Grant

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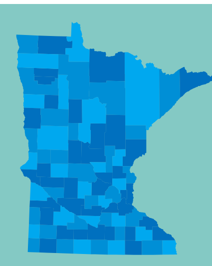
Sand Creek Section 319 Small Watershed Focus Program Nine-Element Plan

MINNESOTA POLLUTION CONTROL AGENCY



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Executive summary

This plan was developed to fulfill the requirements set forth by the U.S. Environmental Protection Agency (EPA) for recipients of grants appropriated by Congress under Section 319 of the Clean Water Act (EPA 2013). The requirements emphasize the use of watershed-based plans that contain the nine minimum elements documented in the guidelines and EPA's *Handbook for Developing Watershed Plans to Restore and Protect our Waters* (EPA 2008).

The Sand Creek Watershed encompasses an area of 274 square miles and includes several streams and lakes. The watershed is classified as a Hydrological Unit Code (HUC)-10 watershed that includes three smaller aggregated HUC-12 subwatersheds. It is located in the Lower Minnesota River major (HUC-8 07020012) watershed. Agricultural land use dominates the subwatershed, with 50.5% managed for row crop production and nearly 25% used as pastureland. Agricultural lands are concentrated in the southern regions of the watershed and shift towards more pasture, forested and developed acres moving north towards the watershed's outlet. Jordan, New Prague, and Lonsdale are the largest communities in the watershed and comprise a majority of it is nearly 7% developed acres. The watershed lies in the fringe of the southwestern Twin Cities Metropolitan Area (TCMA) and is home to many farms, small acreages, and a growing population of commuters to the Twin Cities. As population to the region continues to grow, land use within the northern and eastern most reaches of the subwatershed are projected to shift from agricultural uses towards increases in residential development. Natural areas are prevalent near the watershed's outlet as it enters the Minnesota Valley National Wildlife Refuge and surround its lakes and wetlands.

This plan builds on the foundation of many levels of planning efforts, water quality conditions, implementation goals and activities and an evaluation approach for the watershed. With the EPA approval of the plan, the plan will set the stage to further the previous and current restoration activities and continue efforts on to achieve the water quality goals in the watershed.

1. Introduction

1.1 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 EPA feels 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 (IWM, Assessments, TMDLs, WRAPS, 1W1P, etc.) are conducted and reported on as a HUC 8. These foundational efforts provide the support and understand to develop the very targeted and detailed Focus Grant Workplans for small watersheds. Instead of broad, strategies, this Focus Grant Workplan will delve into specific and targeted actions to achieve water quality goals in the Sand Creek Watershed.

This Grant Workplan is intended to be a living document. Through the building on the substantial foundation of previous work in this watershed, initial development of this planning method (Small Watershed Focus), first steps of the implementation of this plan, and the final data collection, this road map is intended to change, react, and correct the course of watershed implementation in the Sand Creek 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. The nine elements are listed in Table 1 along with the section of this report in which each nine element can be found.

The implementation measures described in Section 7 are estimated to bring the waterbodies to water quality standards, if established as outlined in this plan. On a biennial basis this plan will utilized the adaptive management approach to evaluate BMP effectiveness and proposed implementation timelines. Necessary adjustments will be made to continue the progress towards achieving water quality standards.

Table 1. Nine elements and report section

Section 319 Nine Element	Applicable Report Section
a. Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan.	Section 5: Pollutant source assessments
b. An estimate of the load reductions expected from management measures.	Section 7: Implementation priorities
c. A description of the nonpoint source management measures that will need to be implemented to achieve load reductions in element b, and a description of the critical areas in which those measures will be needed to implement this plan.	Section 7: Implementation priorities
d. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.	Section 7: Implementation priorities

Section 319 Nine Element	Applicable Report Section
e. An information and education component used to enhance public understanding of the project and encourage the public's early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.	Section 1.4 NPS pollution management strategies in the Sand Creek Watershed
f. Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.	Section 7: Implementation priorities
g. A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.	Section 6: Watershed goals
h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.	Section 6: Watershed goals
i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item h immediately above.	Section 8: Monitoring

1.2 Planning purpose and process

The purpose of this plan effort is to build upon the existing foundation of work that has been completed in the Sand Creek Watershed. The plan builds on the past efforts to inform the details of this plan. Implementing the actions in this plan will achieve the water quality goals for the streams and lakes in the watershed. The goals include meeting the water quality standards for the waterbodies.

This plan incorporates detailed work for specific waterbodies. It builds off of the Scott Watershed Management Organization (WMO), Rice County, and Le Sueur County's 10-year planning cycle or frameworks. Considerable cross interactions between various programs makes it difficult to single out any one document/plan as the complete picture for the watershed plan that fully meets EPA's nine key elements for every waterbody in the watershed. Instead, each of these plans, studies, and efforts brings more information to the table to inform the actions needed to obtain improved water quality and to ultimate reach water quality standards.

Part of the development of this plan includes synthesizing and compiling the information from these multiple scale planning efforts. Planning needs to be conducted within the existing structure of the WMO and framework of the partners. This Small Watershed Grant Workplan will contain more detail than planning efforts to date and bring that value to implementation efforts.

Circumstances in the watershed will continue to change. Land use will change, BMPs will be implemented, the climate will continue to change, etc., and the needs of the watershed will change based on these inputs. The milestones and intentional monitoring of progress will guide the changes needed to this plan throughout the implementation process.

1.3 Watershed management team

Several agencies, organizations, and individuals have been active in one or more watershed management-related activities in the Sand Creek Watershed. A list of these with a brief description of their involvement is given in Table 2.

Table 2. Agencies, organizations, and individuals participating in watershed activities in the Sand Creek Watershed.

