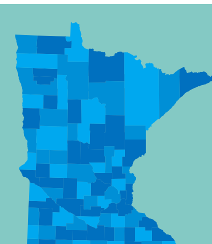
Grant

September 2021

Rice Creek Watershed Nine Key Element Plan

MINNESOTA POLLUTION CONTROL AGENCY



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Contents

Contents i

List of figures iii

List of tables iv

Executive summary 6

Introduction 7

Document overview 7

Planning purpose and process 8

Nonpoint source (NPS) pollution management 8

Watershed description 10

Impairment 303(d) listings 10

Topography and drainage 13

Soils 13

Waterbodies 15

Aquatic habitat and wetlands 16

Land use 16

Wastewater 18

Climate and precipitation 19

Conclusion 20

Water quality and quantity 21

Water quality standards 21

Streamflow 23

Water quality data 24

Water quality impairment assessments 31

Biological monitoring and assessment 32

Stream habitat assessment 33

Watershed TMDLs 34

Pollutant source assessments 38

Point sources overview 39

Non-point sources overview 40

Sediment 41

Phosphorus 42

Nitrogen 43

E. coli 45

Altered Hydrology 46

Mercury 46
Critical areas and priorities 47
Watershed goals 49
Management strategies and activities 50
Agricultural BMPs 50
SSTS compliance 50
Lake management 50
Mercury 51
Implementation activities 52
Summary of reductions 60
Partnerships and education 62
Monitoring 64
Literature Cited 66
Appendix A STEPL assumptions and results 67

List of figures

Figure 1. Streams, Lakes, and Impairments in the Rice Creek Watershed 11
Figure 2. Rice Creek Watershed topography 13
Figure 3. Soils in the Rice Creek Watershed 15
Figure 4. Land use in the Rice Creek Watershed 17
Figure 5. Crops in Rice Creek Watershed 18
Figure 6. Precipitation in Rice Creek Watershed 19
Figure 7. HSPF Modeled Flow Data Rice Creek, 1996-2009 (MPCA) 24
Figure 8. Rice Creek 1996-2009 modeled flow data 24
Figure 9. Water clarity trends for Lura Lake (07-0079-00) 1980-2020 30
Figure 10. 10 year summary of transparency data for Lura Lake 31
Figure 11. Trophic State Index for Lura Lake 07-0079-00, June – September 2008-2017.......................... 31
Figure 12. TSS load duration curve, Rice Creek 35
Figure 13. Summary of Lura Lake TP samples from 2009-2010.................... **Error! Bookmark not defined.**
Figure 14. Feedlots in the Rice Creek Watershed 40
Figure 15. Discovery Farms data from comparable, adjacent watershed (Cobb River) 44
Figure 16. HSPF catchments are illustrated by each color, with the ditch systems in each catchment..... 47
Figure 17. Critical areas in dark orange and impaired waterbodies in red.. 48

List of tables

Table 1. Impaired streams 12
Table 2. Impaired lakes 12
Table 3. Soil area by HSG 14
Table 4. General lake information (MN assessment Report) 15
Table 5. Percent of HUC10 watershed land use by 2016 NLCD classification MPCA 16
Table 6. Cropland from 2019 (USDA NASS 2019) 17
Table 7. Acres of harvested cropland in Faribault County (2012 Census of Agriculture) 18
Table 8. Select water quality data from EQuIS, Rice Creek 07020011-668, -669 (S002-431, S005-466, S006-175, S006-365, S006-596, S006-597, S006-598, S006-599, S006-601) 24
Table 9. Select water quality data from EQuIS, Unnamed Stream 07020011-589 (S006-177) 24
Table 10. Select water quality data from EQuIS, Judicial Ditch 1 07020011-532, -533 (S006-600, S003-377) 25
Table 11. Select water quality data from EQuIS, Rice Lake (22-0075-00-101, 22-0075-00-201, 22-0075-00-202, 22-0075-00-203) 26
Table 12. Select water quality data from EQuIS, Bass Lake, (22-0074-00-100, 22-0074-00-201) 27
Table 13. Select water quality data from EQuIS, Lura Lake (07-0079-00-100, 07-0079-00-101, 07-0079-00-103, 07-0079-00-201, 07-0079-00-202, 07-0079-00-203) 27
Table 14. Annual summary of TSS data at Rice Creek (AUID 07020011-531; April–September) 28
Table 15. Monthly summary of TSS data at Rice Creek (AUID 07020011-531; 2008) 28
Table 16. Annual summary of transparency tube data at Rice Creek (AUID 07020011-531; April–September)* 28
Table 17. Monthly summary of transparency tube data at Rice Creek (AUID 07020011-531; 2006–2015) * 29
Table 18. E.coli geometric means for Rice Creek 2008-2009 (Le Sueur TMDL) 29
Table 19. Macroinvertebrate Index of Biotic Integrity monitoring results for the Rice Creek Watershed. 32
Table 20. Fish Index of Biotic Integrity monitoring results for the Rice Creek Watershed. 33
Table 21. MSHA stream habitat assessment results for the Rice Creek Watershed. 34
Table 22. Summary of TMDL and goal reductions in the Rice Creek Subwatershed 34
Table 23. TSS TMDL summary, Rice Creek (MPCA 2019b) 35
Table 24. Monthly and daily fecal coliform loading capacities and allocations for Rice Creek (MPCA 2016). 36
Table 25. *E. coli* TMDL summary for Rice Creek (AUID# 07020011-531) 37
Table 26. Lura Lake TP TMDL summary 37
Table 27. NPDES permitted feedlots in the Rice Creek Watershed 39
Table 28. Animal counts of registered feedlots that are not NPDES permitted in Rice Creek Watershed 41
Table 29. Simulated sediment loading by land use in the project area (MPCA HSPF 2014) 41
Table 30. Simulated total phosphorus loading by land use in the project area 42
Table 31. Simulated total nitrogen loading by land use in the project area (MPCA HSPF 2014) 45
Table 32. Implementation strategies and activities, milestones, schedule, assessment criteria, monitoring plan and costs for the Rice Creek Watershed HUC 10 52
Table 33. Summary of STEPL loads, adjusted TMDLs, estimated reductions for planned and implemented practices, and load following implementation of NKE 60
Table 34. Summary of STEPL estimated reductions for Lura Lake and Rice Creek Subwatersheds 60
Table 35. Summary of Healthier Watersheds practices implemented since 2014 to present 61
Table 36. Partial list of partners providing technical and funding assistance for implementation 62
Table 37. Monitoring costs in Rice Creek HUC 10 Watershed 64
Table 38. Land use, BMPs, and efficiencies for STEPL (added all *E. coli* efficiencies) 67
Table 39. Total loads and reductions by practices for Lura Lake and Rice Creek Watersheds STEPL 75

Table 40. STEPL output for SSTS *E. coli* load reductions 76

Executive summary

This plan is meant to approach the watershed system and holistically address all of the area concerns, with emphasis on the nonpoint sources (NPS) of pollution. As a predominantly agricultural watershed, much of the work will involve improving land use practices and developing projects that reduce soil erosion and improve soil health. Addressing hydrology issues will play a role in managing how pollutants are transported in the watershed and how to reduce the effects of the stressors identified in Rice Creek. The plan will be continually evaluated and updated using the plan's milestones and goals.

The goal of developing the Rice Creek nine key element (NKE) plan will be to mesh local, state and federal planning and implementation activities in conjunction with the existing SWCD work. Water and watershed plans in Minnesota are generally developed on a 10-year timeline with specific activities and projects that will be reasonably achieved within the current funding and capacity of the watershed management organization. The EPA requires that the 10-year timeline address all of the activities and projects that will be required to achieve the reductions needed to meet water quality standards. Part of the NKE document is to then plan for the means to achieve these goals. While it may not appear to be a significant difference, in practice it can be difficult to mesh the two approaches. It is the goal of the Faribault County SWCD and the MPCA to work with the two approaches in achieving the water quality goals for the Rice Creek watershed.

The SWCD comprehensive watershed plan and the future Le Sueur One Watershed One Plan (1W1P) plan uses an adaptive management approach. These plans, combined with the documentation described in this memorandum, fully provide the NKEs identified by EPA as critical in a watershed plan for achieving improvements in water quality for Rice Creek. This memorandum bridges the gap between the details required to meet the NKEs and the SWCD planning processes. The NKE plan is intended to address all pollutants, sources, and implementation strategies in the watershed to reach the reductions needed to achieve and protect water quality standards.

For the purposes of the Section 319 grant program, only practices and activities eligible for funding under the EPA 2014 Section 319 program guidance and Minnesota's Nonpoint Source Pollution Program Management Plan (NPSPPMP) are eligible for Section 319 funding. All match activities must be eligible for Section 319 funding, except where noted in the NPSPPMP. Other activities will need to seek alternative funding sources.

Introduction

The Rice Creek Section 319 Small Watershed Focus Program Nine Key Element (NKE) plan was developed by compiling information from previous studies and planning documents conducted in the watershed. Much of the text and concepts in this NKE plan are derived from the various existing studies and plans in the watershed. Additional information is provided when necessary to address all the U.S. Environmental Protection Agency's (EPA) nine key elements of a watershed-based plan. Key documents include:

- MN River DO TMDL
- LeSueur sediment budget study
- LeSueur Watershed TMDL Report
- LeSueur Watershed WRAPS Report
- MN river sediment source reduction report
- Minnesota River and Greater Blue Earth River Basin TSS TMDL, 2020
- Greater Blue Earth River Basin Fecal Coliform TMDL Report Implementation Plan, 2007
- Fecal Coliform TMDL Assessment for 21 Impaired Streams in the Blue Earth River Basin, 2007
- Faribault County Local Water Management Plan (2018-2027)
- MNDNR geomorphology report
- MNDNR Watershed Health Assessment Framework (WHAF)
- MN River sediment and nutrient reduction plans

This NKE plan is an iterative document that serves as a guide and starting point for local stakeholders within the watershed to achieve water quality goals through implementation of nonpoint source pollution control measures. Milestones and measures are built into this plan, providing the partners with a regular opportunity to evaluate the progress toward their goals. This foundation builds an active adaptive management approach to allow for change, reaction, and course correction throughout implementation.

Document overview

The intent of this document is to concisely address the nine elements identified in EPA's Handbook for Developing Watershed Plans to Restore and Protect our Waters (EPA 2008) that are critical to preparing effective watershed plans to address nonpoint source pollution. EPA emphasizes the use of watershed-based plans containing the nine elements in Section 319 watershed projects in its guidelines for the Clean Water Act Section 319 program and grants (EPA 2013).

This plan's foundation is the data collection, analysis, and development of plans from multiple sources and scales. Most of the monitoring and planning efforts sponsored by the state (Intensive Watershed Monitoring (IWM), Assessments, TMDLs, WRAPS, 1W1P, etc.) are conducted and report on as a HUC 8. These foundational efforts provide the support and understanding to develop the very targeted and detailed NKE plans for small watersheds. Instead of broad, strategies, this NKE plan will delve into specific and targeted actions to achieve water quality goals in the Rice Creek Watershed.

This NKE plan is intended to be a living document. Through the initial development, first steps of implementation, and the final data collection, this road map is intended to change, react, and correct the course of watershed implementation in the Rice Creek Watershed and be the first step along the path to improve water quality in the watershed.

The intent of the nine elements and the EPA watershed planning guidelines is to provide direction in developing a sufficiently detailed plan at an appropriate scale so that problems and solutions are targeted effectively.

Planning purpose and process

The NKE plan provides the opportunity to continue building the framework of the small watershed approach in Minnesota along with continuing the implementation work to achieve the water quality goals for the watershed. The foundation of this plan was written by compiling and synthesizing the information describing previous and current work in the watershed, quantifying current sources and pollutant loads, determining load reductions needed to meet the water quality goals, and identifying the management measures and levels of implementation needed to achieve the reductions. Through this process, gaps in the existing planning efforts have been identified and will be addressed. Efforts will be focused in various levels throughout the watershed in critical areas. As the work continues, critical areas will be refined. Critical area selection includes physical science influence, such as critical loading areas, but also will consider social aspects such as citizens' priorities and landowner willingness to participate.

Nonpoint source (NPS) pollution management

Numerous nonpoint pollution management activities and planning efforts have been and are being conducted in the project area. A summary of these efforts is provided below:

- Minnesota's Watershed Approach. Minnesota has adopted a watershed approach to address the state's major watersheds. The approach incorporates water quality assessment, watershed analysis, public participation, planning, implementation, and measurement of results into a 10-year cycle that addresses both restoration and protection needs. A key aspect of this effort is to develop and use watershed-scale models and other tools to identify strategies for addressing point and nonpoint source pollution that will cumulatively achieve water quality targets. The MPCA is currently drafting a monitoring and assessment report.
- TMDL Development. Several documents have been developed by the Minnesota Pollution Control Agency (MPCA) that are applicable to the project area as part of this process, including the Le Sueur River Watershed TMDL report, Lura Lake TMDL report, Minnesota River and Greater Blue Earth Total Suspended Solids (TSS) Total Maximum Daily Load (TMDL 2019) and the basin-wide fecal coliform TMDL (Water Resources Center et al. 2007) and Implementation Plan. The process used to develop these reports included significant stakeholder involvement; these reports provide much of the background information and inform selection of management activities.
- WRAPS Development. Cycle I Watershed Assessment work has created several documents providing information on the larger Le Sueur River Watershed and in particular the Rice Creek watershed. Documents utilized for the NKE plan include: Le Sueur River Watershed Monitoring and Assessment Report, Le Sueur River Watershed Biotic Stressor Identification Report and the Le Sueur River WRAPS Report.

- The State of Minnesota has developed nutrient and sediment reduction strategies targeting the Le Sueur River Watershed as it is one of the highest loading watersheds in the MN River basin.
- DNR Watershed Assessment of River Stability and Sediment Supply (WARSSS) work. The Minnesota DNR is currently developing a WARSSS report for the Rice Creek watershed to develop potential stream restoration activities in the watershed.
- Local Watershed Planning. Local water planning efforts by the Faribault County SWCD have prioritized efforts in the Rice Creek Watershed.

Watershed description

The Rice Creek Watershed (aggregated HUC 07020011090) lies within the southwestern portion of the Le Sueur River watershed and is located in north central Faribault County. This watershed includes the full 28 miles of Rice Creek and two tributaries to it, and is located in the lower (northern) portion of the Le Sueur River HUC-8 watershed. This approximately 82 square mile watershed represents roughly 8% of the Le Sueur River watershed. Cropland (8%) and development (5%) are the major land uses within this watershed. There are three assessed lakes in the watershed unit. There are several small tributaries that flow to Rice Creek and Judicial Ditch 1 is the main tributary. The Rice Creek watershed drains north into the Maple River through Rice Creek near Mapleton. Biological station 08MN004 represents the outlet of the Rice Creek Watershed.

Impairment 303(d) listings

Water quality impairments are identified in Minnesota's proposed 2020 303(d) list, Rice Creek watershed has listed impairments dating back to 2006. Figure 1 maps the watershed, with listed impaired waterbodies showing in red.

Figure 1. Streams, Lakes, and Impairments in the Rice Creek Watershed

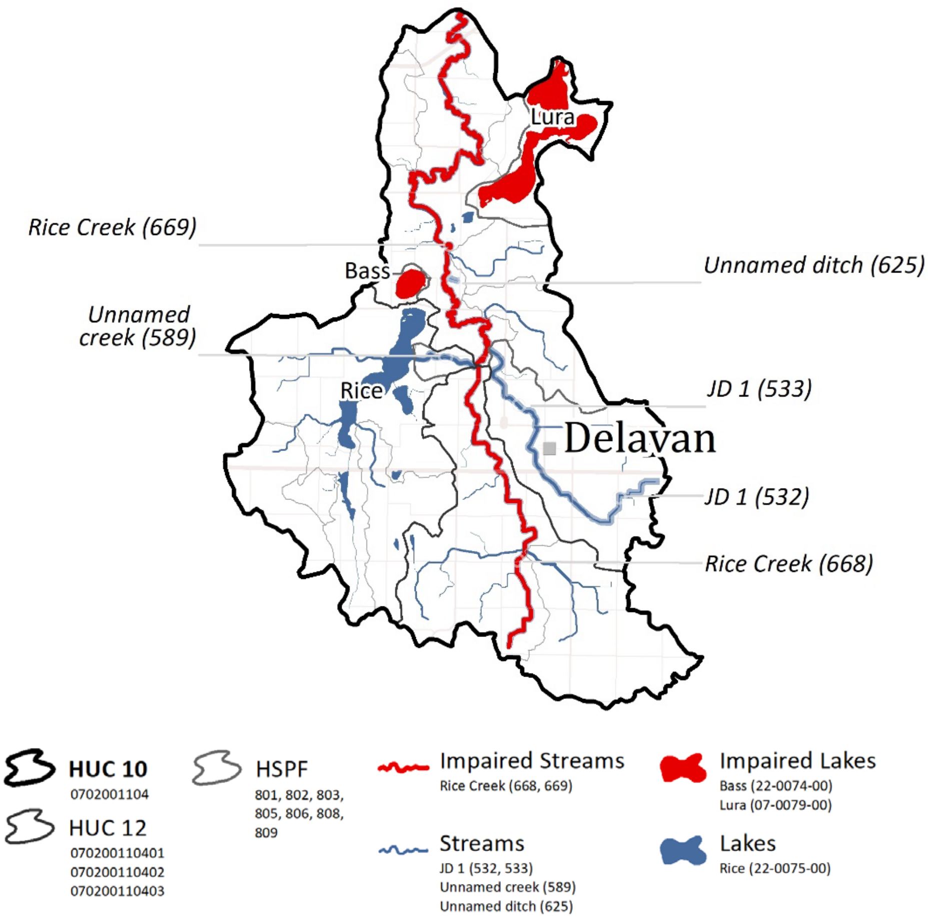


Table 1 lists the stream reach, classification, the year listed, impairment, pollutant/stressor, and the status of the TMDL for the waterbody. The impairment for Rice Creek is listed as reach -531, but was later split into two reaches, -668 and -669. For the purposes of this NKE plan, it will be referred to as -668 and -669.

Table 1. Impaired streams

Reach name	Reach description	Classification	Year listed	AUID	Affected designated use	Pollutant or stressor	Status of TMDL
Rice Creek	Headwaters to Maple R	2Bg, 3C	2006	531	Aquatic Life	Fish bioassessments	
Rice Creek	Headwaters to Maple R	2Bg, 3C	2010	531	Aquatic Life	Turbidity	Approved 2020
Rice Creek	Headwaters to Maple R	2Bg, 3C	2012	531	Aquatic Life	Benthic macroinvertebrates bioassessments	
Rice Creek	Headwaters to Maple R	2Bg, 3C	2012	531	Aquatic Recreation	Escherichia coli (*E.coli*)	Approved 2016

Table 2 lists the lake, classification, the year listed, impairment, pollutant/stressor, and the status of the TMDL for the waterbody.

