3	Southern Headwaters	>50	50-36	<36
4	Northern Rivers	>34	34-20	<20
5	Northern Streams	>49	49-35	<35
6	Northern Headwaters	>39	39-25	<25
7	Low Gradient Streams	>39	39-25	<25
10	Southern Coldwater	>45	45-30	<30
Invertebrates				
1	Northern Forest Rivers	>51	52-36	<36
2	Prairie Forest Rivers	>31	31-16	<16
3	Northern Forest Streams RR	>50	50-35	<35
4	Northern Forest Streams GP	>52	52-37	<37
5	Southern Streams RR	>36	36-21	<21
6	Southern Forest Streams GP	>47	47-32	<32
7	Prairie Streams GP	>38	38-23	<23
9	Southern Coldwater	>46.1	46.1-31.1	<31.1

Appendix 9: Channelized stream AUID- fish IBI

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Fish Class	Good	Fair	Poor	FIBI
HUC-11: 07040008010 (North Branch Root River)								
07040008-F43	07LM023	Trib. to Root River, North Branch	2.50	3	100-51	50-36	35-0	41
HUC-11: 07040008040 (Mill Creek)								
07040008-536	04LM129	Mill Creek	31.31	10	100-45	44-30	29-0	33
HUC-11: 07040008070 (Deer Creek)								
07040008-546	08LM077	Deer Creek	5.58	3	100-51	50-36	35-0	64
07040008-F44	08LM078	Trib. to Deer Creek	6.76	3	100-51	50-36	35-0	63
HUC-11: 07040008080 (Bear Creek)								
07040008-F45	08LM055	Bear Creek, North Fork	13.84	3	100-51	50-36	35-0	65
HUC-11: 07040008090 (Spring Valley Creek)								
07040008-548	10EM015	Spring Valley Creek	14.00	10	100-45	44-30	29-0	48
HUC-11: 07040008200 (South Branch Root River)								
07040008-561	08LM034	Judicial Ditch 1	8.69	3	100-51	50-36	35-0	62.5
07040008-586	09LM001	Root River, South Branch	15.38	3	100-51	50-36	35-0	68
HUC-11: 07040008230 (Rush-Pine Creek)								
07040008-523	08LM003	Rush Creek	134.12	10	100-45	44-30	29-0	55

Appendix 10: Channelized stream AUID - macroinvertebrate IBI

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Name	Drainage Area Mi2	Invert Class	Good	Fair	Poor	MIBI
HUC-11: 07040008040 (Mill Creek)								
07040008-536	04LM129	Mill Creek	31.31	9	100-46.1	46-31	30.9-0	19.3
HUC-11: 07040008070 (Deer Creek)								
07040008-546	08LM077	Deer Creek	5.58	6	100-48	47-32	31-0	23.7
07040008-F44	08LM078	Trib. to Deer Creek	6.76	6	100-48	47-32	31-0	19.1
HUC-11: 07040008080 (Bear Creek)								
07040008-F45	08LM055	Bear Creek, North Fork	13.84	6	100-48	47-32	31-0	13.9
HUC-11: 07040008090 (Spring Valley Creek)								
07040008-548	10EM015	Spring Valley Creek	14.00	9	100-46.1	46-31	30.9-0	37.2
HUC-11: 07040008200 (South Branch Root River)								
07040008-561	08LM034	Judicial Ditch 1	8.69	6	100-48	47-32	31-0	22.9
07040008-586	09LM001	Root River, South Branch	15.38	6	100-48	47-32	31-0	10.9
HUC-11: 07040008230 (Rush-Pine Creek)								
07040008-523	08LM003	Rush Creek	134.12	9	100-46.1	46-31	30.9-0	38.5