Entity or individual	Description of activity
Scott County	Administration of the Scott WMO and lead for watershed implementation
Rice County	Support and watershed planning in Rice County
Le Sueur County	Support and watershed planning in LeSueur County
Scott SWCD	Implementation of BMPs with landowners in Scott County
Rice County SWCD	Implementation of BMPs with landowners in Rice County
Le Sueur SWCD	Implementation of BMPs with landowners in LeSueur County
Cedar Lake Improvement District?	Partner for In-Lake management effort per the TMDL for Cedar Lake

1.4 Nonpoint source (NPS) pollution management in the Sand Creek Watershed

The NPS pollution management in the Sand Creek Watershed has evolved over time. Historically it focused on efforts by the Soil and Water Conservation Districts in Rice, Le Sueur, and Scott Counties working in partnership with the federal Soil Conservation Service and later the Natural Resources Conservation Service. Efforts gathered momentum since the 2000s, with new partners added and state and federal grants successfully completed. The combined result has been the implementation of thousands of practices across the watershed, delisting of McMahon (Carl's) Lake from the impaired waters list (MPCA 303(d) List), and a few other positive trends. This story is told in the Sand Creek StoryMap, which can be found at http://www.scottcountymn.gov/1700/Sand-Creek-Watershed-Story-Map. Another outcome of these efforts is the evolution of a strategic approach for sustained collective action for NPS control by building community capacity. Details regarding this approach were recently published by Nelson, Davenport, and Kuphal (2017). This approach submits that NPS programs are more successful when they:

1. Apply systems thinking
2. Are locally relevant
3. Engage local community members
4. Build strong relationships and enduring partnerships
5. Stay focused, learn and adapt

This is now the approach of the partners in the Sand Creek Watershed with the desired outcome being sustained collective action. The approach did not come together all at once. Instead, it evolved through trial and error, and the application of adaptive management. The following section briefly describes the evolution of this approach by describing how the various partners came together around various studies, strategies, and plans; and then describes how with the incorporation of social science data the focus has changed to building community capacity and collective action. The section ends with a description and tabulation of the collective results to date.

1.4.1 Evolution of partnerships and plans

There is a long history of NPS pollution management in the Sand Creek watershed involving the Le Sueur, Rice, and Scott Soil and Water Conservation Districts (SWCD). The three SWCDs have each been in existence for close to 75 years, and over that period have supported federal Soil Conservation

Service/ Natural Resources Conservation Service programs and state programs, and have assisted numerous landowners in the watershed.

The Sand Creek Watershed Management Organization (WMO) was formed in the 1980s following passage of the Metropolitan Surface Water Management Act, Minn. Stat. § 103B. This was a joint powers organization of the cities and townships in the Scott County portion of the watershed. However, the Minnesota Board of Water and Soil Resources (BWSR) declared the Sand Creek WMO non-implementing in the late 1990s. The Scott WMO, or SWMO, (a county-based WMO) was then formed. The first SWMO Watershed Plan, approved in 2004, emphasized information gathering and development of standards and programs. The third plan, approved in 2019, built on the information, standards, and programs of the first plan to place a greater emphasis on implementation (SWMO 2019). This plan was successfully implemented over the next ten years with almost all the strategies initiated or completed. A new 2019–2026 Comprehensive Water Resources Management Plan was recently completed, approved by BWSR September 2018, and adopted by the SWMO in December 2018 (SWMO 2018). This plan continues a strong emphasis on partnerships and implementing NPS practices.

The Cedar Lake Improvement District is a local unit of government focused on Cedar Lake. Cedar Lake is a 790-acre lake in the Sand Creek Watershed. There are numerous residents around the lake, two boat launches, and a county regional park—the Cedar Lake Farms Regional Park located on the south end of the lake. Aquatic recreation on the lake is considered impaired due to excessive nutrients that lead to algae blooms and excessive submerged aquatic plants, particularly curly-leaf pondweed. The lakeshore residents organized to form the Cedar Lake Improvement District (CLID), which was approved by the County Board in 1981. The CLID initiated a comprehensive investigation to determine the source and potential solutions to improve the water quality of the lake. In 1999, the Cedar Lake Sanitary Sewer District was formed. It was initiated by the CLID as a solution to failing septic systems near the lake. The sewer system became operational in the early 2000s serving 325 homes with a large collector system that was piped to the City of New Prague's wastewater treatment plant.

The Sand Creek Watershed partners (i.e., the three SWCDs, the SWMO, the CLID, and Le Sueur and Rice Counties along with the Metropolitan Council) started working more closely together in 2007 when the SWMO was awarded a Clean Water Partnership Phase 1 grant for the Sand Creek Watershed from the MPCA. This grant provided support for the partners to complete a Diagnostic and Feasibility Study for Sand Creek and TMDLs for Cedar and McMahon (Carl's) Lakes. The Diagnostic and Feasibility Study focused on the fish and turbidity impairments in Sand Creek, while the lake TMDLs and TMDL implementation plans focused on the aquatic recreation impairments. The resulting reports and studies (SWMO 2010a and 2010b) were finalized in 2010.

The strategy developed in the Sand Creek Impaired Waters Feasibility Study (SWMO 2010b) addresses turbidity and focuses on reducing TSS (Table 3). The strategy is based on findings that 1) turbidity was mostly a function of suspended inorganic solids; 2) most of the TSS load was from near channel sources; 3) the Middle Sand Creek Management Area produced 5 to 10 times the TSS per acre yield compared to other Management Areas; and 4) Sand Creek and its tributaries (particularly in the middle Management Area) are still incising following creation of the Minnesota River valley. This strategy will also help reduce phosphorus and improve riparian and stream habitat. Practices ranging from specific to general were identified and prioritized for each of the subwatersheds following this general strategy. This strategy was incorporated into the 2019 SWMO Comprehensive Water Resources Management Plan (SWMO 2019) and both the Le Sueur and Rice County's Water Resources Management Plans (Le Sueur County 2016, Rice County 2016). For the purposes of this plan, these issues are the basis for creating management areas (MAs) and will be discussed in Section 2.