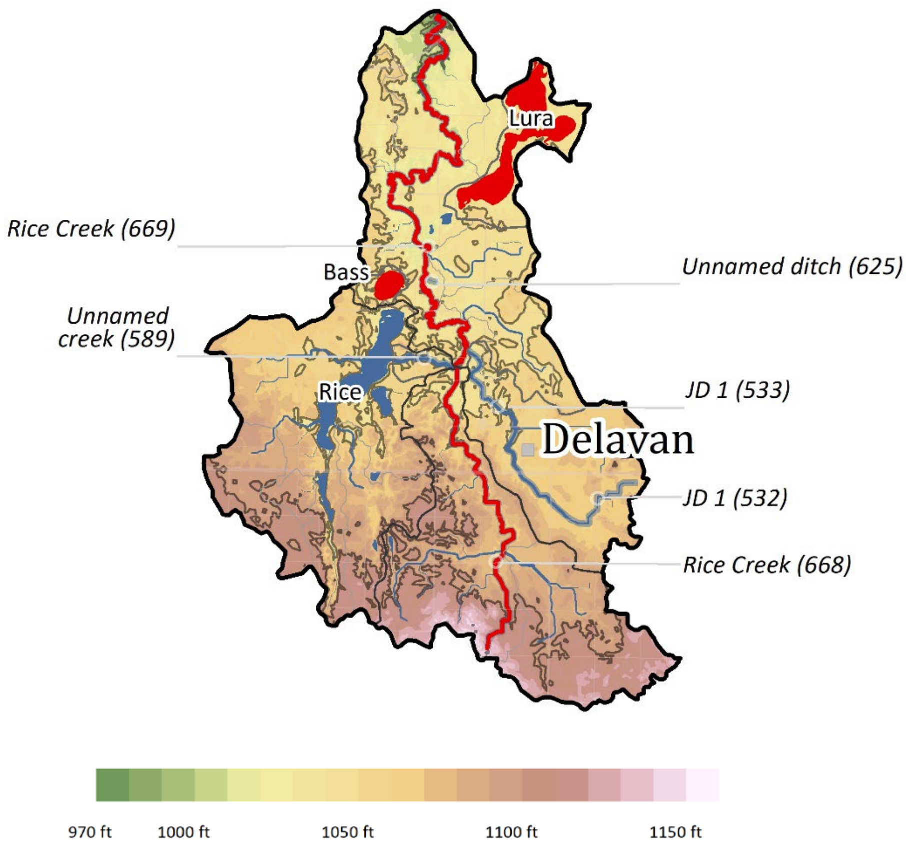
Table 2. Impaired lakes

Lake name	Description	Classification	Year listed	Lake ID	Affected designated use	Pollutant or stressor	Status of TMDL
Lura	Lake	2B, 3C	2002	07-0079-00	Aquatic Recreation	Nutrients	Approved 2014
Lura	Lake	2B, 3C	2002	07-0079-00	Aquatic Recreation	Mercury in fish tissue	Approved 2008
Bass	Lake	2B, 3C	2002	22-0074-00	Aquatic Recreation	Mercury in fish tissue	Approved 2008

Topography and drainage

The Rice Creek Watershed spans approximately 53,000 acres, topography across the project area ranges from 974 to 1,154 feet above mean sea level (Figure 2). Rice Creek Watershed topography). There is very little variation in elevation across this watershed. Agricultural lands are particularly flat (slope less than 3%) and are typically tile-drained, which impacts watershed hydrologic pathways.

Figure 2. Rice Creek Watershed topography

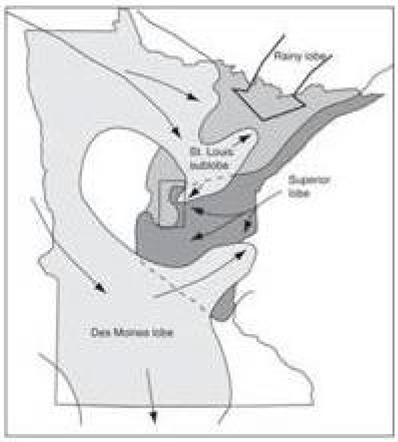


Soils

Soils in the Le Sueur watershed are primarily loamy glacial till with scattered lacustrine areas, potholes, outwash and flood plains. It was formed during the Wisconsin glaciation in Minnesota with glacial till deposited from the Des Moines lobe. The landscape is nearly level to gently undulating with relatively short slopes throughout much of the watershed and the most northern portions can be described as gently undulating to rolling with relatively short hills.

The western half of the watershed lies primarily in the Blue Earth Till Plain. The landscape is a mixture of gently sloping (2-6%) well drained loamy soils and nearly level (0-2%) poorly drained loamy soils. In this area of the watershed, there is extensive artificial drainage to remove ponded water from the more flat and depressional areas. There is a moderate potential for water erosion on nearly half the lands (46%) in this portion of the watershed.

Soils in the morainal complexes are usually loamy in texture and a majority of them are moderately steep and well drained, although roughly one-fourth of the tilled lands are nearly level and poorly drained that require artificial drainage. Cropped lands in these boundary areas have a high potential for water erosion.

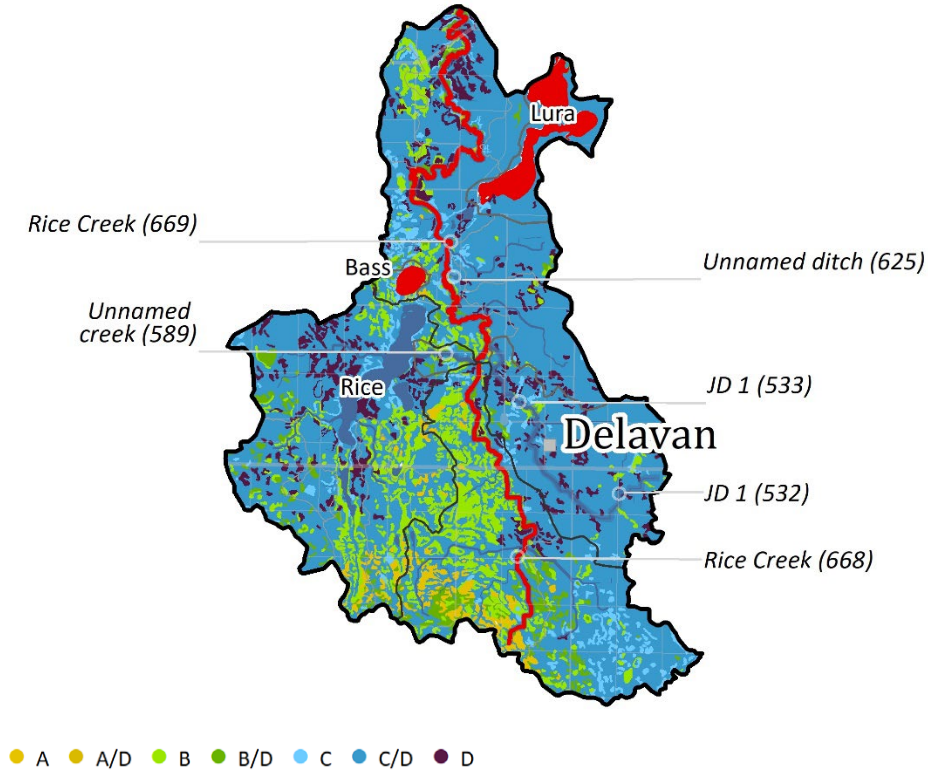


The eastern half of the watershed is a mixture of glacial lake plains, till plains, and moraines. Portions of this half of the watershed are located in the “glacial” Minnesota Lake Plain. Landscapes located in the lake plain can be characterized as nearly level with poorly drained or very poorly drained clayey or silty clay soils. This area tends to have extensive subsurface and surface tiling. The western, eastern, and southern boundaries of the watershed are end moraines; various ground moraines are also in the eastern half of the watershed. These moraines display an undulating to hilly landscape with slopes from 2-12%.

Table 3. Soil area by HSG

HSG	Percent of project area
A	3%
B	12%
B/D	5%
C	5%
C/D	68%
D	7%
Total	**100%**

Figure 3. Soils in the Rice Creek Watershed



Waterbodies

Streams

In the Rice Creek Watershed, the prominent waterbody is Rice Creek, which flows from South to North. The headwaters consists of three main ditch systems that create the headwater. As the stream flows north it collects other natural and ditched tributaries and also collects the lakesheds of the three main lakes in the watershed.

Lakes

Three main lakes within the Rice Creek Watershed have had data collected for assessment purposes; each lake outlets to Rice Creek. Information for each lake is included in the table below.

Table 4. General lake information (MN assessment Report)

Lake	Lake ID	Surface area (ac)	Littoral area (ac)	Max depth (m)	Lake to Watershed ratio
Lura	07-0079	1295	1295	2.7	2:1
Bass	22-0074	199	167	6.1	2:1
Rice	22-0075	978	978	1.5	

Aquatic habitat and wetlands

Wetlands provide many beneficial ecosystem services to watersheds; however, wetlands have been extensively drained across much of Minnesota. In general, over 90% of the original wetlands in the southern and western regions of the state have been lost. Approximately 6% of the planning watershed area is classified as wetland, based upon an evaluation of the NLCD 2016 land cover raster. Agricultural drainage has drained many of the wetlands originally present in the watershed. Wetlands in the Rice Creek HUC 10 Watershed are often degraded and not ecologically functioning properly. As such, they often act as a source of phosphorus rather than a sink for phosphorus.

Land use

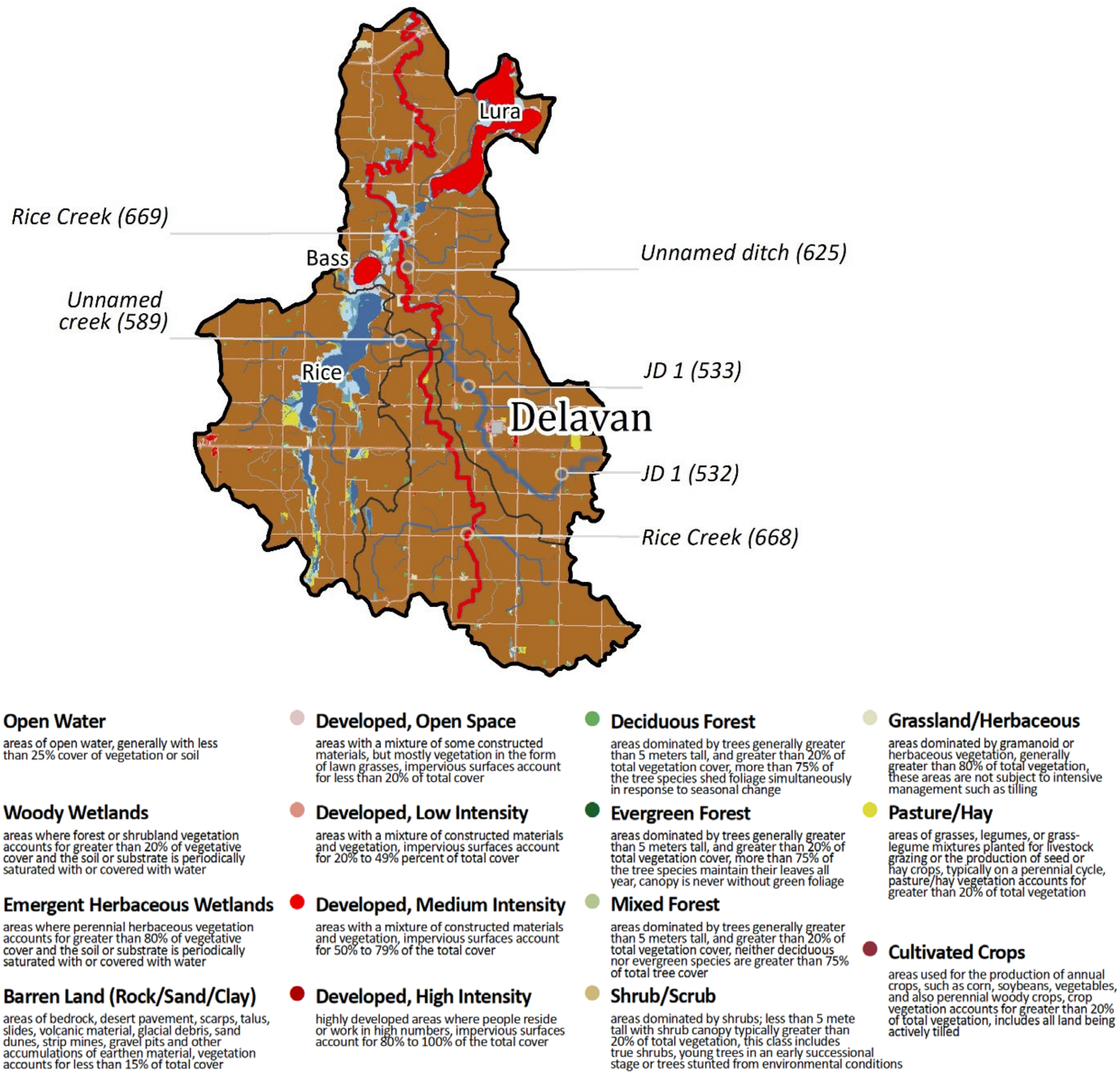
Cultivated cropland, developed land uses and open water areas make up the majority of the land cover in the project area (Table 5, Figure 4). Cultivated cropland was explored further using data products from the USDA's National Agricultural Statistics Service (NASS) Cropland Data Layer (CDL) and the Census of Agriculture (MPCA review). In the project area the dominant crop types from the 2016 CDL are corn and soybeans (Table 6, Figure 5).

Table 5. Percent of HUC10 watershed land use by 2016 NLCD classification MPCA

Land use classification	**Acres**	**Total**
Water	2,185	4%
Low Intensity and Open Space Development	1,972	4%
Medium and High Intensity Development	98	<1%
Barren	27	<1%
Forest (all types) and shrub/scrub	265	<1%
Rangeland (Grassland/Herbaceous and Pasture/Hay)	897	2%
Cultivated Crops	44,149	83%
Wetlands (all types)	3,407	6%
Total	**53,000**	**100%**

Figure 4 illustrates land uses by using brown for cropland, red for impaired lakes and streams, dark blue for open water, light blue for wetlands, and yellow for hay/pasture land.

Figure 4. Land use in the Rice Creek Watershed



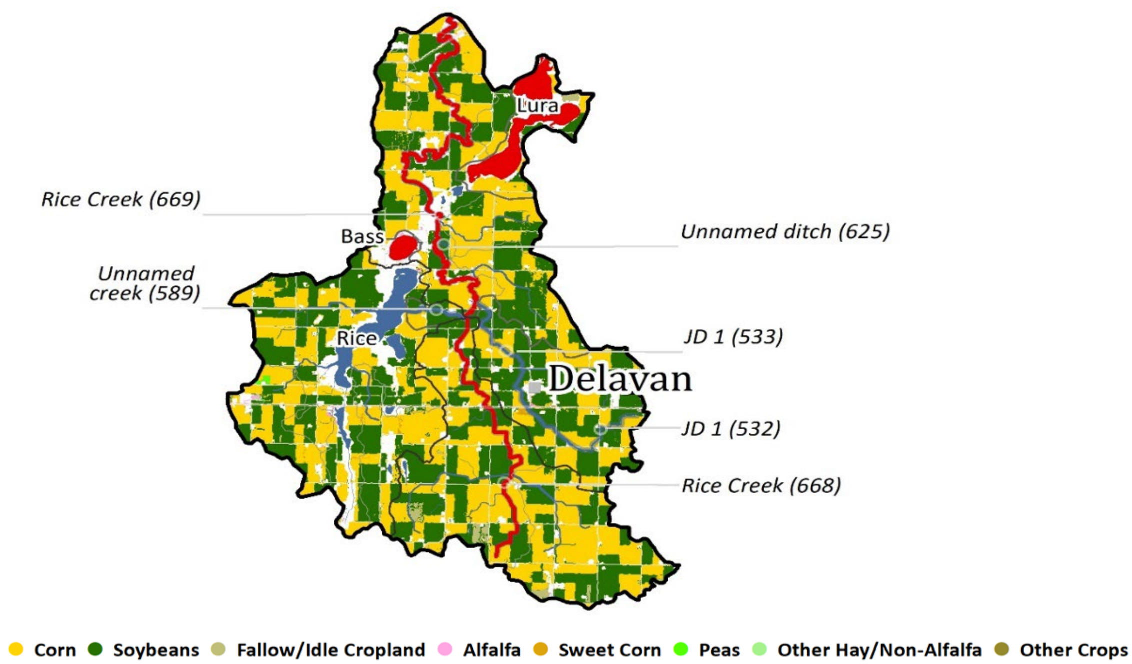
Corn and soybeans make up the majority of crops grown in the Rice Cree Watershed (Table 6). A very small amount of hay and other crops are grown.

Table 6. Cropland from 2019 (USDA NASS 2019)

Watershed	Crop	83% ag of 53000 acres= 43990 ag	2019 Average (% cover)
Rice Creek	Corn	21,713	49%
	Soybean	21,590	49%
	Other crops	131	<1%
	Leguminous hay (alfalfa)	118	<1%
	Non-leguminous hay (other hay/ non alfalfa)	30	<1%

Watershed	Crop	83% ag of 53000 acres= 43990 ag	2019 Average (% cover)
	Fallow / Idle Cropland	408	<1%

Figure 5. Crops in Rice Creek Watershed



In Figure 5, corn is represented by yellow and soy beans are represented by green. Impaired water bodies are in red, with unimpaired streams and lakes in blue. Uncultivated lands are white. Less than 1% of cropland is planted in crops other than corn or soy.

Table 7. Acres of harvested cropland in Faribault County (2012 Census of Agriculture)

Crop	Harvested acres	% Total cropland
Corn (grain)	199,803	55%
Soybeans	150,363	41.5%
Vegetables	5,585	1.5%
Sweet Corn	3,929	<1%
Forage	2,639	<1%
Total cropland	**362,319**	**100%**

Total cropland includes Alfalfa, Other Hay/Non-Alfalfa, and Fallow/Idle Cropland and therefore does not equal the sum of the listed crops

Wastewater

Wastewater treatment and handling within the watershed is important as it may impact bacteria and nutrient loading to waterways and waterbodies. Municipal and industrial wastewater treatment facilities are regulated through National Pollutant Discharge Elimination System permits. These permits include pollutant effluent limits designed to meet water quality standards, along with monitoring and reporting requirements to ensure effluent limits are met. The City of Delevan wastewater treatment facility (Permit number MNG580109 discharges to Judicial Ditch 1. Rural residents are served by subsurface treatment systems (SSTS), including development around Bass and Lura Lakes.

Climate and precipitation

The climate of the project area is typical of southcentral Minnesota. The long-term average annual precipitation is 32.5 inches per year based on records from the Minnesota State Climatology Office for the Le Sueur River HUC-8 watershed. Most of the precipitation (70%) occurs between March and August with the large percentage of the remainder falling between November and February as mostly snow. The normal average annual temperature in the watershed is 45 degrees Fahrenheit (F) with the winter and summer normal average temperatures being 18 degrees and 70 degrees F, respectively. The average minimum and maximum temperatures are 10 degrees and 80 degrees F, respectively. (DNR WHAF include site). Figure 6 illustrates the precipitation in Rice Creek Watershed 1989 to 2018.

Detailed weather data for the Le Sueur River HUC-8 watershed along with other weather stations and volunteer observation sites are available at http://climate.umn.edu.

Figure 6. Precipitation in Rice Creek Watershed

Conclusion

To quote Chief Seattle, "What's written on the land is read in the water," this describes the Rice Creek watershed and its land use conversion. These changes along with changing climate, precipitation amount and timing, have affected the supply of nutrients, sediment and pathways of hydrology to create the issues with the functioning of the stream channel and biologic diversity.

Intensive agricultural practices have changed the hydrologic system through an increased drainage network designed to remove more water faster through an increased drainage system. This system needs to find a new balance to improve stream function and biology. Practices will be designed to decrease nutrient loading and improve stream function.

Water quality and quantity

Water quality standards

The federal Clean Water Act requires states to designate beneficial uses for all waters and develop water quality criteria to protect each use. Water quality standards consist of several parts:

- Beneficial uses — Identify how people, aquatic communities, and wildlife use our waters
- Numeric criteria — Amounts of specific pollutants allowed in a body of water and still protects it for the beneficial uses
- Narrative criteria — Statements of unacceptable conditions in and on the water
- Antidegradation protections — Extra protection for high-quality or unique waters and existing uses

Together, the beneficial uses, numeric and narrative criteria, and antidegradation protections provide the framework for achieving Clean Water Act goals.

Minnesota's water quality standards are provided in Minnesota Rules chapters 7050. All current state water rules administered by the MPCA are available on the Minnesota water rules page (https://www.pca.state.mn.us/water/water-quality-rules).