Table 3. Sand Creek Sediment Reduction Strategy

Moderate flows (particularly in the upstream subwatersheds) to help reduce near channel sediment production from stream banks, bluffs, and ravines in the middle Sand Creek Management Area.
Simultaneously improve buffering and vegetation in the riparian corridors to help improve resistance to streambank erosion so that the creek can come to a new dynamic equilibrium.
Promote grade control practices to slow down and moderate the rate of incision in more active areas of the watershed.
Complete capital improvements controlling near channel sources of sediment where the erosion and sediment source is acute, where it will get significantly worse without intervention, or where infrastructure is threatened.

TMDL Implementation Plans completed for Cedar and McMahon (Carl's) Lakes largely focus on the control of internal sources of phosphorus (SWMO 2012). For Cedar Lake, this focus was on controlling curly-leaf pondweed, reducing the carp population, and, depending on the success of those efforts, an alum treatment would be considered. The plan for McMahon (Carl's) Lake also includes curly-leaf pondweed control and an alum treatment. Watershed based NPS pollution control efforts are a modest, but ongoing, part of both plans.

In the years since the completion of the Clean Water Partnership study and the lake TMDLs, the SWMO and Scott SWCD have completed additional studies and analysis to further target implementation actions. These include:

- In 2013, the completion of a subwatershed assessment for the direct Cedar Lake subwatershed, which identified and prioritized 24 potential BMP, projects (Scott SWCD 2013).
- In 2014, the completion of a subwatershed assessment for the Picha Creek subwatershed (tributary to Sand Creek) which identified and prioritized 36 potential BMP projects (Scott SWCD 2014).
- The completion of the Sand Creek Near Channel Sediment Reduction Feasibility Report which identified and prioritized the highest near channel sediment-producing streambanks, bluffs, and ravines in the Middle and Lower Sand Creek Management Areas, assessed feasibility for stabilization, and developed concepts for the six most active sites (Inter-Fluve 2015).
- The completion of the Cedar Lake Carp study, which estimated the abundance and biomass of carp in Cedar Lake and provided recommendations (Carp Solutions 2017).

In addition to these studies, the Minnesota Department of Natural Resources completed a Whole Lake Vegetation Management Plan for Cedar Lake that sets out a strategy for reducing curly-leaf pondweed and increasing native plant coverage in 2013. The local partners consider these efforts as part of an overall comprehensive strategy.

1.4.2 Community capacity and collective action

The local partners have known for a long time the importance of relationships and trust, and providing good service when dealing with landowners regarding the control of NPS pollution. Staff from partner organizations have been tracking research on the importance of informal and formal networks. These networks are used for the dissemination of information, how social norms affect behavior and behavior change, factors that influence behavior change, as well as factors that influence how and when communities organize to sustain behavior change. The local organizations experimented with this information over the years to try to increase the adoption of NPS practices by landowners. This effort of converting research to application took a large step forward in 2009 when Scott County received a McKnight Foundation Grant and worked with the Scott SWCD and SWMO to host meetings with landowners to discuss potential practices that were identified on their properties as part of the Sand

Creek Watershed Clean Water Partnership study. Over 120 invitations were sent to landowners where potential projects were identified; ultimately, over 40 landowners responded and agreed to meet. Resource Conservationists that met with the landowners were coached to talk with the landowners about their plans (i.e., dreams) for their property before bringing up the potential project identified. This approach made for very positive discussions and built trust.

Around this same time, SWMO and Scott SWCD staff were formulating new plans through the Clean Water Partnership project and updating the SWMO Comprehensive Water Resources Management Plan. As part of this planning, the two organizations defined staff roles: SWMO staff were assigned to develop relationships with organizations in the watershed, and Scott SWCD staff were assigned to take the lead with individual land owners with the hope of not only building trust, but also of tapping into both formal and informal networks in the watershed.

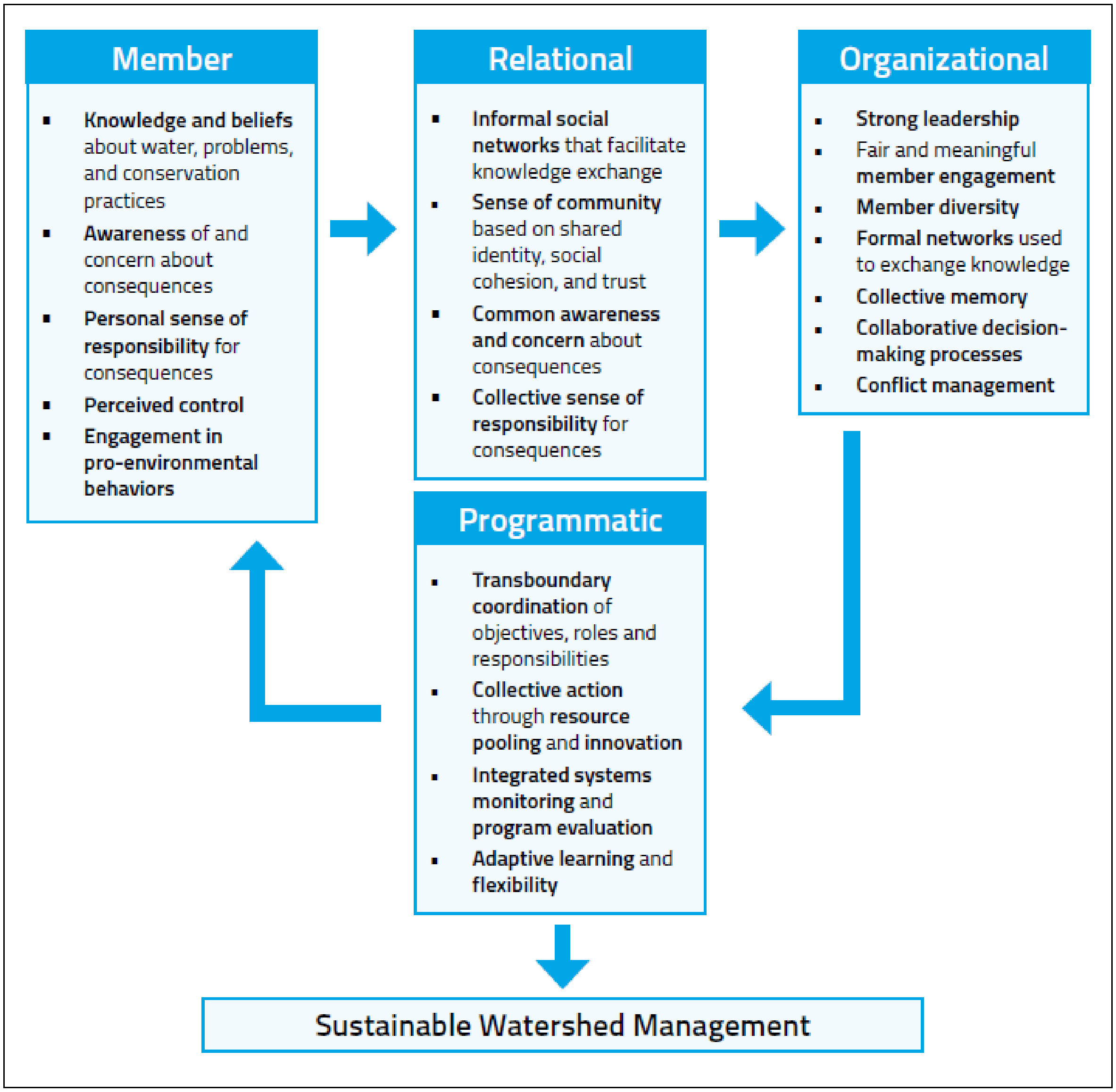
In 2011, the Scott County portion of the Sand Creek Watershed was selected by Dr. Mae Davenport for a survey of landowner attitudes of water management and buffers (Davenport and Pradhananga 2012). Findings from this study were used by the SWMO to revise community engagement and outreach efforts as described in Table 4. At the same time, Dr. Davenport was also developing and publishing her Multilevel Community Capacity Model for Sustainable Watershed Management (Davenport and Seekamp 2013; Figure 1). Staff from the SWMO read a draft of her model and saw that it brought together many of the things that the local partners had experimented with over the years, and the SWMO and Scott SWCD adopted the Community Capacity Model as their collective way of thinking about and framing NPS pollution management.

Table 4. Sand Creek Riparian Landowner Survey Finding, Program Revisions, and Practical Applications (updated from Davenport, Pradhananga, and Nelson 2013)

Significant finding	Program revision	Practical application
High level of concern about the consequences of water pollution, sense of responsibility for water quality and feeling of personal obligation to engage in conservation practices.	Partners enhanced efforts to show appreciation, and publicly reinforce that conservation practices are a community norm.	Host “Thank You” events to show appreciation to those who have participated in the Technical and Cost Share (TACS) program. Two events have been held since 2012. Press release – news article publicizing the conservation ethic locally. Staff training on showing appreciation. Personalized thank you cards sent to all program participants. Focus communications on social/ecological benefits of conservation relevant to targeted audiences.
Lack of awareness of water quality problems and their consequences and belief that water resources are adequately protected.	Partners have increased efforts to make information on the condition of water resources available to landowners and staff.	Annually review with staff water quality monitoring results for local water bodies so they are better prepared to discuss with landowners. Develop single page fact sheets on water bodies.

Significant finding	Program revision	Practical application
Perception that the community does not have the leadership needed to protect water resources.	Partners have demonstrated and highlighted "successes." These include successes at the individual practice and water body scales.	Compile and promote success stories. Staff training on story telling. Hold up conservation adopters and leaders. Celebrate successes. Promote sense of momentum.
Low sense of personal obligation to work with others in the community to protect the environment.	Partners have hosted events and provided opportunities to demonstrate the value of people working together on conservation projects.	Host buffer planting or other cleanup events. Provide mini-grants to community groups/schools.
Local Soil and Water Conservation District had greatest influence on landowner's decisions about conservation practices outside of family.	Continue to have SWCDs lead efforts with individual landowners.	Have SWCD staff lead all efforts with individual landowners. SWMO and Scott County in support role with respect to individual landowners. Avoid to the extent practical having SWCD staff in an enforcement role. Advertise the TACS program locally as an SWCD effort.

Figure 1. Multilevel Community Capacity Model (Davenport and Seekamp 2013)



In 2017, the UMN Center for Changing Landscapes (Pradhananga and Davenport 2017) completed a second survey of landowners in Scott County under contract with the SWMO. The survey was funded by BWSR through a Clean Water Land & Legacy Targeted Watershed Grant for Sand Creek. The target recipients of the survey were Scott County landowners who had participated in the TACS program, most of whom were located in the Scott County portions of the Sand Creek Watershed. The survey was designed to serve as a "customer satisfaction" survey – querying what the landowners' motivations were for participating, whether their needs were met, and what the partners could do better.

Results are published in *Social Science-Based Evaluation of Scott County's Technical Assistance and Cost Share Program* (Pradhananga and Davenport 2017). Overall satisfaction with the program is good, with an overwhelming majority of respondents (94%) expressing satisfaction with the SWCD staff (Figure 2). Financial assistance that exceeds 75% is not recognized as much of an additional incentive (Figure 3). The survey also confirmed that equipment, financial resources, and leadership were the greatest barriers to implementation (Figure 4). This confirmation provided support for continuation of the current cost share, equipment rental, and acknowledgement efforts.