Beneficial uses

The beneficial uses for public waters in Minnesota are grouped into one or more classes as defined in Minn. R. ch. 7050.0140. The classes and beneficial uses are:

- Class 1 – domestic consumption
- Class 2 – aquatic life and recreation
- Class 3 – industrial consumption
- Class 4 – agriculture and wildlife
- Class 5 – aesthetic enjoyment and navigation
- Class 6 – other uses and protection of border waters
- Class 7 – limited resource value waters

The aquatic life use class now includes a tiered aquatic life uses (TALU) framework for rivers and streams. The framework contains three tiers—exceptional, general, and modified uses. All surface waters are protected for multiple beneficial uses.

Numeric criteria and state standards

Narrative and numeric water quality criteria for all uses are listed for four common categories of surface waters in Minn. R. ch. 7050.0220. The four categories are:

- Cold water aquatic life and habitat, also protected for drinking water: classes 1B; 2A, 2Ae, or 2Ag; 3A or 3B; 4A and 4B; and 5
- Cool and warm water aquatic life and habitat, also protected for drinking water: classes 1B or 1C; 2Bd, 2Bde, 2Bdg, or 2Bdm; 3A or 3B; 4A and 4B; and 5
- Cool and warm water aquatic life and habitat and wetlands: classes 2B, 2Be, 2Bg, 2Bm, or 2D; 3A, 3B, 3C, or 3D; 4A and 4B or 4C; and 5

- Limited resource value waters: classes 3C; 4A and 4B; 5; and 7

The narrative and numeric water quality criteria for the individual use classes are listed in Minn. R. ch. 7050.0221 through 7050.0227. The procedures for evaluating the narrative criteria are presented in Minn. R. ch. 7050.0150.

The MPCA assesses individual water bodies for impairment for class 2 uses—aquatic life and recreation. Class 2A waters are protected for the propagation and maintenance of a healthy community of cold water sport or commercial fish and associated aquatic life and their habitats. Class 2B waters are protected for the propagation and maintenance of a healthy community of cool or warm water sport or commercial fish, and associated aquatic life and their habitats. Both class 2A and 2B waters are also protected for aquatic recreation activities including bathing and swimming.

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

Protection of aquatic life entails the maintenance of a healthy aquatic community as measured by fish and macroinvertebrate IBIs. Fish and invertebrate IBI scores are evaluated against criteria established for individual monitoring sites by water body type and use subclass (exceptional, general, and modified).

The ecoregion standard for aquatic recreation protects lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential.

Antidegradation policies and procedures

The purpose of the antidegradation provisions in Minn. R. ch. 7050.0250 through 7050.0335 is to achieve and maintain the highest possible quality in surface waters of the state. To accomplish this purpose:

1. Existing uses and the level of water quality necessary to protect existing uses shall be maintained and protected.
2. Degradation of high-water quality shall be minimized and allowed only to the extent necessary to accommodate important economic or social development.
3. Water quality necessary to preserve the exceptional characteristics of outstanding resource value waters shall be maintained and protected.
4. Proposed activities with the potential for water quality impairments associated with thermal discharges shall be consistent with section 316 of the Clean Water Act, United States Code, title 33, section 1326.

Standards and criteria

The waters in the project area are primarily designated as class 2B waters. The water quality standards and criteria used in assessing the waters include the following parameters:

- *Escherichia (E.) coli* – not to exceed 126 organisms per 100 milliliters as a geometric mean of not less than five samples representative of conditions within any calendar month, nor shall more than ten% of all samples taken during any calendar month individually exceed 1,260 organisms per 100 milliliters. The standard applies between April 1 and October 31.
- Dissolved oxygen (DO) – daily minimum of 5 mg/L.
- pH – to be between 6.5 and 9.0 pH units.
- Total suspended solids – 65 mg/L not to be exceeded more than 10% of the time between April 1 and October 31.
- Stream eutrophication – based on summer average concentrations for the South River Nutrient Region
  - Total phosphorus concentration less than or equal to 150 µg/L and
  - Chlorophyll-a (seston) concentration less than or equal to 35 µg/L or
  - Diel dissolved oxygen flux less than or equal to 4.5 mg/L or
  - Five-day biochemical oxygen demand concentration less than or equal to 3.0 mg/L.
  - If the TP criterion is exceeded and no other variable is exceeded, the eutrophication standard is met.
- Lake eutrophication – based on summer average concentrations in the Western Corn Belt Plains ecoregion:
  - Deep lakes: Total phosphorus less than 65 µg/L and chlorophyll-a less than 22 µg/L or transparency not less than 0.9 meters.
  - Shallow lakes: Total phosphorus less than 90 µg/L and chlorophyll-a less than 30 µg/L or transparency not less than 0.7 meters.
- Biological indicators – The basis for assessing the biological community are the narrative water quality standards and assessment factors in Minn. R. 7050.0150. Attainment of these standards is measured through sampling of the aquatic biota and is based on impairment thresholds for indices of biological integrity (IBI) that vary by use class.

Streamflow

Flow data were obtained from the Minnesota Department of Natural Resources (DNR)/MPCA Cooperative Stream Gauging program. This data was used in the HSPF modeling for the Le Sueur River TMDL. The Rice Creek watershed flows were estimated for the time period of 1996-2009 (Figure 7 or Figure 8). A flow duration curve was created to understand flow conditions and to help in determining loading and reductions need in the watershed.

Figure 7. HSPF Modeled Flow Data Rice Creek, 1996-2009 (MPCA)

Flow Duration Interval

Water quality data

Water quality data are present for three lakes, two tributary streams to Rice Creek and the mainstem stream of Rice Creek in the subwatershed from 24 stations. Water quality data were obtained from the MPCA Environmental Quality Information System (EQuIS) database.

Table 8. Select water quality data from EQuIS, Rice Creek 07020011-668, -669 (S002-431, S005-466, S006-175, S006-365, S006-596, S006-597, S006-598, S006-599, S006-601)

Sample species	Number of samples	Sample mean	Sample median	Sample range	Units	Sample date range
Chl-*a*	23	9 .9	6.73	1.0 -37.2	ug/L	6/18/2008-9/27/2019
DO	68	8	7.825	3.46-14.6	mg/L	5/6/2008-9/27/2019
E. coli	33	434	310	70-2909	MPN/100 rnl	6/4/2008-8/30/2019
Orthophosphate	9	0.29	0.346	0 .08-0.39	m L	3/22/2010-8/30/2010
pH	47	8.08	8.04	7.45-9.12	None	5/6/2008-9/27/2019
Phosphorus	39	0 .19	0.186	0 .066-0.396	mg/L	5/6 2008-9/27/2019
Specific Conductance	76	582	581.5	297-1217	uS/ cm	4/8/1996-9/27/2019
Stream Condition	369	None	NA	None	NA	5/7/2003-10/4/2019
Water Temperature	88	20.50	21.6	4.52-30.80	deg C	5/7/2003-9/27/2019
Transparency Tube	389	16.40	14	4.0 4	cm	5/7/2003-10/4 2019
Turbidity	26	20.5	15	7,f,.72		5/22/2008-3/22/2010
TSS	22	31.1	15	9,f,.57	mg/L	5/6/2008-9/4/2019

Table 9. Select water quality data from EQuIS, Unnamed Stream 07020011-589 (S006-177)

Sample species	Number of samples	Sample mean	Sample median	Sample range	Units	Sample date range
DO	3	2.79000	2.8	.74-4.62	mg/l	6/29/10-7/15/20
Inorganic nitrogen	1	1.70	1.7	1.7	mg/l	7/21/2010
Orthophosphate	1	0.034	0.03	0.034	mg/L	6/30/2010

Sample species	Number of samples	Sample mean	Sample median	Sample range	Units	Sample date range
pH	1	7.55	7.55	7.55	None	6/29/2010
Phosphorus	1	0.1130	0.1130	0.113	mg/L	7/26/2010
Specific conductance	1	450	450	450	uS/cm	6/29/2010
Stream condition	2	NA	NA	NA	NA	7/14/10 - 7/5/10
Water temperature	3	25.2	25.4	21.8-28.3	degC	6/29/10 - 7/15/10
Transparency tube	3	27.5	19	16-5-47	cm	6/29/2010 -7/15/2010

Table 10. Select water quality data from EQuIS, Judicial Ditch 1 07020011-532, -533 (S006-600, S003-377)

Sample species	Number of samples	Sample mean	Sample median	Sample range	Units	Sample date range
Chl-a	2	9.44000	9.4	7.59-11.29	mg/L	*7/14/2010-7/15/2010*
Stream condition	57	NA	NA	NA	NA	3/30/2004-7/15/2010
Water temperature	2	20.300	20.30	17.7-22.9	deg C	7/14/2010-7/15/2010
Transparency tube	59	41.60	43.00	7.0-60.0	cm	3/30/2004-7/15/2010

Table 11. Select water quality data from EQuIS, Rice Lake (22-0075-00-101, 22-0075-00-201, 22-0075-00-202, 22-0075-00-203)

Sample species	Number of samples	Sample mean	Sample median	Sample range	Units	Sample date range
Chl-a	8	25.31375	12.4	2.13=123	ug/L	5/27/2008-9/17/2013
Depth, Secchi	9	.65	.6	.25-1.5	m	7/14/2004-9/17/2013
DO	5	7.278	7.44	3.3-10.27	mg/L	5/27/2008-7/22/2008
pH	3	8.65	8.92	7.64-9.39	None	7/9/2008-7/22/2008
Phosphorus	10	.1951	.1395	.01-.683	mg/L	7/14/2008-9/17/2013
Specific conductance	5	296	267	212-402	uS/cm	7/14/2004-8/11/2011
Water temperature	9	21.33	23.9	14-26.67	deg C	7/14/2004-9/17/20013
TSS	5	12.8	7.6	2.4-42	mg/L	5/27/2008-9/23/2008

Table 12. Select water quality data from EQuIS, Bass Lake, (22-0074-00-100, 22-0074-00-201)

Sample species	Number of samples	Sample mean	Sample median	Sample range	Units	Sample date range
Chl-a	47	48.89	38.4	6.73-148	ug/L	9/10/1981-9/25/2019
Depth, Secchi	189	1.01	.9	.3-4.42	M	9/10/1981-9/25/2019
DO	203	7.27	8.88	0-18/2	mg/L	9/10/1981-8/29/2019
pH	83	8.59	8.74	6.93-9.33	Non	9/10/1981-8/29/2019
Phosphorus	67	.07	.06	.036-.191	mg/L	9/10/1981-9/25/2019
Specific conductance	79	356.2	252.4	300-440	uS/cm	4/22/1981-8/29/2019
Water temperature	203	21.78	22.41	10.1-29.1	deg C	9/10/1981-8/29/2019
TSS	86	168.76	224	3.2-280	mg/L	4/22/1981-8/29/2019
Turbidity	21	7.3	5	1.5-20	NTRU	4/11/1981-9/2004

Table 13. Select water quality data from EQuIS, Lura Lake (07-0079-00-100, 07-0079-00-101, 07-0079-00-103, 07-0079-00-201, 07-0079-00-202, 07-0079-00-203)

Sample species	Number of samples	Sample mean	Sample median	Sample range	Units	Sample date range
Chl-a	17447	35.61	10.5	.23-468	ug/L	9/10/1981-9/24/2018
Depth, Secchi	300	1.29	1.2	.15-3.1	M	9/10/1981-9/24/2018
DO	336	8.3	7.7	1.2-8.69	mg/L	9/10/1981-9/24/2018
Orthophosphate	128	.07	.03	.005-.409	mg/L	4/30/2009-10/22/201
pH	222	8.89	8.8	6.02-11.9	Non	9/10/1981-9/24/2018
Phosphorus	177	.13	.11	.02-.558	mg/L	9/10/1981-9/24/2018
Specific conductance	230	322.23	307.95	201.6-1910	uS/cm	6/7/1994-9/24/2018
Lake condition	278	NA	NA	NA	NA	9/10/1981-9/24/2018
Water temperature	337	20.54	22	1-30.9	deg C	9/10/1981-9/24/2018
TSS	155	8.75	6	1-63	mg/L	6/7/1994-10/22/2010
Turbidity	22	9.37	6	.99-50	NTRU	6/7/1994-9/16/2004

Total suspended solid (TSS) data

Rice Creek was initially assessed then listed impaired in 2010 for poor aquatic life use water quality based on violating turbidity, TSS and STUBE data from 2001 to 2009 at two stations S002-431 and S006-455 (Table 14, Table 15, Table 16, and Table 17). The Minnesota River and Greater Blue Earth TSS TMDL was completed in 2020. Rice Creek was included, and the assessment information is included below.

Newer data for TSS taken at the downstream station in 2018 and 2019 did not have a single violation across 11 samples. A much larger STUBE dataset bolstered by citizen monitoring reveals low clarity associated with high sediment concentrations is still occurring when given more historical context.

Based on the location of the original turbidity listing data and the current STUBE dataset the reach impairment is in need of reductions in order to be considered for delisting. Total phosphorus is elevated in violation of criteria, there is not a significant response clear in the chl-a dataset, no RES listing purposed at this time. Dissolved oxygen has a few violations, two relatively weak in magnitude, noted are some higher values during daytime hours in the summer months suggests diurnal flux may be erratic.

Table 14. Annual summary of TSS data at Rice Creek (AUID 07020011-531; April–September)

Year	Sample count	Mean (mg/L)	Minimum (mg/L)	Maximum (mg/L)	Number of exceedances	Frequency of exceedances
2008	14	40	10	110	2	14%

Table 15. Monthly summary of TSS data at Rice Creek (AUID 07020011-531; 2008)

Month	Sample count	Mean (mg/L)	Minimum (mg/L)	Maximum (mg/L)	Number of exceedances	Frequency of exceedances
January	0	–	–	–	n/a	–
February	0	–	–	–	n/a	–
March	0	–	–	–	n/a	–
April	0	–	–	–	–	–
May	2	37	26	47	0	0%
June	3	42	18	56	0	0%
July	4	51	15	88	1	25%
August	3	45	10	110	1	33%
September	2	10	10	11	0	0%
October	0	–	–	–	n/a	–
November	0	–	–	–	n/a	–
December	0	–	–	–	n/a	–

Table 16. Annual summary of transparency tube data at Rice Creek (AUID 07020011-531; April–September)*

Year	Sample count	Mean (cm)	Minimum (cm)	Maximum (cm)
2006	0	–	–	–
2007	0	–	–	–
2008	50	19	4	64
2009	32	15	6	34
2010	46	25	8	60
2011	22	15	8	30
2012	16	8	7	10
2013	22	16	6	24
2014	17	14	4	20
2015	22	14	6	26

* In previous assessment cycles, a transparency tube measurement of less than 20 cm indicated a violation of the 25 NTU turbidity standard.

Table 17. Monthly summary of transparency tube data at Rice Creek (AUID 07020011-531; 2006–2015) *

Month	Sample count	Mean (cm)	Minimum (cm)	Maximum (cm)
January	0	–	–	–
February	0	–	–	–
March	2	15	8	21
April	35	16	4	31
May	41	17	4	33
June	45	14	4	59
July	59	20	8	60
August	34	18	7	46
September	13	16	8	64
October	0	–	–	–
November	0	–	–	–
December	0	–	–	–

* In previous assessment cycles, a transparency tube measurement of less than 20 cm indicated a violation of the 25 NTU turbidity standard.

E. coli data

E.coli data are provided in Table 18 as summarized in the Le Sueur River Watershed TMDL (MPCA 2015). Samples were collected from Rice Creek (S002-431) in 2008 and 2009 for assessment purposes during the Le Sueur River Watershed assessment process. Geomeans of the annual data regularly exceeded the 126 MPN/100 mL standard with one exceedance of the maximum value of the 1,260 MPN/100 mL standard seen in June of 2009.

Table 18. *E.coli* geometric means for Rice Creek 2008-2009 (Le Sueur TMDL)

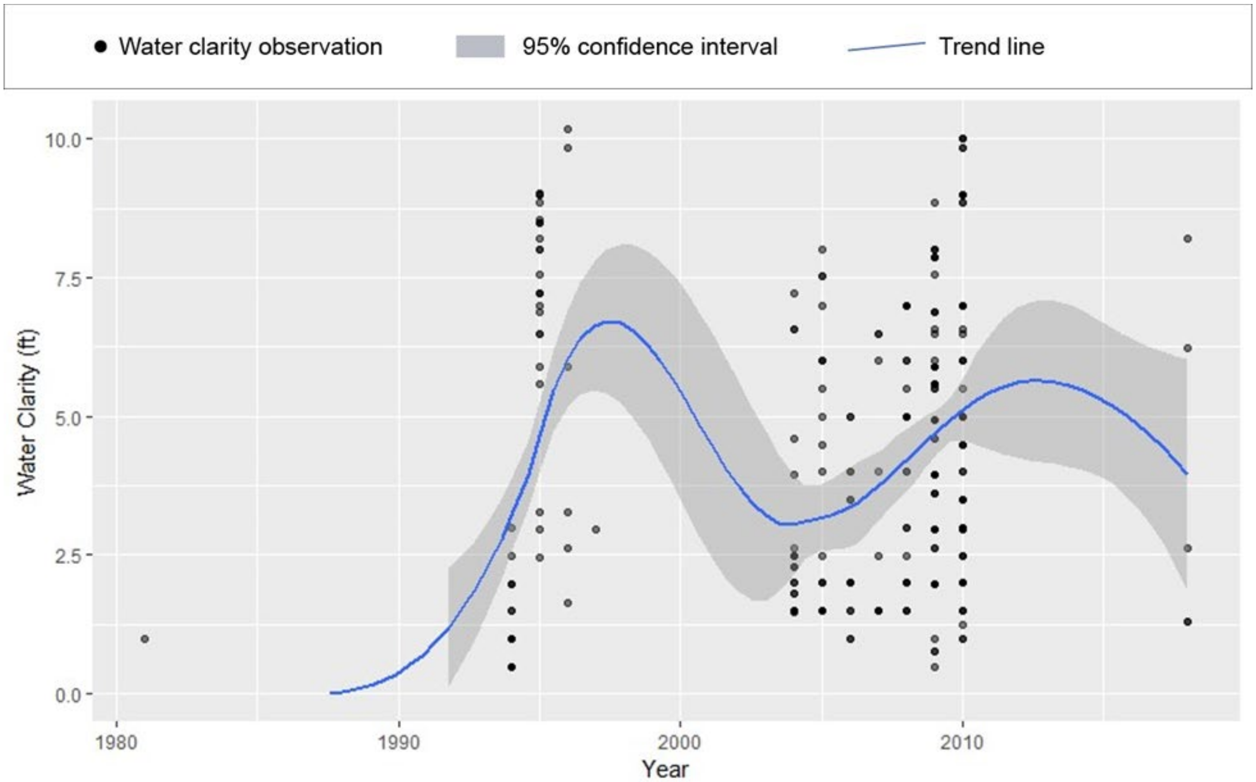
Site	Range of data (org.mL)	Geometric mean (org/mL) [number of samples]	Geometric mean(org/mL) [number of samples]						
			Apr	May	Jun	Jul	Aug	Sep	Oct
Rice – 531	70-2909	319 [17]	-	-	378 [6]	417 [5]	216 [6]	-	-

The reach was initially assessed then listed impaired in 2010 for poor recreational water quality based on violating bacteria data from 2008 and 2009 at S002-431. Since completion of the TMDL report, newer bacteria data was collected for assessment at S002-431 in 2018 and 2019 associated with Cycle 2 monitoring efforts. While there are no individual violations of the 1260 org/100 mL criteria, a persistently high pattern of bacterial contamination is still clear in the recent dataset. Three of three months with minimum data requirement for mean calculations violate the 126 org/100 mL criteria confirming the initial impairment.