The SWMO and Dr. Pradhananga and Dr. Davenport from the University of Minnesota Center for Changing Landscapes are currently collaborating to complete an additional survey. This survey is essentially a repeat of the 2011 survey and is designed to assess whether the local efforts implemented since the original survey have affected landowner attitudes. Results are being analyzed and will be used to refine local programs.

Figure 2. Respondents' satisfaction with aspects of the conservation assistance program

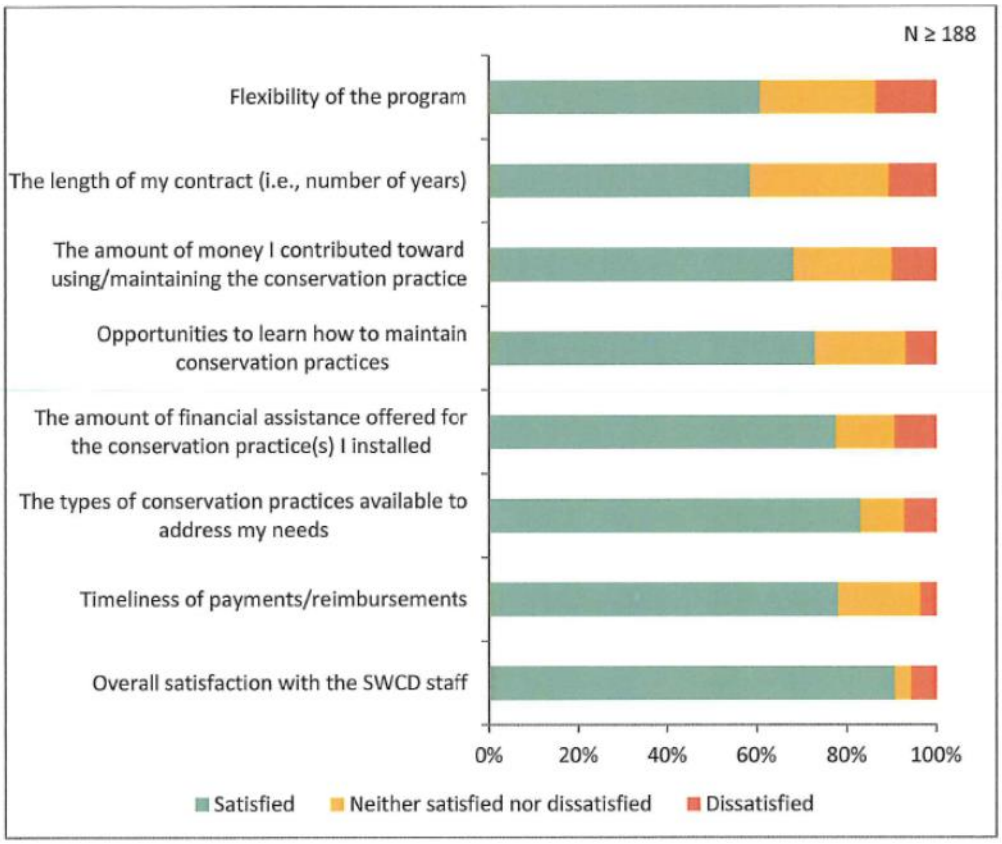


Figure 3. Percent of respondents likely to install conservation practices at various levels of financial support.

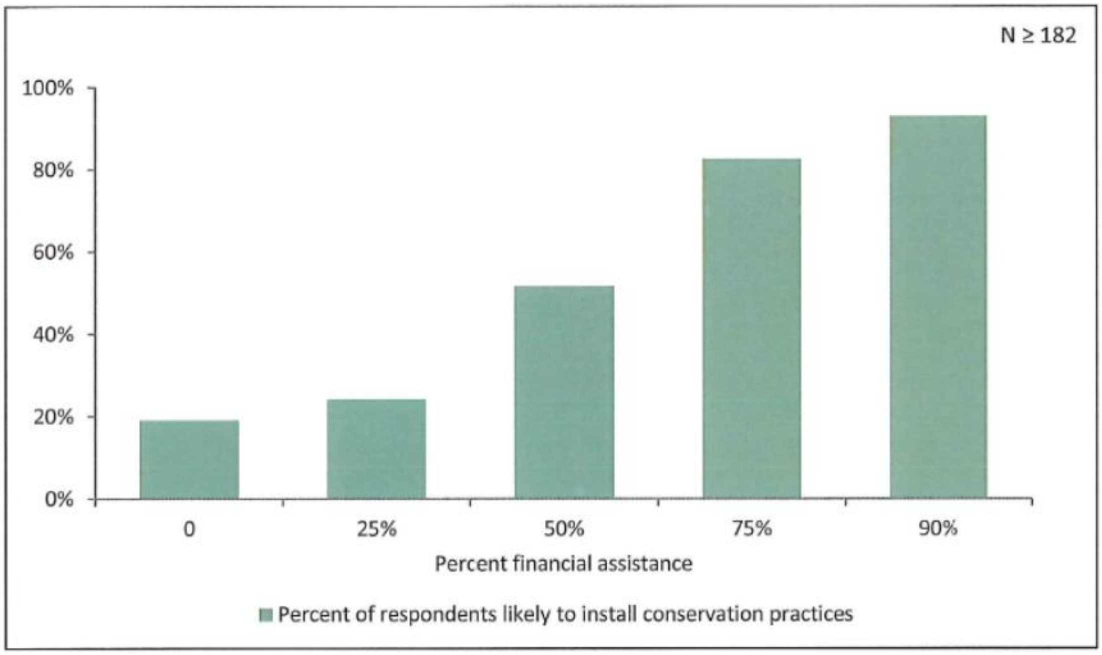
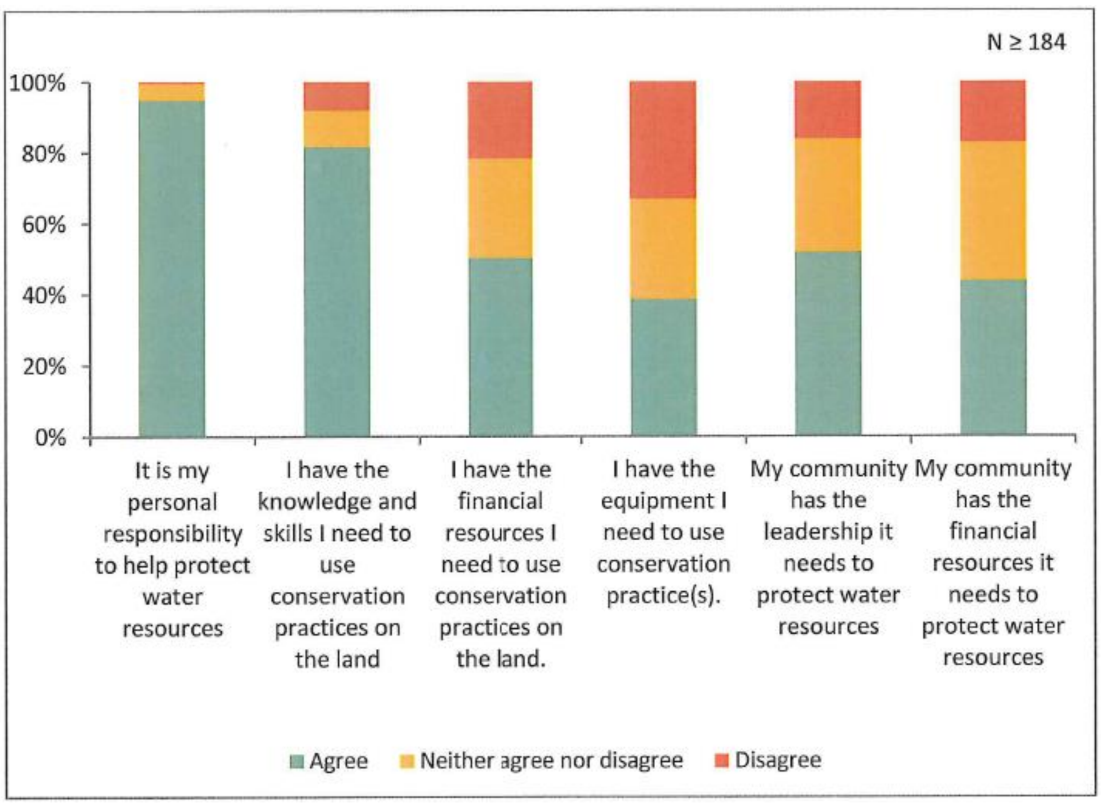
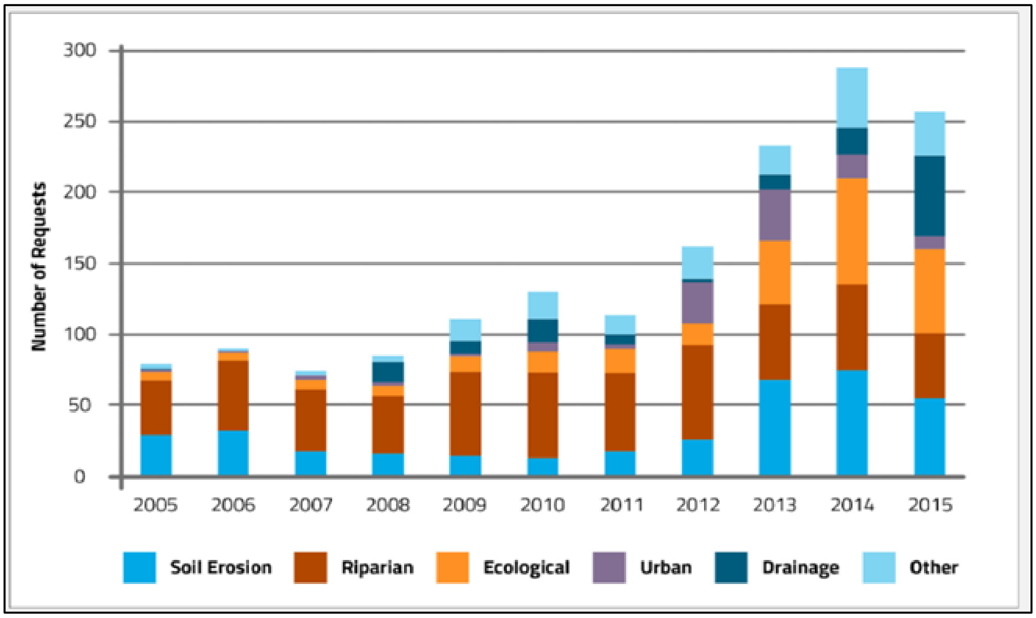


Figure 4. Respondents' beliefs about water resource protection and conservation practices



Overall, the partners believe that the approach being used for collective action is working as evidenced by increased landowner requests for assistance (Figure 5) and the amount of conservation being implemented as discussed in the next section.

Figure 5. Landowner Technical Assistance Requests at the Scott SWCD



1.4.3 Collective NPS results to date

Local partners collaborate on four programs that implement practices and projects aimed at reducing NPS pollution in the Sand Creek Watershed:

- The Technical Assistance and Cost Share (TACS) program, which provides technical and financial assistance to landowners (both public and private) to adopt conservation practices.
- The SWMO's Capital Improvement Program is used to implement large capital projects. For the Sand Creek Watershed, this program is used to complete the near channel stabilization projects where sediment sources are most acute as described in the Sand Creek Sediment Reduction Strategy (Table 3).
- The Scott SWCD Equipment Rental Program, which provides landowners with access to various seeders and no-till seed drills.
- Soil health initiatives to increase cover crop usage, decrease tilling, and increase organic matter.