Nutrients

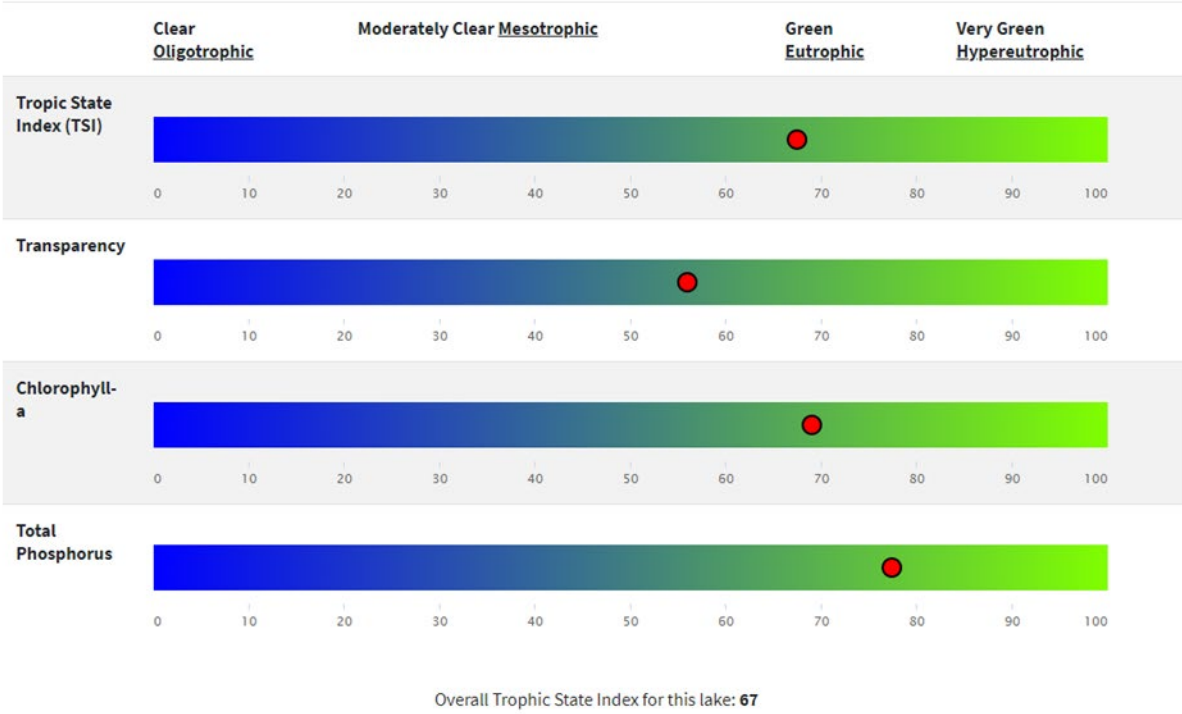
Water clarity data for Lura Lake was found at https://webapp.pca.state.mn.us/surface-water/impairment/07-0079-00. Trend data is illustrated in Figure 9.

Figure 9. Water clarity trends for Lura Lake (07-0079-00) 1980-2020



Data indicated that the overall condition of Lura Lake is not conducive to water recreation, such as swimming, because of high algal growth and low clarity. Lura Lake is described as green eutrophic (Figure 11). The Trophic State Index (TSI) provides a number as a summary of the lake's nutrients. Figure 11 includes the TSI, but also the data scores that inform the TSI. This data is found https://webapp.pca.state.mn.us/surface-water/impairment/07-0079-00, under the water quality summary tab.

Figure 11. Trophic State Index for Lura Lake 07-0079-00, June – September 2008-2017



The majority of the water transparency data were collected by Citizen Lake Monitoring Program Volunteers. The transparency, Chl-a, and TP are summarized in Figure 10.

Figure 10. 10-year summary of transparency data for Lura Lake

Parameters	10-Year average of all summer samples	Parameter TSI	Expected TSI range of lakes in same ecoregion	Number of samples
Transparency (meters)	1	56	60 - 70	46
Chlorophyll-a (parts per billion)	50	69	64 - 74	28
Total Phosphorus (parts per billion)	160	77	64 - 76	30

Water quality impairment assessments

Rice Creek had sufficient data to be assessed for water quality impairments from various projects and watershed assessment studies. Rice Creek was listed as impaired for turbidity in 2010 and *E. coli* bacteria in 2012.

A TMDL for the *E. coli* impairment was completed in 2016 as part of the Le Sueur River Watershed TMDL. The Rice Creek turbidity impairment was included in the Minnesota River Greater Blue Earth River TSS TMDL approved in 2020. TMDL for the Lura Lake Nutrient impairment was completed in 2014.

Biological monitoring and assessment

The MPCA analyzes the chemistry of the water samples it collects in rivers and streams. But biological monitoring can often detect water quality problems that water chemistry analysis misses or underestimates. One measure of lake or stream health is the community of fish, and other aquatic life it sustains (i.e., biological community). Certain species cannot survive without clean water and a healthy habitat while other species are tolerant of degraded conditions. Chemical pollutants, agricultural runoff, hydrologic alterations such as stream bed alterations and damming, and other human activities have cumulative effects on biological communities over time. The condition of these communities represent the condition of their aquatic environment. An index of biological integrity (IBI) is a score that compares the types and numbers of fish and other aquatic life observed in a lake or stream to what is expected for a healthy lake or stream.

The Minnesota Pollution Control Agency (MPCA) has developed IBIs to assess biological communities in streams and rivers in Minnesota. For more information on these IBIs, go to the MPCA index of biological integrity and biological monitoring of water in Minnesota webpages. The DNR has developed IBIs for fish communities in lakes. Sampling gears used include gill netting, trap netting, seining and backpack electrofishing to collect the fish community information needed to calculate an IBI score for a lake. More information about these measurements and the species included in each can be found on the classification of fish species in Minnesota lakes webpage. Often, multiple scores are considered when making an assessment on an individual lake or stream. The assessment decisions can be used by MPCA, local governments and conservation groups, lake associations and homeowners to guide future lake management actions.

Table 19. Macroinvertebrate Index of Biotic Integrity monitoring results for the Rice Creek Watershed.

Stream reach	Field Num	Visit Date	Macroinvertebrate IBI	Threshold	Assessment status
Unnamed Creek (589)	08MN009	8/13/2008	36.26	37	Impaired
Unnamed Creek (589)	08MN009	8/8/2018	10.12	37	Impaired
Rice Creek (669)	08MN004	8/22/2008	46.17	41	Supporting
Rice Creek (669)	08MN004	8/8/2018	52.01	41	Supporting
Rice Creek (669)	08MN010	8/12/2008	22.61	37	Impaired
Rice Creek (669)	08MN076	8/13/2008	38.26	41	Impaired
Rice Creek (669)	08MN076	8/5/2020	32.38	41	Impaired
Rice Creek (669)	08MN086	8/14/2008	30.91	41	Impaired
Rice Creek (669)	18MN001	8/8/2018	38.07	41	Impaired
Judicial Ditch 1 (533)	08MN011	8/13/2008	29.22	41	Impaired
Judicial Ditch 1 (533)	08MN011	8/13/2008	18.24	41	Impaired
Judicial Ditch 1 (532)	08MN077	8/12/2008	17.93	41	Impaired

Table 20. Fish Index of Biotic Integrity monitoring results for the Rice Creek Watershed.

Stream reach	Station	Visit Date	Fish IBI	Threshold	Assessment status
Unnamed Creek (589)	08MN009	7/31/2018	36.7	55	Impaired
Unnmaed Creek (589)	08MN009	6/23/2008	34.0	55	Impaired
Rice Creek (669)	08MN004	7/15/2019	46.4	50	Impaired
Rice Creek (669)	08MN004	7/23/2008	45.4	50	Impaired
Rice Creek (669)	08MN010	6/23/2008	52.2	55	Impaired
Rice Creek (669)	08MN076	8/6/2008	30.2	50	Impaired
Rice Creek (669)	08MN086	7/30/2008	47.2	50	Impaired
Rice Creek (669)	18MN001	7/31/2018	47.0	55	Impaired
Judicial Ditch 1 (533)	08MN011	6/25/2008	27.9	55	Impaired
Judicial Ditch 1 (532)	08MN077	7/14/2008	37.1	55	Impaired

Stream habitat assessment

Habitat, as identified in this report, refers to the in- and adjacent-stream habitat. Important stream habitat components include stream size and channel dimensions, channel gradient (slope), channel substrate, habitat complexity, and in-stream and riparian zone vegetation. Degraded habitat reduces aquatic life's ability to feed, shelter, and reproduce, which results in altered behavior, increased mortality, and decreased populations. Habitat characteristics are recorded using a qualitative, observation-based method (modified from: Rankin 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application. Ohio EPA, Division of Water Quality Planning and Assessment, Ecological Analysis Section, Columbus, Ohio.). Although similar to the Ohio QHEI, the MSHA has been modified to more adequately assess important characteristics influencing Minnesota streams. The MSHA scores assessed at biological sample locations (used in part combined with biological community attributes to assess habitat within a stream reach).

The MSHA incorporates measures of watershed land use, riparian quality, bank erosion, substrate type and quality, instream cover, and characteristics of channel morphology, stability, and development.

Generally, "good" habitat scores (>65) are necessary to support healthy, aquatic communities. Of the nine bio stream sites assessed for habitat, only three were found to have a fair (MSHA >45) rating. The rest of the sites had a poor habitat rating (MSHA<45). MPCA Stream Habitat Assessment (MSHA) scores in the Rice Creek Watershed range from 28 to 57.5 (Table 21).

Table 21. MSHA stream habitat assessment results for the Rice Creek Watershed.

Station number	Stream	Visit date	MSHA	Habitat rating
08MN011	Judicial Ditch 1	25-Jun-08	48.2	Fair
08MN077	Judicial Ditch 1	14-Jul-08	38	Poor
08MN004	Rice Creek	23-Jul-08	40.5	Poor
08MN004	Rice Creek	08-Aug-18	38.5	Poor
08MN004	Rice Creek	15-Jul-19	48	Fair
08MN010	Rice Creek	23-Jun-08	42	Poor
08MN076	Rice Creek	06-Aug-08	42	Poor
Station number	Stream	Visit date	MSHA	Habitat rating
08MN076	Rice Creek	05-Aug-20	29.5	Poor
08MN086	Rice Creek	30-Jul-08	57.5	Fair
18MN001	Rice Creek	31-Jul-18	32.5	Poor
18MN001	Rice Creek	08-Aug-18	28	Poor
08MN009	Trib. to Rice Creek	23-Jun-08	37.9	Poor
08MN009	Trib. to Rice Creek	31-Jul-18	43	Poor
08MN009	Trib. to Rice Creek	08-Aug-18	37	Poor

Watershed TMDLs

Fecal coliform and turbidity/TSS TMDLs have been developed to address the impaired stream reaches in the project area. Lura Lake has a completed nutrients TMDL. A summary of the reductions needed to achieve TMDLs is provided in Table 22. The reductions and loading estimates were calculated using the EPA's Spreadsheet Tool for Estimating Pollutant Loading (STEPL).

Table 22. Summary of TMDL and goal reductions in the Rice Creek Subwatershed

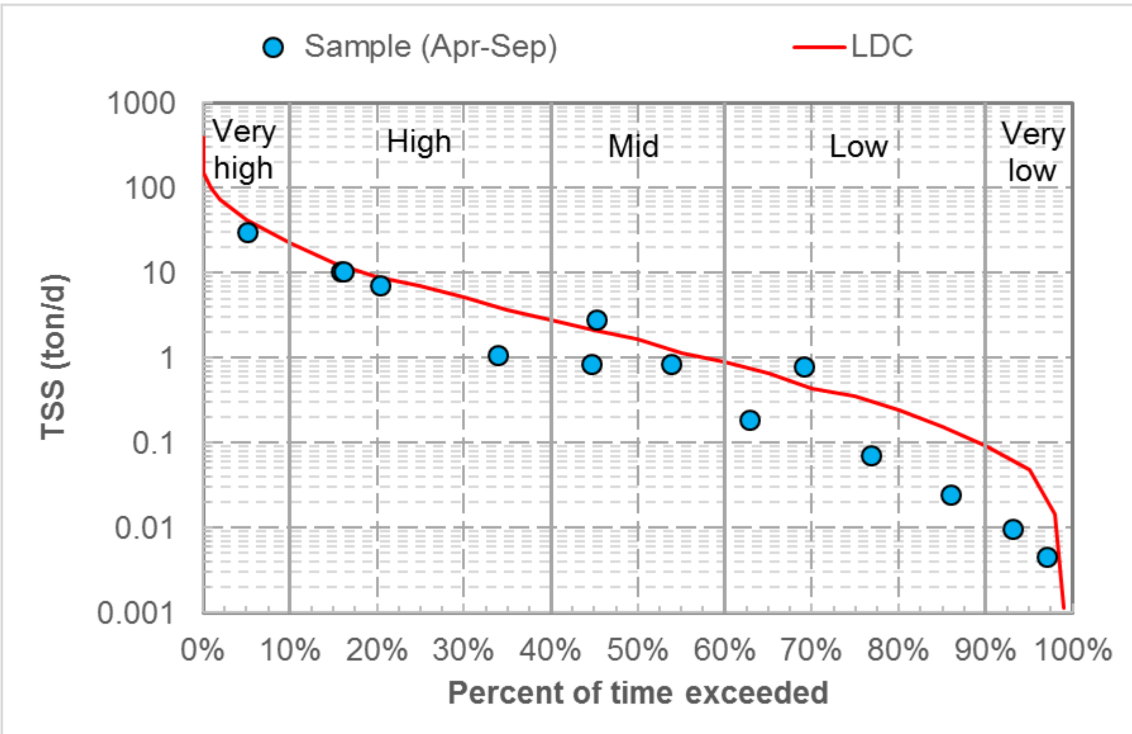
Waterbody	TSS t/yr	TP	*E. coli* Billion MPN/yr	TN
Rice Creek -531	2,316	37432*	191,761	178,379*
Lura Lake		4,035		4,126*

* Watershed goal, no TMDL for this pollutant

Minnesota River and Greater Blue Earth River Basin TSS TMDL Report

Rice Creek (07020011-531) was added to Minnesota's impaired waters list in 2010 for turbidity. The listing was addressed in a TSS TMDL for the larger Minnesota River and Greater Blue Earth River Basins (MPCA 2019a). The TSS TMDL study determined the load duration curve for Rice Creek (Table 12). The needed reduction for Rice Creek is 127 t/yr.

Figure 12. TSS load duration curve, Rice Creek



The Rice Creek TSS TMDL summary is described in Table 23.

Table 23. TSS TMDL summary, Rice Creek (MPCA 2019b)

TMDL parameter	Flow regimes				
	Very high	High	Mid	Low	Very low
	TSS load (ton/d)				
WLA: Industrial/Construction stormwater	0.075	0.012	0.0028	0.00047	–[b]
WLA: Wastewater	0.076	0.076	0.076	0.076	–[a]
Load allocation	38	6.2	1.5	0.24	–[b]
Margin of safety	4.2	0.70	0.17	0.035	0.0048
Loading capacity	42	7.0	1.7	0.35	0.048
Existing concentration (mg/L)	79				
Percent reduction to Achieve concentration standard	17%				

[a] Permitted wastewater design flows exceed stream flow in the indicated flow zone(s). The allocations are expressed as an equation rather than an absolute number: allocation = flow contribution from a given source x 65 mg/L (or NPDES permit concentration). See Municipal and Industrial Wastewater (Section 5.4.1) for more detail.

[b] Unable to calculate allocations because the wastewater WLA exceeds the loading capacity. The allocations are expressed as an equation rather than an absolute number: allocation = flow contribution from a given source x 65 mg/L. See Sections 5.4.2 and 5.6 for more detail.

Fecal Coliform TMDL

Rice Creek was added to Minnesota's impaired waters list in 2012 for excess *E. coli* concentrations. The listings were addressed in the Le Sueur River Watershed TMDL (MPCA 2016) The TMDL for Rice Creek is provided in Table 24. Monthly and daily fecal coliform loading capacities and allocations for Rice Creek (MPCA 2016).

Table 24. Monthly and daily fecal coliform loading capacities and allocations for Rice Creek (MPCA 2016).

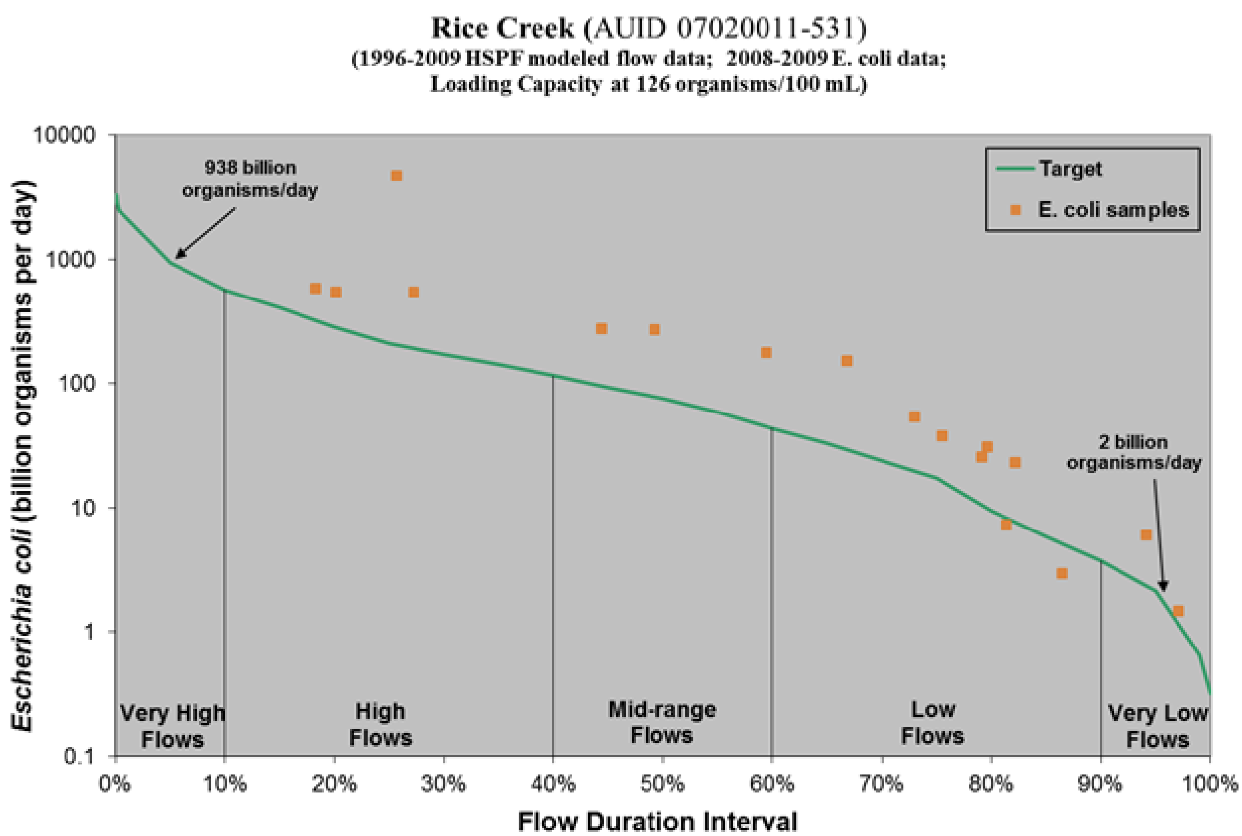


Table 25. *E. coli* TMDL summary for Rice Creek (AUID# 07020011-531)

Rice Creek Headwaters to Maple River	Flow Zone				
	Very High	High	Mid	Low	Very Low
	Billion organisms per day				
Average daily loading capacity	938	209	76	17	2
Margin of Safety	94	21	8	2	NA
Wasteload Allocation*					
Wastewater treatment facilities	2	2	2	2	***
Livestock facilities requiring NPDES permits	0	0	0	0	0
"Straight Pipe" Septic Systems	0	0	0	0	0
Load Allocation	842	186	66	13	***

It was determined that the reduction needed for Rice Creek -531 is 39,958 billion MPN/year (Table 25).

Lura Lake Nutrient TMDL

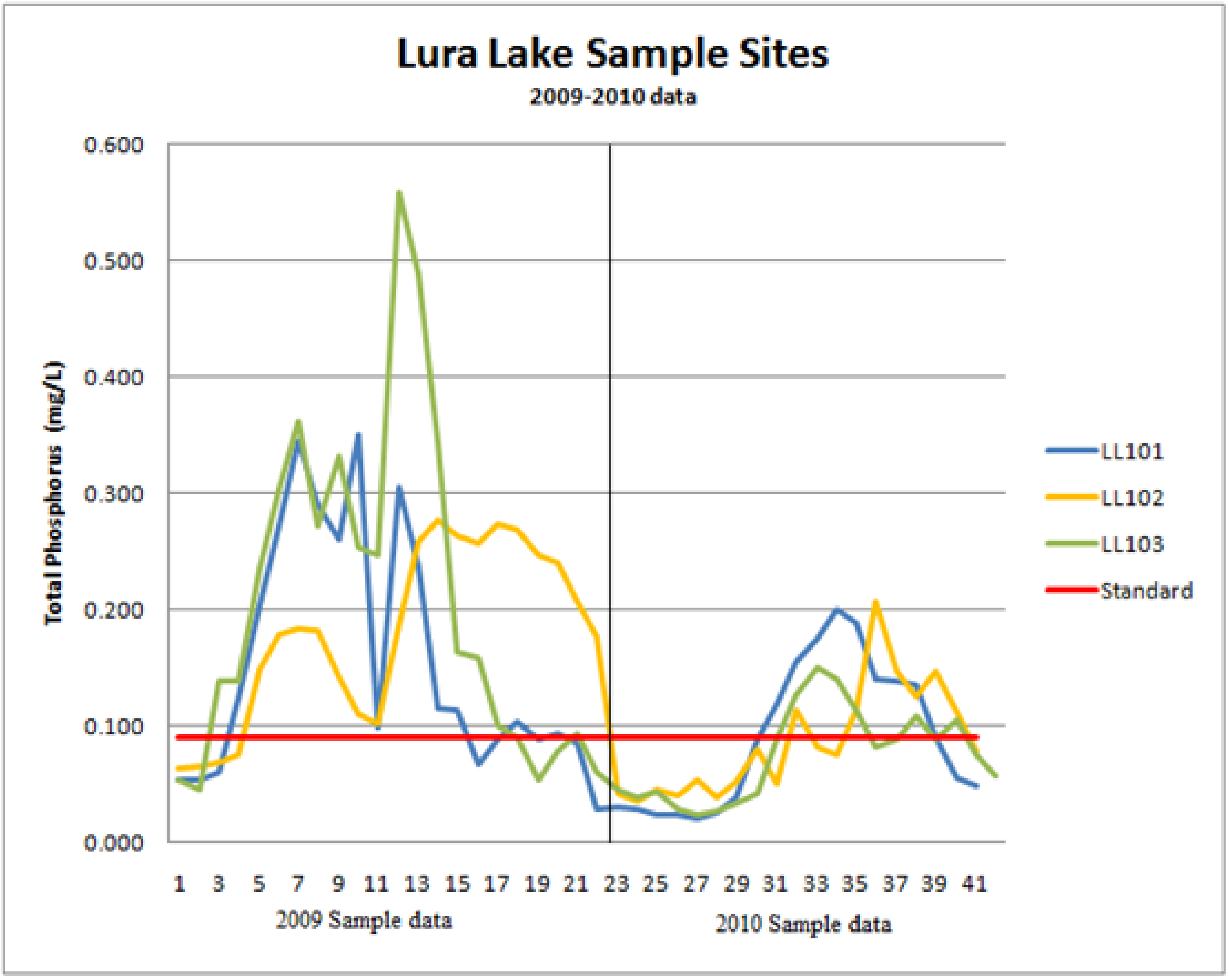
Lura Lake was added to the impaired waters list in 2002 for excess nutrients. The listing was addressed in the Lura Lake Excess Nutrients TMDL Study (MPCA 2014) (Table 26).

Table 26. Lura Lake TP TMDL summary

Allocation	Source	Existing TP Load		TP Allocations (WLA & LA)		Load reduction	
		(lbs/year)	(lbs/day)	(lbs/year)	(lbs/day)	(lbs/year)	%
Wasteload allocation	Construction Stormwater	18	0.05	18	0.05	--	0
Load allocation	Atmospheric	347	0.95	347	0.95	--	0
	Internal Load	5,818	15.93	1,571	4.3		
	Total LA	**6,165**	**16.88**	**1,918**	**5.2**	**4,247**	**69**
	MOS (10%)	--	--	212	0.58	--	--
	TOTAL	**6,183**	**17**	**2,148**	**5.83**	**4,035**	**65**

The Lura Lake TMDL (2014) did not break out load allocations by specific use. The TMDL (2014) identified internal loading as the primary source of P in the lake. The calibrated BATHTUB model, along with vegetation survey work, indicated that internal loading is the primary loading mechanism for Lura Lake. TP data are summarized in Figure 13.

Figure 13. Summary of Lura Lake TP samples from 2009-2010



Pollutant source assessments

Pollutant source assessments are conducted for pollutant impairment listings and where a biological stressor identification report process identifies a pollutant as a stressor. The pollutants of concern in the Rice Creek watershed include TSS, phosphorus, nitrogen, *E. coli* (formerly fecal coliform).

Sources of pollutants to lakes and streams are primarily nonpoint sources.

Rice Creek was listed as impaired for aquatic life by fish index of biotic integrity (FIBI) in 2006. In 2010, it was listed as impaired for aquatic life by turbidity and, in 2012, it was listed as impaired for aquatic life by macroinvertebrates IBI (MIBI) and for aquatic recreation by *E. coli*. In Rice Creek, low DO, elevated phosphorus, elevated nitrate, elevated TSS/turbidity, lack of habitat, and altered hydrology are all stressors to the biological community. The instability in the Rice Creek system is affecting the habitat availability for fish and invertebrate communities in these reaches.

Likely sources of bacteria to the larger watershed that includes Rice Creek include wastewater treatment facilities (WWTFs), municipal unsewered communities, inadequate subsurface sewage treatment systems (SSTS), and livestock (Le Sueur R. TMDL, 2015).

Point sources overview

The Rice Creek subwatershed has only one point source facility, Delevan WWTF, which operates a controlled pond system that discharges seasonally, typically in spring and fall. Based on a permit limit of 126 org/100ml, the TMDL report prescribed a 2 billion organisms per day waste load for Delevan WWTF to meet permit discharge limits.

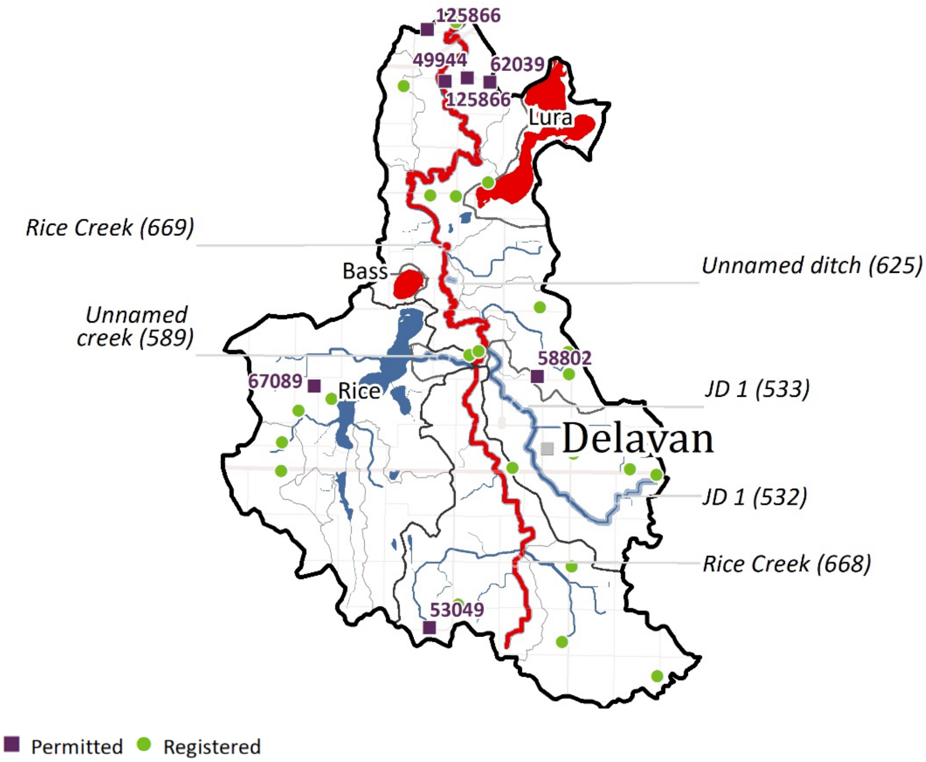
No communities in the Rice Creek subwatershed are subject to Municipal Separate Storm Sewer (MS4) National Pollution Discharge Elimination System (NPDES) requirements or are known to be unsewered.

Seven feedlots are permitted NPDES facilities (Table 27), with approximately 28,440 animals. All of the NPDES permitted feedlots are swine, with the primary stock type is swine between 55-300 lbs. None of the NPDES facilities are in the shoreland. These facilities are considered zero discharge and are given a waste load allocation of zero, and should not influence water quality as a point source (TMDL 2015).

Table 27. NPDES permitted feedlots in the Rice Creek Watershed

Permit Number	Subwatershed	Animal count (Swine)
MNG440764	Upper Rice Creek	6,600
MNG441485	Lower Rice Creek	4,000
MNG440757	Rice Lake	4,000
MNG440374	Lower Rice Creek	4,000
MN0071129	Lower Rice Creek	3,840
MNG441064	Lower Rice Creek	3,000
MNG441064	Lower Rice Creek	3,000

Figure 14. Feedlots in the Rice Creek Watershed



A more focused source identification effort on the Le Sueur River Watershed, which includes Rice Creek, indicates point sources play a very small role in total phosphorus (TP) sources, around 2% on a normal flow year (WRAPS 2015). There was only one measurement of TP below the discharges in Delavan in judicial Ditch 1, which was meets TP standard (MPCA 2010).

Non-point sources overview

Sediment sources to watersheds in this area are exclusively related to non-point sources. Three non-point contributors common to this area include: channel sources (banks, bluffs, beds, and floodplains), ravines (including gullies), and uplands (Le Sueur WRAPs 2019). Rice Creek is part of the larger Le Sueur River watershed, which was found to be 24-30% of the total TSS load to the Minnesota River while only covering 7% of the watershed area in the Minnesota River Basin (Belmont et al. 2011; Gran et al. 2011). Recent sediment source investigation in the Le Sueur indicated the following sources for this watershed: bluffs 57%, uplands 27%, ravines 9% and streambank channels and floodplains 8% (Gran et al., 2011).

Near channel sources play a more prominent role in sediment contributions in downstream watersheds. Upland sources are predicted to contribute 70% of the sediment load in the upper Maple River, which includes the Rice Creek sub watershed. Upland erosion comes from a combination of erosion from direct precipitation and overland flow, erosion from concentrated flow in rills or gullies, and wind-blown erosion. Tile drains also contribute both surface sediment produced by the above processes and sediment entering the pipeline in the subsurface (Gran et al. 2011).

Cropland agriculture is by far the most significant land use in the Rice Creek subwatershed at 82% (Le Sueur TMDL, 2015). The central portion of the Le Sueur River watershed was the historical location of the Glacial Lake Minnesota. This area has a relatively flat topography and the soils of a glacial lake bottom: fine, erodible, and poorly drained (WRAPs 2019). The driver of altered hydrology in the Rice Creek subwatershed is to increase surface water transport from these poorly drained area soils and increase area available for row crop agricultural. Rice Creek was identified as needing a 17% reduction in total suspended solids (TSS) concentrations to meet downstream water quality goals (Minnesota River and Greater Blue Earth River Basin TSS TMDL 2020). Achieving water quality standards will require priority investment in more temporary water storage to reduce high river flows and bluff erosion (Collaborative for Sediment Source Reduction 2017). Water storage (including short- and longer-term detention) can include a wide range of practices, including wetland restoration and various types of detention basins and impoundments. Cover crops, winter annual crops, and perennials can also contribute to flow reductions.

There are seven NPDES permitted feedlot sites and 22 sites that are required to register with the MPCA under Minn. Stat. 7020, but do not have an NPDES permit (Table 28). Only one of the registered feedlots utilizes a pasture area and three feedlots are in shoreland areas. The primary animals raised are swine.

Table 28. Animal counts of registered feedlots that are not NPDES permitted in Rice Creek Watershed

Type	Number of animals
Swine	45,948
Cattle	528
Sheep	60

In the Minnesota River basin, in an average precipitation year, roughly half of the total phosphorus (TP) load to surface water is directly from agricultural runoff and tile drainage, with additional contributions from point sources, stream bank erosion and atmospheric deposition (Barr 2007). HSPF model results indicate non-point source yields of TP are generally the highest in the southern and central Le Sueur river watershed, including Rice Creek. The Rice Creek subwatershed that includes Rice Lake has a TP yield greater than 0.75 lb/ac, identified as one of the highest contributors of TP in the Le Sueur River watershed.

Sediment

Sediment loading for the Rice Creek watershed was calculated as part of the Le Sueur River Watershed TMDL using HSPF modeling. The Table summarizes modeled sediment loading by landuse. Table 29 summarizes HSPF modeled sediment loading by land use. Cultivated crops contribute the majority of sediment loading, followed by bed and bank erosion. High-till cropland accounts for over twice as much sediment than low-till fields. Cultivated crops in this area are predominantly corn and soybean rotations.

Table 29. Simulated sediment loading by land use in the project area (MPCA HSPF 2014)

Landuse	Sediment t/yr
Developed	54
Forest	0.2
Cropland LowTill	994
Cropland HighTill	2,087
Grassland	20

Landuse	Sediment t/yr
Pasture	3
Wetland	5
Developed EIA	79
Feedlot	30
Bluff	0
Ravine	0
Septics	0
Cropland Tile Drainage	144
Baseflow (headwater lakes)	0
Baseload (headwater lakes)	0
Point Source	0.9
Atm. Dep.	0
Bed/Bank	1,242

Phosphorus

Watershed runoff

Phosphorus loading by land use in the project area was modeled using HSPF. Table 30 summarizes modeled total phosphorus loading by land use. Cultivated crops contribute the majority of phosphorus loading, followed by urban land uses. High-till cultivated fields contribute more than twice the amount of TP than the low-till cultivated fields.

Table 30. Simulated total phosphorus loading by land use in the project area

Landuse	Phosphorous lbs/yr
Developed	293
Forest	2
Cropland LowTill	11,822
Cropland HighTill	20,218
Grassland	58
Pasture	4
Wetland	14
Developed EIA	70
Feedlot	82
Bluff	0
Ravine	0
Septics	134
Cropland Tile Drainage	0
Baseflow (headwater lakes)	0
Baseload (headwater lakes)	1
Point Source	32
Atm. Dep.	0

Landuse	Phosphorous lbs/yr
Bed/Bank	0.4

Internal loading

Rice Creek's remaining two subwatersheds have TP yield roughly 0.6 to 0.75 lb/ac (WRAPS 2015). The Rice Creek Watershed has three surface water basins that play a role in TP cycling. Lake mixing regimes, sediment suspension and nutrient cycling can impact TP concentrations in basins and impacts on downstream waters like Rice Creek. Releases from vegetation and sediment are suspected to be a major driver in the internal loading of Lura Lake (MPCA 2013). Rice Lake has the largest contributing watershed (MPCA 2010), which increases the stress potential from pollutants such as TP. The DNR fish survey (2008) indicated that a high level of rough fish (carp, black bullheads) were a major concern. The contribution of upland watershed sources is estimated to be small.

Nitrogen

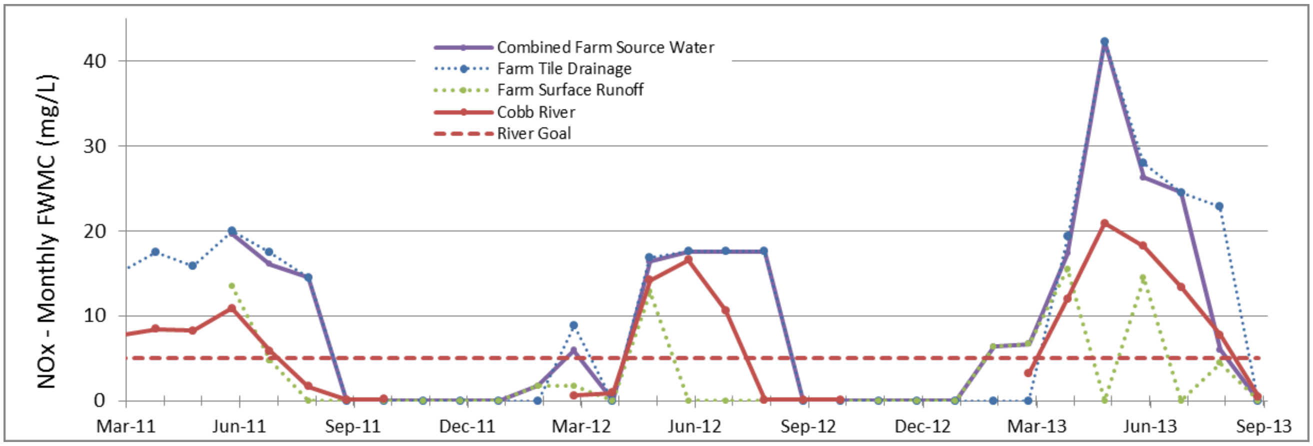
The MPCA's Nitrogen in Minnesota Surface Waters report (2013h) estimates nitrogen sources for the Minnesota River Basin. In an average precipitation year, agricultural sources account for approximately 90% of TN load to the Minnesota River.

There is no nitrogen TMDL for any of the waterbodies in Rice Creek. Nitrogen levels have been identified as a stressor to fish and macroinvertebrates. The goals for this watershed are to reduce the levels of nitrogen loading to improve habitat and impact downstream waters. The estimated TN load for Rice Creek is 393,396 lbs/yr and 9,169 lbs/yr for Lura Lake. An initial 45% reduction of TN loading is planned for both watersheds. This goal will be evaluated for success based on the response of the fish and macroinvertebrate responses and adjusted based on the observation and monitoring throughout this plan. If a TMDL is developed for one or more waterbodies, this plan will be updated accordingly.

Discovery Farms data illustrate the nitrogen contributions made by individual, similar farm fields. The Discovery Farm data tends to provide the most granular data about what is happening at the field scale and gives a clear look of how the land is responding. This Discovery Farm is located in the Cobb River Watershed, which is a similar watershed and is adjacent to Rice Creek. Due to similar land use, soil types and slopes, the Discover Farms data is relatable to the Rice Creek Watershed.

Table 31 shows the nitrite plus nitrate (NOx) concentration of: farm field runoff, tile-drained water, and the combined contributions of the farm field by month. For comparison, the receiving water, the Cobb River, and the river goal are shown. The monthly average NOx concentrations illustrate the seasonal nature of high NOx concentrations. Typically, NOx concentrations in tile drainage water are high throughout the spring and summer. However, since most of the water flowing from the tile drainage system occurs in spring/early summer, most NOx contributions (by total mass) from tile drainage water occur in the spring/early summer.

Figure 15. Discovery Farms data from comparable, adjacent watershed (Cobb River)



Nitrogen loading by land use in the project area was modeled using HSPF. Table 13 summarizes modeled total nitrogen loading by land use. Cultivated crops contribute the majority of nitrogen loading, followed by urban land uses.