These programs are in turn supported by the engagement and outreach efforts promoting collective action. The partners have also had significant financial assistance from state and federal grants including the Minnesota Board of Water and Soil Resources through the Clean Water Land and Legacy, Clean Water Fund; the Legislative Citizens Commission on Minnesota Resources; and the Minnesota Pollution Control Agency and the EPA through the EPA Section 319 Grant Program.

Joint TACS program efforts have been successful, with over 800 practices implemented with landowners through the provision of technical assistance, financial assistance, or both (Table 5). Technical assistance is provided to all landowners when requested. Cost Share and Incentives are provided in accordance with the Conservation Practice Financial Assistance Policy Manual (PPM). A copy of the 2018 PPM is included as Appendix E to the SWMO Comprehensive Water Resources Management Plan available at http://www.scottcountymn.gov/wmo/waterplanreview. In addition to these more recent efforts through the TACS program, the partner SWCDs have assisted with the implementation of over 1,000 additional practices through other state and federal programs (i.e., State Cost Share, Reinvest in Minnesota [RIM], Conservation Stewardship Program [CSP], Conservation Reserve Program [CRP], and Environmental Quality Incentives Program [EQIP]). The Scott SWCD also completed a paired watershed study in the County Ditch 10 and West Raven subwatersheds to Sand Creek in the late 1990s funded by the Metropolitan Council's Twin Cities Water Quality grant program. This project offered the use of no-till equipment and implemented numerous additional practices with a combined sediment reduction benefit estimated at more than 110,000 tons/year.

Table 5. Practices enabled and implemented in the SWMO (with most in the Sand Creek Watershed) as part of the TACS program since its inception in 2006.

Practice	Number completed
Practices that Moderate Flow	
Cover Crops	10
Native Grasses/Prescribed burning	77/11
Stormwater Runoff Control	22
Wetland Restoration	15
Practices that Control Grade or Stabilize Erosion	
Channel Bed Stabilization	3
Critical Area Planting	3
Diversion	1
Grade Stabilization	69
Grassed Waterway	57
Lined Waterway or Outlet	12
Streambank Stabilization	51
Terrace	5
Water and Sediment Control Basin (WASCOB)	78
Practices that Buffer or Filter	
Field Bolder	2
Filter Strip	205
Rain Garden	46
Riparian Forest Buffer	5
Riparian Herbaceous Cover	9
Shoreline Protection	22
Underground Outlet	28
Other Misc. Practices	
Waste Management (Impoundment closure, Storage Facility, Utilization)	13
Herbaceous Wind Barriers/ Windbreak-Shelterbelt Renovation	3/3
Mulching	1
Subsurface Drain	2
Well Decommissioning	50
Wetland Wildlife Habitat Management	2
Whole Farm Planning	1
Total 809 Practices	

Capital improvements completed by the partners in the Sand Creek Watershed are shown in Table 6. These are generally larger perennial grass plantings and/or near channel sediment stabilization projects.

Table 6. Water Quality Capital Improvement Projects Completed In the Sand Creek Watershed by the Local Partners

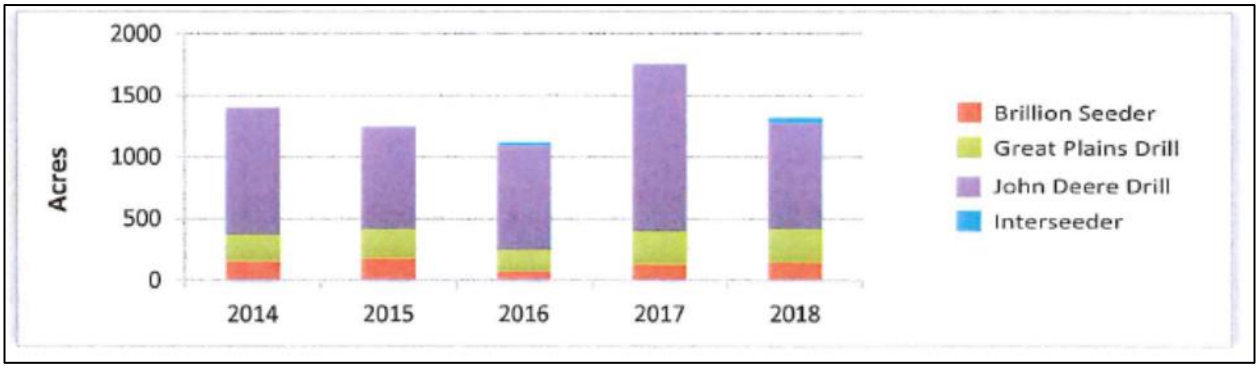
Project	Year completed	Partners	Description
Cedar Lake Farm Regional Park Shoreline Buffer	2013	Great River Greening, Scott County Parks, Legislative Citizens Commission on Minnesota Resources (LCCMR), SWMO	150 volunteers helped plant over 9,000 native plants on 1,500 feet of shoreline creating 1 acres of native prairie buffer and an acre of wetland.
Cedar Lake Farm Regional Park West Shoreline Stabilization	2012	Scott County Parks, Board of Water and Soil Resources (BWSR) and the Clean Water Fund, and SWMO	Stabilized 900 feet of eroding shoreline using cedar tree revetments, 600 willow and dogwood stakes, and a small area of native seed.
Cedar Lake North Shoreline Buffer	2012	Scott County Highway, and BWSR and Clean Water Fund, and SWMO	Established 275 feet of native vegetative buffer and a bioswale in a disturbed area north end of Cedar Lake.
Picha Creek Restoration	2011	BWSR and Clean Water Fund, and SWMO	Restoration of 2,600 feet of a ditched, incised and eroding section of the creek, re-connected/created a floodplain, and removed a fish migration barrier.
Upper Porter Creek Stabilization	2011	BWSR and Clean Water Fund, and SWMO	Stabilized three priority streambank/bluff erosion sites with bioengineering approaches consisting of large woody debris cribs, bank sloping and vegetative planting.
Doyle-Kennefick Regional Park Native Prairie	2010	Scott County Parks, Scott SWCD, and BWSR	Established a 47-acre native prairie planting in an area that was row cropped.
Pexa Native Prairie Planting	2015	Scott County Parks, and SWMO	Establishment of an 18-acre native prairie planting in an area at the northern end of the Cedar Lake Farm Regional Park that was row cropped, and drains to Cedar Lake.
Sand Creek Near Channel Stabilization Phase I	2016	BWSR Clean Water Land & Legacy Fund, MPCA and USEPA 319 Program, and SWMO	Stabilized two priority bluffs, one adjacent to Porter Creek and one adjacent to Sand Creek using log jams at the bluff toe, and one priority eroding ravine.
Sand Creek Near Channel Stabilization Phase II	2018	BWSR Clean Water Land & Legacy Fund, MPCA and USEPA 319 Program, and SWMO	Stabilized a priority bluff site along Sand Creek with logjams at the toe.
Sand Creek Riparian Plantings	2015-2017	BWSR Clean Water Land & Legacy Fund, Great River Greening, Scott SWCD, Le Sueur SWCD, and SWMO	Improved native riparian vegetation at 13 priority targeted sites along Sand Creek and its tributaries. Volunteers were utilized at a number of the sites to plant over 5,000 native plugs and shrubs.