Table 31. Simulated total nitrogen loading by land use in the project area (MPCA HSPF 2014)

Landuse	Nitrogen lbs/year
Developed	9086.8
Forest	136.7
Cropland LowTill	457822.0
Cropland HighTill	736539.3
Grassland	1775.5
Pasture	141.2
Wetland	859.4
Developed EIA	1116.7
Feedlot	1681.2
Bluff	0.0
Ravine	0.0
Septics	2599.4
Cropland Tile Drainage	0.0
Baseflow (headwater lakes)	0.0
Baseload (headwater lakes)	66.0
Point Source	257.2
Atm. Dep.	4930.9

E. coli

Sources of *E. coli* were evaluated in the Blue Earth River Basin Fecal Coliform TMDL (Water Resources Center, Minnesota State University, Mankato and Blue Earth River Basin Alliance 2007). According to the report, the major source of *E. coli* during wet conditions is surface applied livestock manure. During dry conditions, the major sources of *E. coli* to the creeks are straight pipe septic systems (and other improperly treated waste from septic systems and overgrazed pastures.

Bacteria sourcing can be difficult due to the bacteria's ability to persist, reproduce, and migrate in unpredictable ways (WRAPS 2015). Factors with strong relationships to bacteria contamination include high storm flow, percentage rural or agricultural area greater than forest area, livestock presence, and suspended solids.

Failing SSTS are challenging to track without individual inspections of each system, county estimates range from 35% to 75% compliance, straight pipe systems are illegal but could be an uncontrolled source of bacteria to surface waters such as Rice Creek.

According to the TMDL, domesticated farm animals produce 99% of fecal coliform, although this number does not technically represent what is reaching surface waters. Locations of feedlots within the project area in 2018 on file with the SWCD. A summary of animal counts can be found in Table 27 and Table 28. Significant sources of *E. coli* are estimated to be surface applied manure and incorporated manure. Manure from the feedlot facilities is likely land-applied to nearby crop fields.

Altered Hydrology

Agricultural drainage via surface ditches and subsurface tile has greatly altered the hydrology of the Rice Creek watershed. The drainage has connected and then drained many of the historical wetlands in the watershed to enable the production of agricultural crops. The drainage is necessary to maintain crop production, but does affect the ecological condition of the waterbodies in the watershed. The watershed hydrology is also affected by the changing climate with more frequent and intense precipitation events. The altered hydrology then affects the stability of the streams and ditches resulting in increases in pollutant loading, decreases in aquatic habitat, and flooding issues. Opportunities exist to adapt drainage management in the watershed to maintain the drainage needed for crop production, make connections to the floodplain, stabilize channels and banks, and improve habitat and stream connectivity.

Mercury

Almost all the mercury in Minnesota's lakes and rivers is delivered by the atmosphere. Mercury can be carried great distances on wind currents before it is brought down to earth in rain and snow. About 90% of the mercury deposited on Minnesota comes from other states and countries. Similarly, the vast majority of Minnesota's mercury emissions are carried by wind to other states and countries. It's impossible for Minnesota to solve this problem alone; the United States and other countries must greatly reduce mercury releases from all sources.

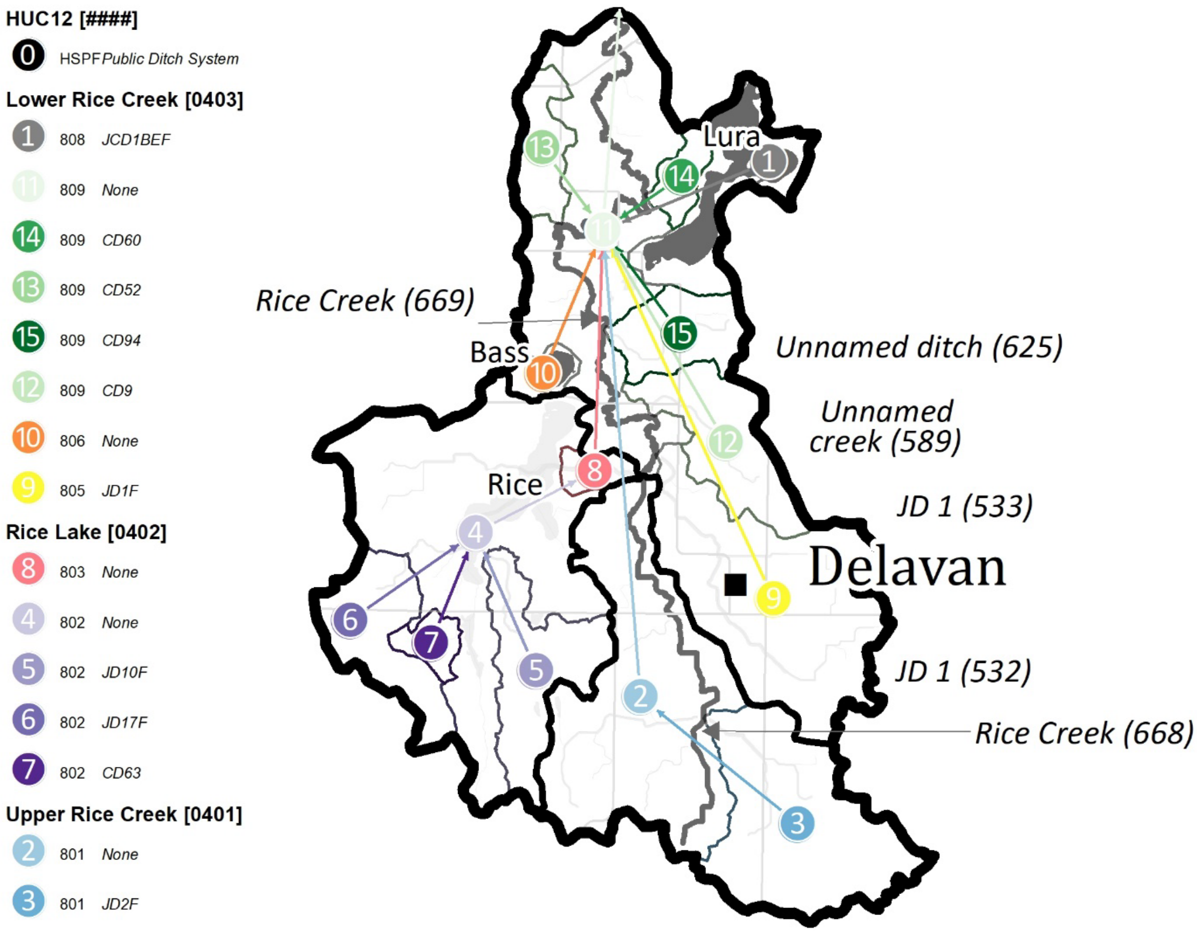
Atmospheric deposition of mercury is uniform across the state and supplies more than 99.5% of the mercury getting into fish. Agency research has demonstrated that 70% of current mercury deposition in Minnesota comes from human sources and 30% from natural sources, such as volcanoes. There are no known natural sources in the state that emit mercury directly to the atmosphere.

Critical areas and priorities

The NPS pollution implementation goals are focused on a whole watershed approach and include cropping systems to improve tillage practices and increase cover cropping, permanent vegetation, and water storage. The ditch systems have a significant impact to hydrology and increase the rate of transport of sediment, nutrients, and bacteria pollutants Figure 16.

It is well-accepted that intensive agricultural practices in this area increase the NPS loading to Rice Creek and other waterbodies in southern Minnesota. Agricultural land throughout the watershed can likely decrease pollutant loading to surface waters by adopting soil health practices and implementing structural BMPs.

Figure 16. HSPF catchments are illustrated by each color, with the ditch systems in each catchment



HSPF modeling was conducted in the Rice Creek Watershed in 2014. Figure 16 illustrates the various catchments modeled by HSPF and are illustrated by color group.

Catchments that include ditch systems are further highlighted by variant shades of color and are labeled by ditch name. The ditch systems are important as they represent a method of targeting landowners as a group. The Faribault SWCD's relationship with the Drainage Authority has a proven track record of working water quality improvements into ditch maintenance projects.

Being part of a public drainage system creates an opportunity to contact landowners, work within an existing system, and increase the likelihood of including projects that may be "outside the box" in ditch maintenance to help achieve the goals for this watershed.

Figure 17. Critical areas in dark orange and impaired waterbodies in red

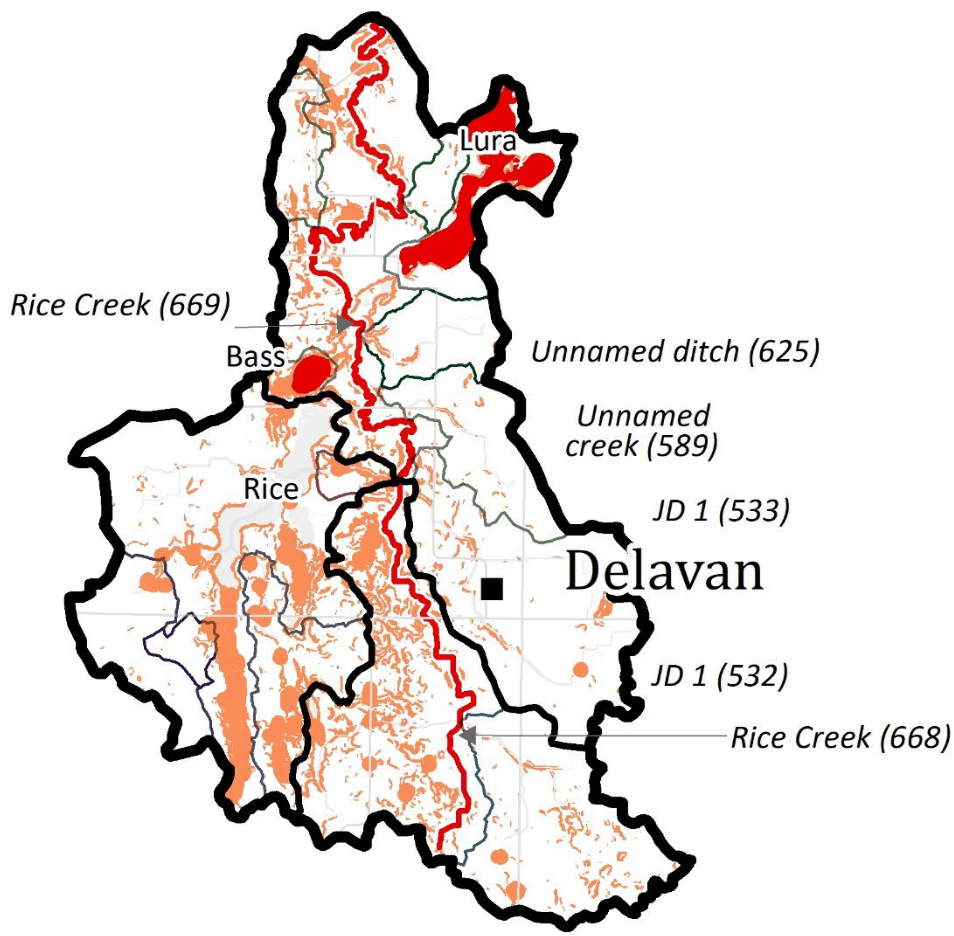


Figure 17 highlighted in dark orange are the highest loading areas within the watershed. Nutrients, sediment, and bacteria are transported more quickly in these areas. The gray areas represent farmland that has a greater than 3% slope, the soils are highly erodible, and are in riparian areas. These areas will be the focus of targeting by the Faribault SWCD and their partners to address the highest loading areas in the watershed. Outreach efforts and implementation will be targeted in these areas, beginning in the headwaters, or HSPF 801 (blue), and working toward the mouth, HSPF 809 (green).

Watershed goals

Watershed goals are developed for impairments and biological stressors within the Rice Creek project area and are derived from existing TMDLs and planning documents. The primary goals of this plan are to restore and to protect the water quality of the impaired waterbodies in the watershed (Rice Creek and Lura Lake). Implementation of the plan will result in the attainment of the water quality standards for Rice Creek and Lura Lake. Implementation work will be prioritized to critical areas, with a focus on the impaired waters. Protection for waters trending toward impairments will be considered high priority areas of concern. Specific goals are:

- To reduce TSS concentrations for Rice Creek below the TSS water quality standard.
- To meet the *E. coli* water quality standard in Rice Creek.
- To attain the lake water quality standards for Lura Lake.

The Rice Creek project partners have created a goal for nitrogen reduction in both Rice Creek and Lura Lake. Neither water body has a listed impairment for nitrogen; however, the partners have developed a reduction goal to support the *Minnesota Nutrient Reduction Strategy*. This NKE plan includes a nutrient reduction goal for nitrogen for Rice Creek and Lura Lake and the strategies outlined in the plan exceed the desired reductions. There is a nitrate drinking water standard; however, no aquatic life standards for nitrogen have been adopted in Minnesota.

Management strategies and activities

Management strategies and activities to meet watershed goals have been described in many existing documents, including the TMDLs for Lura Lake and Rice Creek. Table 32 contains the lists of BMPs, education and outreach activities, and monitoring information for this NKE plan to reach the reductions needed to achieve water quality standards in the next 10 years. The table includes the costs, the timeline, milestones, measurement criteria and assessments to ensure that the plan is on the correct path. Reductions for the planned and completed BMPs and practices can be found in Table 33.

Agricultural BMPs

Agricultural BMPs were selected based on input provided by Faribault County SWCD, the local water management plan and the Le Sueur WRAPS goals and strategies work. These BMPs have multi-pollutant benefits and reductions. The suitable area for conservation tillage, nitrogen management, and cover crops includes all agricultural land in the watershed.

There are wetlands in the Rice Creek HUC 10 that are not functioning due to the excessive nutrient inputs. It is a goal of this plan to restore about 5% of the existing wetlands in Rice Creek and about 10% of the existing wetlands in Lura Lake Subwatershed to proper functioning.

Livestock and livestock manure in feedlots and pastures are a potential source of *E. coli*, sediment, and nutrients to streams, particularly when direct access to streams is not restricted and where feeding structures are located near riparian areas. Land application of manure from animal operations can be sources of *E. coli* and nutrients, if not managed correctly.

SSTS compliance

SSTS are identified as a source of fecal bacteria in the watershed. SSTS that are conforming and are appropriately sited are assumed to not contribute fecal bacteria to surface waters but still discharge small amounts of phosphorus. Septic systems that discharge untreated sewage to the land surface or directly to streams are considered imminent threats to public health and safety and can contribute fecal bacteria and nutrients to surface waters.

Lake management

The TMDL for Lura Lake described a significant internal loading that needs to be addressed. The estimated internal loading was 5,818 lbs/yr based on estimates using HSPF and BATHTUB models with the total load to the lake estimated at 6,165 lbs/yr. The TMDL did not include a watershed reduction target; however, watershed BMPs identified in the plan will provide a reduction in TP load of 2,176 lbs/yr even though the drainage area contributing to the lake is small. This results in a remaining internal load of 2,513 lbs/yr TP.

Internal sources of phosphorus include curly leaf pondweed, carp, and anoxic P release from the sediment. Curly leaf pondweed is a significant source of P loading in Lura Lake. Modeling completed by James et al. suggested a 36 to 48% reduction by eliminating 100% of the weed. Considering an average 75% removal rate in Cedar Lake, it is expected that the reduction of internal P loading will be approximately 30% reduction of internal loading. Research suggests that P reductions with decreased carp densities are variable. Carp should be controlled to a density of 100 kg/ha. Research does suggest that carp management aids the control of aquatic invasive plant species by encouraging the growth of native aquatic plant species. A 20% reduction in P release in shallow areas of the lake is estimated. It is expected that the management of the rough fish and the curly leaf pondweed will reduce the internal loading 1256.6 lbs/yr, and the remaining 1256.6 lbs/yr will be treated with alum, if it is determined to be needed in years 9 or 10. The success of the overland reduction will be monitored and in-lake treatment will be designed and applied in years 9 and 10 of this plan.

Mercury

Atmospheric deposition of mercury is uniform across the state and supplies more than 99.5% of the mercury getting into fish. Agency research has demonstrated that 70% of current mercury deposition in Minnesota comes from human sources and 30% from natural sources, such as volcanoes. There are no known natural sources in the state that emit mercury directly to the atmosphere.

The long-term goal of the mercury TMDL is for the fish to meet water quality standards; the approach for Minnesota's share is mass reductions from state mercury sources. This mercury TMDL establishes that there needs to be a 93% reduction in state emissions from 1990 for the state to meet its share. Water point sources will be required to stay below one percent of the total load to the state and all but the smallest dischargers will be required to develop mercury minimization plans. Air sources of mercury will have a 93% emission reduction goal.

Almost all the mercury in Minnesota's lakes and rivers is delivered by the atmosphere. Mercury can be carried great distances on wind currents before it is brought down to earth in rain and snow. About 90% of the mercury deposited on Minnesota comes from other states and countries. Similarly, the vast majority of Minnesota's mercury emissions are carried by wind to other states and countries. It is impossible for Minnesota to solve this problem alone; the United States and other countries must greatly reduce mercury releases from all sources.

Because mercury in runoff is derived from atmospheric deposition, mercury in stormwater is accounted for in the calculation of the atmospheric load. Separate strategies for reducing nonpoint sources are not included in this plan because implementation of the strategies to reduce air deposition will ultimately reduce stormwater loading.

Any efforts to reduce soil erosion will tend to reduce mercury entering a lake or river from nonpoint water sources. Many of these practices are already employed for control of sediment and nutrient loading and will result in reducing mercury loading to surface waters.

Implementation activities

Table 32. Implementation strategies and activities, milestones, schedule, assessment criteria, monitoring plan and costs for the Rice Creek Watershed HUC 10

Activity	Milestones					Long-Term Goals	Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10-year (2031)			
Chemical Monitoring				IWM and analysis	Reevaluate Impairments	Have the data needed to evaluate change	# grab samples # samples	$50,000
Biological Monitoring				IWM and analysis	Reevaluate assessments	Have the data needed to evaluate change	# samples collected # data analysis completed	$25,000
Stressor identification					Complete stressor ID monitoring and evaluation	Have the data needed to evaluate change	# data analysis completed	$1,000
Habitat Monitoring				IWM and analysis	Reevaluate assessments	Have the data needed to evaluate change	# samples collected # data analysis completed	$25,000
Lake Monitoring	In-lake monitoring by MSU/ SWCD	Annual in-lake monitoring	Annual in-lake monitoring	Annual in-lake monitoring	Annual in-lake monitoring	Long term data available	Data collected	$70,000
Aquatic invasive species (AIS)	Prevent AIS program education and outreach	Prevent AIS program education and outreach	Prevent AIS program education and outreach	Prevent AIS program education and outreach	Prevent AIS program education and outreach	Continue to stay AIS free	AIS continued to be blocked	$1,000
Small wetland restoration in Lura Lake (10%)	4 acres restored	4 acres restored	4 acres restored	4 acres restored	4 acres restored	20.33 acres	# acres	$50,000
Small wetland Restorations in Rice Creek (5%)	32 acres restored	32 acres restored	32 acres restored	32 acres restored	32 acres restored	163 acres	# acres	$400,000

Activity	Milestones					Long-Term Goals	Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10-year (2031)			
Filter strips	5 acres of filter strips installed (above and beyond MN Buffer Law)	5 acres of filter strips installed (above and beyond MN Buffer Law)	5 acres of filter strips installed (above and beyond MN Buffer Law)	5 acres of filter strips installed (above and beyond MN Buffer Law)	20 acres of filter strips installed (above and beyond MN Buffer Law), effectiveness evaluated	Adequate buffers beyond law on all streams and ditches	# acres of filter strips	$4,000
MN Buffer law	100% compliance continued	100% compliance continued	100% compliance continued	100% compliance continued	MN Buffer law enforced			$500
Alternative tile intakes (intake risers, rock inlets, etc.)	10 alternative tile intakes installed	10 alternative tile intakes installed	10 alternative tile intakes installed	10 alternative tile intakes installed	10 alternative tile intakes installed	Sediment and nutrient reduction	# intakes	$37,500
Grassed waterways	Site identification and placement/landowner outreach	7,500 linear ft.	Continue to locate appropriate sites		Total of 7,500 linear feet of grassed waterways	Appropriate grassed waterways sited and installed in the watershed	# linear feet of grassed waterways	$100,000
Grade Stabilization Structure (Rice Creek)	Site identification and placement/landowner outreach	1 structure	1 structure	1 structure	1 structure	Appropriate grade stabilization structures sited and installed in the watershed	# of Structures	$80,000
Grade Stabilization (Lura Lake)			1 structure				# acres # structures	$20,000

Activity	Milestones					Long-Term Goals	Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10-year (2031)			
Bioreactors (Rice Creek)		Landowner education and outreach about the benefits of bioreators-10 knock and talks per year	2 bioreactors installed		Total of two bioreactors installed	Maintenance of bioreactors	# of bioreactors	$50,000
Bioreactors (Lura Lake)			1 installed			1 installed bioreactor	# bioreactor	$50,000
Saturated buffers	Work with landowners to promote and site and design projects	2 saturated buffers (500 ft ea)	Continue outreach and landowner engagement	Monitor potential effectiveness and maintain the BMPs	Total of 2 saturated buffers installed (500 ft each)	Verify effectiveness and plan accordingly to continue or change the goal (2,000 ft total)	# of saturated buffers # of feet saturated buffers	$50,000
WASCOBs Rice Creek	4 WASCOBs	4 WASCOBs	4 WASCOBs	4 WASCOBs	Total of 16 WASCOBs installed	Verify effectiveness and plan accordingly to continue or change the goal	# of WASCOBs	$150,000
WACOBs Lura Lake		1 WASCOBs		1 WASCOBs	Total 2 WASCOBs		# of WASCOBs	$8,500
Reduced tillage practices (no plowing)	2200 acres	2200 acres	2200 acres	2200 acres	2200 acres	25 % of acres in reduced tillage (no plowing)	# of acres in conservation tillage	$25,000
Reduced tillage practices (no plowing) Lura Lake	171 acres	171 acres	171 acres	171 acres	171 acres	42.5% of acres in reduced tillage (no plowing) (854.25 acres total)	# of acres in conservation tillage	$8,540

Activity	Milestones					Long-Term Goals	Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10-year (2031)			
Reduced tillage practices (no plowing) Rice Creek	4,310.5 acres	4,310.5 acres	4,310.5 acres	4,310.5 acres	4,310.5 acres	50 % of acres in reduced tillage (no plowing)	# of acres in conservation tillage	$21,553
No till/strip till practices Lura Lake	171 acres	171 acres	171 acres	171 acres	171 acres	42.25% of acres in no till	# acres	$8,550
No till/strip till practices Rice Lake	4,310.5 acres	4,310.5 acres	4,310.5 acres	4,310.5 acres	4,310.5 acres	50% of acres in no till	# acres	$215,520
Introduce small grains in rotation in Rice Creek	Outreach and promotion	862 acre	862 acre	862 acre	862 acre	Increase small grain planting to 1% of cropland acres (4,310 acres)	# of acres in small grains	$43,100
Nutrient management plans Lura Lake	171 acres	171 acres	171 acres	171 acres	171 acres	85% of cropland using nutrient management plan	# acres	$8,550
Nutrient management plans Rice Creek	8,621 acres	8,621 acres	8,621 acres	8,621 acres	8,621 acres	100% of cropland acres using nutrient management plan (4,310 acres)	# acres	$215,520
Cover crops Lura Lake	171 acres	171 acres	171 acres	171 acres	171 acres	Increase participation in cover crops (85% of cropland acres or 101 acres)	# acres	$8,550
Cover Crops Rice Creek	8,621 acres	8,621 acres	8,621 acres	8,621 acres	8,621 acres	Increase participation in cover crops (100% of cropland acres)	# acres	$215,520
Outreach activities	2 Soil health days (annually)	2 Soil health days (annually)	2 Soil health days (annually)	Evaluate the soil health day effectiveness	Continue effective outreach and education program		# of field days/demos	$2,000

Activity	Milestones					Long-Term Goals	Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10-year (2031)			
	Fair booth, radio promotion, social media, newsletters, knock and talk	Fair booth, radio promotion, social media, newsletters, knock and talk	Fair booth, radio promotion, social media, newsletters, knock and talk	Fair booth, radio promotion, social media, newsletters, knock and talk			# of outreach events	$1,000
peer mentoring	Conduct feasibility to purchase minimal disturbance manure injection system for rent by SWCD	Soil Health Team expansion	Leverage demonstration of no till/strip till practices by producer for education		Potential rental program, based on feasibility and funding	To increase availability of tools and support peer-to-peer mentoring	# mentors # mentor training # Soil Health Team members	$200,000
Rain Gardens	Work with landowners to promote and site and design projects	Work with landowners to promote and site and design projects	Work with landowners to promote and site and design projects	Work with landowners to promote and site and design projects	Work with landowners to promote and site and design projects	To cultivate interest and participation in raingardens	# of personal interaction	$3,000
Rain Gardens (Lura Lake)	2 raingardens	2 raingardens	2 raingardens	2 raingardens	2 raingardens	10 raingardens	# raingardens implemented	$10,000
Raingardens (Bass Lake)	2 raingardens	2 raingardens	2 raingardens	2 raingardens	2 raingardens	10 raingardens	# raingardens implemented	$10,000

Activity	Milestones					Long-Term Goals	Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10-year (2031)			
Rain Barrels	Work with landowners to promote and site and design projects	Work with landowners to promote and site and design projects	Work with landowners to promote and site and design projects	Work with landowners to promote and site and design projects	Work with landowners to promote and site and design projects	10 rain barrels placed	# rain barrels placed	$10,000
AIS control	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Educate landowners about AIS	# mailings # radio spots # social media posts	$5,000
Fish barrier	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Educate landowners about rough fish populations	# mailings # radio spots # social media posts	$5,000
Lakeshore restoration	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Work with landowners and DNR to promote practices	Educate landowners about lakeshore restoration	# mailings # radio spots # social media posts	$5,000
Shoreland restoration (Bass Lake)	600 ln ft shoreland restoration	600 ln ft shoreland restoration	600 ln ft shoreland restoration	600 ln ft shoreland restoration	600 ln ft shoreland restoration	10 - 300 ln ft shoreland restoration	# feet restored	$100,000
Shoreland restoration (Rice Lake)	600 ln ft shoreland restoration	600 ln ft shoreland restoration	600 ln ft shoreland restoration	600 ln ft shoreland restoration	600 ln ft shoreland restoration	10 - 300 ln ft shoreland restoration	# feet restored	$100,000
Rough fish management	Reduce carp population to less than 100 kg/1 ha	Reduce carp population to less than 100 kg/1 ha	Reduce carp population to less than 100 kg/1 ha	Reduce carp population to less than 100 kg/1 ha	Reduce carp population to less than 100 kg/1 ha	Reduce carp and internal P loading	# pounds removed	$20,000
Curly leaf pondweed treatment/management	Manage and treat curly leaf pondweed (mechanical and herbicidal)	Manage and treat curly leaf pondweed (mechanical and herbicidal)	Manage and treat curly leaf pondweed (mechanical and herbicidal)	Manage and treat curly leaf pondweed (mechanical and herbicidal)	Manage and treat curly leaf pondweed (mechanical and herbicidal)	Reduce P internal load	# acres treated/ harvested	$20,000

Activity	Milestones					Long-Term Goals	Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10-year (2031)			
Alum Treatment				Analyze monitoring data and design alum treatment	Alum treatment	Stabilize the P in the lake sediment	# acres treated # pounds applied	$250,000
SSTS replacement/up grades	20 upgrades	20 upgrades	20 upgrades	20 upgrades	20 upgrades	100 SSTS upgraded	# SSTS upgraded	$2,000,000
Delevan Street clean	Annual street sweeping	Annual street sweeping	Annual street sweeping	Annual street sweeping	Annual street sweeping	To reduce TSS and TP loading	# sweep events	$10,000
Streambank restoration	.672 miles (3,548.16 feet)	.672 miles (3,548.16 feet)	.672 miles (3,548.16 feet)	.672 miles (3,548.16 feet)	.672 miles (3,548.16 feet)	Total of 6% of streambank restored (17,740.8 ln ft)	# feet streambank # mile streambank	$2,500,000
Manure management plans (Lura Lake)	171 acres	171 acres	171 acres	171 acres	171 acres	85% of cropland acers using nutrient management plan	# plans # acres	$8,550
Manure management plans (Rice Creek)	8,621 acres	8,621 acres	8,621 acres	8,621 acres	8,621 acres	100% of cropland acres using nutrient management plan	# plans # acres	$215,520
Waste management system	Work with feedlot owners to promote waste management systems	1				One waste management system	# management systems	$5,000
Waste Storage facility		Work with feedlot owners to promote waste storage systems	1			One waste storage facility	# facilities	$25,000
Filter strips			Work with feedlot owners to promote filter strips	1		One 300 ft filter strip	# acres # feet	$15,000

Activity	Milestones					Long-Term Goals	Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10-year (2031)			
Runoff management systems				Work with feedlot owners to promote runoff management systems	1	One runoff system	# systems	$30,000

Summary of reductions

Reductions have been calculated using the Spreadsheet Tool for Estimating Pollutant Load (STEPL) for the practices planned (Table 32). The reductions calculated from planned practices and work completed since the development of the TMDLs are summarized in Table 33. Data about completed practices were collected through the Healthier Watersheds website (https://www.pca.state.mn.us/water/healthier-watersheds). Data used to develop the Healthier Watersheds is data about NPS practices entered by local governments in eLINK (i.e., Clean Water Funded projects, Section 319 grants, and Clean Water Partnership loans and grants) and by the National Resource Conservation Service (NRCS).

The reduction estimates in Table 33 are based in STEPL load estimates, STEPL-adjusted TMDLs, and estimated reductions associated with the implementation of practices.

The combination of these completed and planned efforts, when fully implemented, will meet the reductions needed to meet the water quality standards and goals in the Rice Creek Watershed HUC 10.

Table 33. Summary of STEPL loads, adjusted TMDLs, estimated reductions for planned and implemented practices, and load following implementation of NKE

	Watershed	Lura Lake	Rice Creek
TSS	Load	307.3	13,626.90
	TMDL		2,316.60
	Reductions	302.5	12096.5
	Load after BMPs	**4.8**	**1530.4**
TP	Load	6,183.00	93,534.00
	TMDL	4,035.00	37,413.60
	Reductions	4,675.40	85157.9
	Load after BMPs	**1,507.60**	**8,376.1**
TN	Load	9,169.00	396,396.60
	Goal	4,126.10	178,378.50
	Reductions	8,149.20	260417.1
	Load after BMPs	**1,019.80**	**135979.5**
E. coli	Load	14,972.50	324,979.70
	TMDL		191,760.70
	Reductions	13,933.10	291,056.9
	Load after BMPs	**1,309.40**	**33922.8**

Table 34. Summary of STEPL estimated reductions for Lura Lake and Rice Creek Subwatersheds

Practice types	Watershed	N reduction lb/yr	P reduction lbs/yr	Sediment reduction t/yr	*E. coli* reduction Billion MPN/yr
Wetland restoration	Lura Lake	718.0	159.1	23.5	100.5
Combined Efficiencies of cropland practices	Lura Lake	1406.0	315.7	47.1	197.3
Minnesota Buffer Law	Lura Lake	2843.6	863.7	132.7	725.5

Practice types	Watershed	N reduction lb/yr	P reduction lbs/yr	Sediment reduction t/yr	*E. coli* reduction Billion MPN/yr
Soil Health Calculator	Lura Lake	2561.6	823.9	99.1	746.7
SSTS	Lura Lake	167.9	65.8		12031.3
Internal load	Lura Lake		2513.1		
Total Reductions		**4164.6**	**3676.0**	**153.0**	**12858.8**
Minnesota Buffer Law	Rice Creek	121867.2	37014.0	6809.6	31094.1
Healthier Watersheds	Rice Creek	991.9	3706.4	32.0	253.5
Alternative tile intakes	Rice	1058.6	307.5	49.5	166.5
Combined Efficiencies	Rice Creek	2224.1	500.9	74.0	318.6
Soil Health Calculator	Rice Creek	129154.9.6	41539.6	4994.9	37647.8
Filter Strip	Rice Creek	0.0	216.1	0.0	0.0
Runoff management system	Rice Creek	0.0	209.7	0.0	0.0
Waste management system	Rice Creek	1016.8	228.8	0.0	0.003459
Waste Storage facility	Rice Creek	826.2	152.5	0.0	0.0
Streambank Restoration	Rice Creek	185.7	71.5	136.5	0.0
SSTS replacement	Rice Creek	3091.7	1210.9		221576.4
Total Reductions		**260417.1**	**85157.9**	**12096.5**	**291,056.9**

Table 35. Summary of Healthier Watersheds practices implemented since 2014 to present

Practices	Acres treated
Alternative Tile Intake	140
Conservation Cover	118
Cover Crop	741
Critical Area Planting	11
Grade Stabilization Structure	2400
Nutrient Management	741
Roofs and Covers	1.5
Water & Sediment Control Basins	60
Wetland Restoration	80

The costs are included on a per practice basis in the tables following each practice group. It is estimated that the total cost of implementation of all practices that would likely achieve water quality standards is $5.4 million.

Every two years, the progress of the plan will be checked against the milestones to determine any necessary course corrections and milestones will be amended or new ones added.

Partnerships and education

The Faribault SWCD has an extensive network and engagement process to build support and educate the landowners and users in the Rice Creek HUC 10 Watershed. The SWCD works diligently to develop lasting and trusted relationships within the watershed.

[Faribault SWCD Soil Health Team]

The mission of the Soil Health Team is “to increase awareness of soil health and benefits of reduced tillage, cover crops, and diverse crop rotations.” (Faribault Co SWCD, n.d.)

The Team started in 2016 and is landowner led, with Faribault SWCD providing the coordination. The farmers are from throughout the county and practice different types of farming to broaden appeal. Members implement soil health practices and promote it to their peers.

[Faribault County Drainage Authority]

“Faribault County consists of 113 public drainage systems, with over 260 miles of public open ditch and 700 miles of tile.” (Faribault County, n.d.). In addition to following Minn. Stat. 103E, the drainage authority also works on developing partnerships. When inspecting the ditches, they are ready to capitalize on environmental practices for water quality improvement. The drainage authority works closely with the SWCD to fund and provide technical assistance. The SWCD regularly attends ditch authority meetings.

The SWCD is active with the Natural Resource Conservation Service (NRCS) meetings and staff.

The overall goal of the SWCD is to provide funding and technical support for implementing water quality improvement practices. Outreach and interaction with the community is an important goal of the SWCD. Some community outreach includes fairs, promotions, mailing, social media, and working with the schools. There are test plots for students studying agriculture.

The SWCD has a good relationship with the Lura Lake Association and is currently providing assistance to Bass Lake Association’s organization. Staff regularly attend and/or speak at lake association meetings and participate in field days.

Implementation of the Rice Creek HUC 10 Watershed NKE will require additional financial and technical resources. A list of existing partners providing technical and funding assistance to support implementation is provided in Table 36.

Table 36. Partial list of partners providing technical and funding assistance for implementation

Sponsor or Information source	Program description
MPCA	Funding, technical support, data collection
BWSR	Funding, technical support, planning, engagement
MDA	Provides a wide array of other information from their agency as well as other state and federal agencies on conservation programs addressing agriculture and other land uses.

Sponsor or Information source	Program description
Minnesota DNR	Funding, technical support
USDA NRCS	NRCS provides incentive payments for conservation practices and technical assistance through their programs.
USDA FSA	Provides funding and technical assistance to producers to address agricultural conservation issues.
Minnesota Corn Growers	Monitoring and outreach assistance
Mankato State University	Research, engagement, support, technical assistance
Bass Lake Association	Community support, outreach, engagement, funding
Lura Lake Association	Community support, outreach, engagement
Faribault County Soil Health Team	Community support, outreach, engagement
Faribault County Drainage Authority	Administer MN Drainage Law in Faribault County and coordinate water quality activities with the SWCD
Faribault County	Funding, staffing, support
City of Delavan	Support city stormwater practices
Blue Earth SWCD	Cooperation in the watershed across political boundaries
Le Sueur Watershed Network	Network of volunteers that exists to encourage collaboration, empower citizens and nurture a land stewardship among those that live, work, and recreate in the watershed.
South Central (Area 6) TSA	Engineering, design work
Le Sueur 1W1P group	Planning committee to address Le Sueur River concerns across political boundaries
AgBMP Loan Program (MDA)	Revolving loan funds for landowners to implement water quality practices

Monitoring

The every ten-year cycle of MPCA HUC-8 IWM and assessment provides the framework for monitoring and assessing the use support for Minnesota's waterbodies. The Rice Creek HUC 10 Watershed is part of the Le Sueur River major watershed which completed the second cycle of IWM and with the third cycle scheduled to begin in 2029. IWM monitoring consists of biological and water chemistry monitoring over a two-year period in the major watershed. Monitoring sites are identified with stakeholder input prior to the start of monitoring. Stressor identification was completed in 2020, with a draft report in review.

Implementation activities will be tracked using the BWSR eLink database for state and Section 319-funded activities. Implementation activities funded by the USDA are tracked using their database. Field measurements, preliminary and final engineering designs, as-built plans, and photographs will be used to document the improvement in streambank activities. Field measurements will include streambank and streambed profile measurements and field observations to track streambank changes over time due to streambank erosion and subsequent restoration activities.

Changes in land cover and land use not associated with BMP implementation will be tracked using visual observations, field measurements, and aerial imaging.

A stream flow and water quality monitoring site near the mouth of Rice Creek will be established. The site will provide the data needed to determine progress toward and eventual achievement of the biological, TSS, TP, and *E. coli* water quality standards. The site will include continuous water level, turbidity, and temperature monitoring, development and maintenance of a streamflow rating curve, routine field measurements, and discrete water sampling and laboratory analysis. Discrete water samples will be collected on a storm event basis, targeting minimum of 25 samples per year. Lab analysis will include TSS, *E. coli*, TP, and nitrate. Field measurements will include turbidity, Secchi tube transparency, temperature, DO, and specific conductivity. Streamflow and water quality sampling will provide load calculations to evaluate for load reductions and the effectiveness of the practices implemented in the Rice Creek Watershed. Load monitoring in Rice Creek will include continuous stream flow and water sampling to provide pollutant load calculations for TSS, TP, and nitrate. The MDA also conducts pesticide monitoring in Rice Creek as part of their surface water pesticide monitoring program.

Biennially biological monitoring will be completed, if resources are available. Stream habitat and geomorphology monitoring will be completed in conjunction with the flow, chemistry, and biology monitoring. The estimated cost of conducting this monitoring for ten years is $370,000 (Table 37).

Lake sampling will conducted for Lura and Bass Lakes. Lab analysis will include TP, TN, and Chl-*a*. Field measurements will include Secchi disk transparency, temperature, and DO.

The MPCA Citizen Lake Monitoring Program will continue and more participation in the Citizen Stream Monitoring Program will be encouraged (https://www.pca.state.mn.us/water/citizen-water-monitoring). Volunteers measure water clarity at least twice a month each summer at designated locations using a Secchi disk or tube. The data can then be correlated with TP or TSS concentrations and be used as an indicator of algae or sediment in the waterbodies. The goal for the watershed partners is to get four volunteer monitoring sites established in the watershed.

Table 37. Monitoring costs in Rice Creek HUC 10 Watershed

Monitoring type	Description	Unit cost (annual)	Total (10-years)
Streamflow	DNR flow monitoring	$8,000	$80,000
Stream water quality sampling and analysis	Sampling and lab analysis	$17,000	$170,000
Stream biological and habitat monitoring	8 sites (biennially)	$25,000	$125,000
Stream geomorphology	8 sites morphology survey (biennially)	$25,000	$125,000
Lake water quality monitoring	Sampling 2 times/month for 5 months, for 2 lakes	$4,000	$40,000
Citizen Lake Monitoring program	Secchi disk monitoring	Volunteer hours	Volunteer hours
Total			**$540,000**

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Appendix A
STEPL assumptions and results

The STEPL was used to estimate P, N, TSS and *E. coli* loads and reductions for the watershed.

The reductions for BMPs identified in the ten-year milestone table calculated as combined efficiencies and the BMP calculator in STEPL. Reduction efficiencies for *E. coli* were assumed from MPCA (2011) and Wright Water Engineers, Inc. (2010) and added to the “BMPList” worksheet in STEPL. The practices and assumed reduction efficiencies are shown in Table 38. The BMPs with area and percent of watershed treated and assumptions made for STEPL are described in Table 39. The treatment efficiencies for the BMPs that are not in the original list of BMPs and reduction efficiencies (BMPList) in STEPL were assigned based on the similarity of the treatment processes with selected BMPList practices.

Table 38. Land use, BMPs, and efficiencies for STEPL (added all *E. coli* efficiencies)

Landuse	BMP & efficiency	N	P	BOD	TSS	*E. coli*	Assumptions and additions
Cropland							
Cropland	0 No BMP	0	0	0	0	0	Added all E. coli efficiencies
Cropland	Alternative Tile Intake	0.253	0.308	ND	0.4	0.3	Added Alternative Tile Intake, assumption same efficiencies as STEPL practice Terrace. Assumption that each inlet treats 20 acres
Cropland	Bioreactor	0.453	0.3	ND	ND	0.9	Assume treats 20 acres
Cropland	BMP Calculator Lura Lake	0.28	0.403	ND	0.412	0.591	
Cropland	BMP Calculator Rice Lake	0.073	0.094	ND	0.1	0.159	
Cropland	BMP Calculator Healthier Watershed Rice Lake	0.029	0.41	ND	0.03	0.053	
Cropland	Buffer - Forest (100ft wide)	0.478	0.465	ND	0.586	0.9	
Cropland	Buffer - Grass (35ft wide)	0.338	0.435	ND	0.533	0.65	
Cropland	Combined BMPs-Calculated	0	0	0	0	0	
Cropland	Conservation Cover	0.204	0.15	ND	0.2	0.5	Added Conservation Cover, assuming same efficiencies as STEPL practice Cover Crop 3
Cropland	Conservation Tillage 1 (30-59% Residue)	0.15	0.356	ND	0.403	0.3	
Cropland	Conservation Tillage 2 (equal or more than 60% Residue)	0.25	0.687	ND	0.77	0.65	

Landuse	BMP & efficiency	N	P	BOD	TSS	*E. coli*	Assumptions and additions
Cropland	Contour Farming	0.279	0.398	ND	0.341	ND	
Cropland	Controlled Drainage	0.388	0.35	ND	ND	ND	
Cropland	Cover Crop 1 (Group A Commodity) (High Till only for Sediment)	0.008	ND	ND	ND	ND	
Cropland	Cover Crop 2 (Group A Traditional Normal Planting Time) (High Till only for TP and Sediment)	0.196	0.07	ND	0.1	ND	
Cropland	Cover Crop 3 (Group A Traditional Early Planting Time) (High Till only for TP and Sediment)	0.204	0.15	ND	0.2	0.5	
Cropland	Critical Area Planting	0.898	0.808	ND	0.95	0.9	Added cropland Critical Area Planting, assuming same efficiencies as STEPL practice land Retirement
Cropland	Detention Basin	0.253	0.308	ND	0.4	0.3	Assume each basin is 10 acres and each basin treats 100 acres. Assume same efficiencies as STEPL practice Terrace.
Cropland	Diversions	0.898	0.808	ND	0.95	0.9	Added Diversions, assuming same efficiencies as STEPL practice Land Retirement
Cropland	Drainage Water Management	0.253	0.308	ND	0.4	0.3	Added Drainage Water Management, assuming same efficiencies as STEPL Practice Terrace, assume 50 acres treated per practice
Cropland	Field Borders	0.253	0.308	ND	0.4	0.3	Added Field Borders, assuming same efficiencies as STEPL practice Filter Strips (Terrace)
Cropland	Filter Strips	0.253	0.308	ND	0.4	0.3	Added Filter Strip, assuming same efficiencies as STEPL practice Terrace, assume 50 acres treatment per acre of

Landuse	BMP & efficiency	N	P	BOD	TSS	*E. coli*	Assumptions and additions
							of filter strip (assume 1,000 ft=1 acres)
Cropland	Filtration Practices	0.253	0.308	ND	0.4	0.3	Added Filtration Practices, assuming same efficiencies as STEPL practice Terrace, assuming 20 acres treated per practice
Cropland	Grade Stabilization Structures	0.253	0.308	ND	0.4	0.3	Added Grade Stabilization Structures, assuming same efficiencies as STEPL practice Terrace, assume 40 acres treated per practice.
Cropland	Grassed Waterways	0.253	0.308	ND	0.4	0.3	Added Grassed Waterways, assume 1,000 ft of grassed waterways treats 50 acres, assume same efficiencies as STEPL practice Terrace
Cropland	Impoundment	0.898	0.808	ND	0.95	0.9	Added Impoundment, assume same efficiencies as STEPL practice Land Retirement
Cropland	Land Retirement	0.898	0.808	ND	0.95	0.9	Added Nutrient/Manure Management, Assuming same efficiencies as STEPL practice Nutrient Management 1, increased e. coli efficiencies to .9
Cropland	Manure/Nutrient Management	0.154	0.45	ND	ND	0.9	
Cropland	Nutrient Management 1 (Determined Rate)	0.154	0.45	ND	ND	0.5	
Cropland	Nutrient Management 2 (Determined Rate Plus Additional Considerations)	0.247	0.56	ND	ND	0.9	
Cropland	Residue/Tillage Management	0.15	0.356	ND	0.403	0.3	Added Residue/Tillage Management, assuming same efficiencies as STEPL practice Conservation Tillage 1

Landuse	BMP & efficiency	N	P	BOD	TSS	*E. coli*	Assumptions and additions
Cropland	Small Grains Rotation	0.204	0.15	ND	0.2	0.5	Added Small Grains Rotation, assuming same efficiencies as Cover Crop 3
Cropland	Saturated Buffer	0.338	0.435	ND	0.533	0.65	Added Saturated Buffer, assuming same efficiencies as STEPL practice Buffer-Grass; Assume 1,000 ft with treatment as 40 ac/mil (1/8 mile width) as Two-Stage Ditch
Cropland	Side water inlets	0.253	0.308	ND	0.4	0.3	Added Side Water inlets, assumed same efficiencies as Terrace
Cropland	Streambank Erosioin Practices	0.253	0.308	ND	0.4	0.3	Added Streambank Erosion Practices, assuming same efficiencies as STEPL practice Terrace, assuming 5 practices treat 100 acres
Cropland	Streambank Stabilization and Fencing	0.75	0.75	ND	0.75	0.3	
Cropland	Terrace	0.253	0.308	ND	0.4	0.3	
Cropland	Two-Stage Ditch	0.12	0.28	ND	ND	0.3	
Cropland	WASCOB (Water and Sediment Control Basin	0.253	0.308	ND	0.4	0.3	Added WASCOB, assuming the same efficiencies as Terrace, assuming 20 acres treated per WASCOB
Cropland	Water Control Structures	0.253	0.308	ND	0.4	0.3	Added cropland Water Control Structures, assuming same efficiencies as STEPL practice Terrace, assume 40 acres treated per practice installed
Cropland	Wetland Restoration	0.898	0.808	ND	0.95	0.9	Added Wetland Restoration, assuming same efficiencies as STEPL practice Land retirement assuming 40 acres treated per acre of wetland
Pastureland							
Pastureland	0 No BMP	0	0	0	0	0	

Landuse	BMP & efficiency	N	P	BOD	TSS	*E. coli*	Assumptions and additions
Pastureland	30m Buffer with Optimal Grazing	0.364	0.653	ND	ND	0.65	
Pastureland	Alternative Water Supply	0.133	0.115	ND	0.187	0.65	
Pastureland	Cattle Exclusions	0.203	0.304	ND	0.62	0.65	Added pastureland Cattle Exclusions, assuming same efficiencies as STEPL practice Livestock exclusion fencing
Pastureland	Combined BMPs-Calculated	0	0	0	0	0	
Pastureland	Critical Area Planting	0.175	0.2	ND	0.42	ND	
Pastureland	Fencing and Watering Projects	0.203	0.304	ND	0.62	0.65	Added pastureland Fencing and watering projects, assuming same efficiencies as STEPL practice Livestock Exclusion Fencing
Pastureland	Forest Buffer (minimum 35 feet wide)	0.452	0.4	ND	0.533	ND	
Pastureland	Grass Buffer (minimum 35 feet wide)	0.868	0.766	ND	0.648	ND	
Pastureland	Grazing Land Management (rotational grazing with fenced areas)	0.43	0.263	ND	ND	0.65	
Pastureland	Heavy Use Area Protection	0.183	0.193	ND	0.333	ND	
Pastureland	Litter Storage and Management	0.14	0.14	ND	0	ND	
Pastureland	Livestock Exclusion Fencing	0.203	0.304	ND	0.62	0.65	
Pastureland	Multiple Practices	0.246	0.205	ND	0.221	ND	
Pastureland	Pasture and Hayland Planting (also called Forage Planting)	0.181	0.15	ND	ND	ND	
Pastureland	Prescribed Grazing	0.408	0.227	ND	0.333	ND	
Pastureland	Rotational Grazing	0.43	0.263	ND	0.333	0.65	Added pastureland Rotational Grazing, assuming same efficiencies as STEPL practice Grazing Land Management, and TSS

Landuse	BMP & efficiency	N	P	BOD	TSS	*E. coli*	Assumptions and additions
							reduction from Prescribed Grazing
Pastureland	Streambank Protection w/o Fencing	0.15	0.22	ND	0.575	0.3	
Pastureland	Streambank Stabilization and Fencing	0.75	0.75	ND	0.75	0.65	
Pastureland	Use Exclusion	0.39	0.04	ND	0.589	0.9	
Pastureland	Winter Feeding Facility	0.35	0.4	ND	0.4	ND	
Forest							
Forest	0 No BMP	0	0	0	0	0	
Forest	Combined BMPs-Calculated	0	0	0	0	0	
Forest	Road dry seeding	ND	ND	ND	0.41	ND	
Forest	Road grass and legume seeding	ND	ND	ND	0.71	ND	
Forest	Road hydro mulch	ND	ND	ND	0.41	ND	
Forest	Road straw mulch	ND	ND	ND	0.41	ND	
Forest	Road tree planting	ND	ND	ND	0.5	ND	
Forest	Site preparation/hydro mulch/seed/fertilizer	ND	ND	ND	0.71	ND	
Forest	Site preparation/hydro mulch/seed/fertilizer/transplants	ND	ND	ND	0.69	ND	
Forest	Site preparation/steep slope seeder/transplant	ND	ND	ND	0.81	ND	
Forest	Site preparation/straw/crimp seed/fertilizer/transplant	ND	ND	ND	0.95	ND	
Forest	Site preparation/straw/crimp/net	ND	ND	ND	0.93	ND	
Forest	Site preparation/straw/net/seed/fertilizer/transplant	ND	ND	ND	0.83	ND	
Forest	Site preparation/straw/polymer/seed/fertilizer/transplant	ND	ND	ND	0.86	ND	
User_Defined							
User_Defined	0 No BMP	0	0	0	0	0	

Landuse	BMP & efficiency	N	P	BOD	TSS	*E. coli*	Assumptions and additions
User_Defined	Combined BMPs-Calculated	0	0	0	0	0	
Feedlots							
Feedlots	0 No BMP	0	0	0	0	0	
Feedlots	Diversion	0.45	0.7	ND	ND	ND	
Feedlots	Filter strip	ND	0.85	ND	ND	0.3	
Feedlots	Runoff Mgmt System	ND	0.825	ND	ND	0.5	
Feedlots	Solids Separation Basin	0.35	0.31	ND	ND	ND	
Feedlots	Solids Separation Basin w/Infilt Bed	ND	0.8	0.85	ND	0.9	
Feedlots	Terrace	0.55	0.85	ND	ND	ND	
Feedlots	Waste Mgmt System	0.8	0.9	ND	ND	0.9	
Feedlots	Waste Storage Facility	0.65	0.6	ND	ND	0.9	
Urban							
Urban	0 No BMP	0	0	0	0	0	
Urban	Alum Treatment	0.6	0.9	0.6	0.95	ND	
Urban	Bioretention facility	0.63	0.8	ND	ND	0.9	
Urban	Bioretention practices	0.63	0.8	ND	0.85	0.9	Added Urban STEPL Bioretention practice, efficiencies for TSS and E. coli based on MN Stormwater manual (https://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_bioretention)
Urban	Combined BMPs-Calculated	0	0	0	0	0	
Urban	Concrete Grid Pavement	0.9	0.9	ND	0.9	0.9	
Urban	Dry Detention	0.3	0.26	0.27	0.575	ND	
Urban	Extended Wet Detention	0.55	0.685	0.72	0.86	0.9	
Urban	Filter Strip-Agricultural	0.5325	0.6125	ND	0.65	0.3	
Urban	Grass Swales	0.1	0.25	0.3	0.65	ND	
Urban	Infiltration Basin	0.6	0.65	ND	0.75	0.9	
Urban	Infiltration Devices	ND	0.83	0.83	0.94	ND	
Urban	Infiltration Trench	0.55	0.6	ND	0.75	0.9	
Urban	Lakeshore restoration	0.43	0.81	ND	0.73	0.3	
Urban	LID*/Cistern	0	0	0	0	0	
Urban	LID*/Cistern+Rain Barrel	0	0	0	0	0	
Urban	LID*/Rain Barrel	0	0	0	0	0	
Urban	LID/Bioretention	0.43	0.81	ND	ND	ND	

Landuse	BMP & efficiency	N	P	BOD	TSS	*E. coli*	Assumptions and additions
Urban	LID/Dry Well	0.5	0.5	0.7	0.9	ND	
Urban	LID/Filter/Buffer Strip	0.3	0.3	0.4	0.6	0.9	
Urban	LID/Infiltration Swale	0.5	0.65	ND	0.9	ND	
Urban	LID/Infiltration Trench	0.5	0.5	0.7	0.9	ND	
Urban	LID/Vegetated Swale	0.075	0.175	ND	0.475	ND	
Urban	LID/Wet Swale	0.4	0.2	ND	0.8	ND	
Urban	Limestone filter	0.3	0.5	0.7	0.9	0.9	Assumption bases on information regarding Lime Filters in the MPC Stormwater Manual, used efficiencies for STEPL practice Urban LID/Filter/Buffer strip.
Urban	Oil/Grit Separator	0.05	0.05	ND	0.15	ND	
Urban	Porous Pavement	0.85	0.65	ND	0.9	0.9	
Urban	Raingardens	0.6	0.65	ND	0.75	0.9	Added Urban STEPL raingardens, assuming same efficiencies as STEPL practice Infiltration basin (urban)
Urban	Sand Filter/Infiltration Basin	0.35	0.5	ND	0.8	ND	
Urban	Sand Filters	ND	0.375	0.4	0.825	ND	
Urban	Settling Basin	ND	0.515	0.56	0.815	ND	
Urban	Shoreland buffer	0.4	0.425	0.505	0.73	0.3	
Urban	Silva cell	0.55	0.85	ND	0.95	0.9	Added Urban STEPL Silva Cells, assuming same reduction efficiencies as STEPL practice Infiltration Trench and efficiency ratings from https://www.deeproot.com/products/stormwater.html
Urban	Vegetated Filter Strips	0.4	0.4525	0.505	0.73	0.9	
Urban	Weekly Street Sweeping	ND	0.06	0.06	0.16	ND	
Urban	Wet Pond	0.35	0.45	ND	0.6	ND	
Urban	Wetland Detention	0.2	0.44	0.63	0.775	ND	
Urban	WQ Inlet w/Sand Filter	0.35	ND	ND	0.8	ND	
Urban	WQ Inlets	0.2	0.09	0.13	0.37	ND	

Table 39. Total loads and reductions by practices for Lura Lake and Rice Creek Watersheds STEPL

Practice	N load (no BMP) lbs/yr	P load (no BMP) lbs/yr	BOD load (no BMP) lbs/yr	Sediment load (no BMP) t/yr	*E. coli* load (no BMP) B MPN/yr	N reduction lbs/yr	P reduction lbs/yr	BOD reduction lbs/yr	Sediment reduction t/yr	*E. coli* reduction B MPN/yr
Lura Lake Watershed										
Wetland restoration	8,996.3	2,108.3	16,347.7	305.9	2,942.9	718.0	159.1	150.7	23.5	100.5
Combined Efficiencies	9,168.6	2,175.8	16,153.6	307.3	14,972.5	1,406.0	315.7	301.7	47.1	197.3
Minnesota Buffer Law	9,168.6	2,175.8	16,153.6	307.3	14,972.5	2,843.6	863.7	849.5	132.7	725.5
Soil Health Calculator	9,168.6	2,175.8	16,153.6	307.3	14,972.5	3,013.7	969.3	745.9	116.6	878.5
SSTS						167.9	65.8	685.5		12,031.3
Total Reductions						**8,149.2**	**2,373.5**	**2,733.3**	**319.9**	**13,933.1**
Rice Creek Watershed										
Minnesota Buffer Law	396,174.2	93,458.8	680,002.9	11,711.0	324,979.7	121,867.2	37,014.0	36,407.2	5,688.6	31,094.1
Healthier Watersheds	396,174.2	93,458.8	680,002.9	11,711.0	324,979.7	991.9	3,706.4	204.9	32.0	253.5
Combined Efficiencies	396,174.2	93,458.8	680,002.9	11,711.0	324,979.7	2,224.1	500.9	473.4	74.0	318.6
Soil Health Calculator	396,174.2	93,458.8	680,002.9	11,711.0	324,979.7	129,154.9	41,539.6	31,967.3	4,994.9	37,647.8
Feedlot Filter Strip	396,369.6	93,534.0	680,393.8	11,854.7	324,979.7	-	216.1	-	-	-
Runoff management system	396,369.6	93,534.0	680,393.8	11,854.7	324,979.7	-	209.7	-	-	-
waste management system	396,369.6	93,534.0	680,393.8	11,854.7	324,979.7	1,016.8	228.8	-	-	0.0
Waste Storage facility	396,369.6	93,534.0	680,393.8	11,854.7	324,979.7	826.2	152.5	-	-	-
Streambank Restoration	396,369.6	93,534.0	680,393.8	11,854.7	324,979.7	185.7	71.5	371.3	136.5	-
SSTS replacement	396,369.6	93,534.0	680,393.8	11,854.7	324,979.7	3,091.7	1,210.9	12,624.5		221,576.4
Total Reductions	**396,369.6**	**93,534.0**	**680,393.8**	**11,854.7**	**324,979.7**	**259,358.5**	**84,850.4**	**82,048.7**	**10,926.0**	**290,890.4**

The reductions for replacing and/or upgrading failing or non-conforming SSTS were estimated using the STEPL septic tab. Outputs from this worksheet are described in **Error! Not a valid bookmark self-reference.**.

Table 40. STEPL output for SSTS *E. coli* load reductions

Watershed	**N Load, lb/yr**	**P Load, lb/yr**	**BOD, lb/yr**	***E.coli* billion MPN/yr**
Lura Lake	167.88	65.75	685.5	12031.2965
Rice Creek	3091.72	1210.92	12624.54	221576.3772
Totals	3259.6	1276.67	13310.04	233607.6737