The equipment rental program has been available through the Scott SWCD for a number of years. The program currently has four pieces of equipment:

- Brillion Sure Stand Seeder (for seeding in clean-till soils; for introduced grasses, legumes, and grains)
- John Deere 1590 No-Till Drill (new seeding into no-till conditions and/or or inter-seeding into existing vegetation; for soybeans, wheat, cover crops, native grasses)
- Great Plains 1006NT (new seeding into no-till conditions and/or or inter-seeding into existing vegetation; for native grasses and forbs, also handles cool season)
- Cover crop Inter-Seeder (seeding cover crops in between rows of growing corn or beans, usually early to mid-June)

The equipment rental program is well established, with the equipment being used on over 1,000 acres per year (Figure 6). More information is available at the Scott SWCD website: https://www.scottswcd.org/equipment-rental.

Figure 6. Equipment rental program



For the past few years, the partners have worked together to promote soil health and cover crops. Activities include outreach efforts in addition to financial incentives provided through the TACS program. Efforts have included annual workshops, field demonstration plots, tours, and a monthly e-newsletter. From 2016 to 2018, over 1,200 acres of cover crops were planted in the Sand Creek Watershed.

Finally, the partners have additional efforts planned for 2019, funded by the Sand Creek Watershed BWSR Targeted Watershed grant and the current US EPA 319 Grant, as well as new education efforts through BWSR's Watershed Based Funding regarding road and parking salt reduction and *E. coli* reduction. These planned efforts include TACS program practices with landowners, cover crop specific promotion, the design and completion of one or two near channel sediment control capital projects, one riparian vegetation improvement project, road and parking lot salt applicator trainings, and new education efforts regarding de-icing and *E. coli*. These activities are in addition to on-going equipment rental and soil health efforts.

Many phosphorus load reduction and lake restoration activities called for in the Cedar Lake TMDL Implementation Plan have already taken place:

- Native vegetation establishment in the Cedar Lake Watershed resulted in an estimated phosphorus reduction of 18 pounds per year.
- Shoreland stabilization projects resulted in an estimated phosphorus reduction of 14 pounds per year.
- Internal load reduction projects to reduce the load from curly-leaf pondweed and carp have been implemented. The number of native aquatic plant species in Cedar Lake increased from two in 2007 to seven in 2016.

1.4.4 Other complementary actions

Complementary actions have been completed in the Sand Creek Watershed; these actions are either not explicitly targeted at water quality or have been completed by other entities. The complementary actions include, but are not limited to, the following:

- The Scott SWCD Tree Sale Program that sells 30,000 to 35,000 trees and shrubs annually to residents of Scott County.
- Road salt reduction efforts by the City of Jordan and Scott County Hwy.
- Wastewater treatment plant (WWTP) improvements including phosphorus removal at the New Prague WWTP and a dewatering bag at the City of Jordan WWTP.
- Creation of the Sanborn Lake Wildlife Management Area by the Minnesota Department of Natural Resources that converted over 300 acres of row crop to native vegetation plantings.
- Operation of aerators on Cedar and McMahon (Carl's) Lakes by local sportsman's clubs to reduce winter fish kills.
- Ice-off clean-up events hosted by the CLID and the New Market Sportsman's Club.
- Volunteer monitoring through the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP) on Cedar and McMahon (Carl's) Lakes.
- Stream monitoring and analysis by the Metropolitan Council on Sand Creek in Jordan.
- Comprehensive watershed monitoring, assessment, and TMDL and Watershed Restoration Action Plan Strategy Development by the Minnesota Pollution Control Agency.
- Local school districts, churches, or other non-profits performing work through the SWMO's Watershed Stewards Mini-Grant program for activities such as rain gardens, small natural area plantings, and fish surveys of local lakes.
- Outdoor education days that have been hosted for 33 years in the Sand Creek Watershed where 5th and 6th grade students (1,500 students from 17 schools in 2017) spend a day learning about environmental topics such as soil, water, plants, recycling, and wildlife.
- Stormwater runoff water quality standards by the SWMO and NPDES Stormwater Construction permit requirements for new and re-development.
- Septic system permitting, compliance, and replacement programs operated by Scott County.

1.5 Planning foundations

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 targeted areas, such as the Picha Creek and Cedar Lake watersheds. As the work continues, more critical areas will be identified and further fleshing out of those areas will occur.

2. Watershed prioritization

Implementation efforts will vary over the next 10 to 20 years depending on the response to the implementation of conservation, land use changes, and the evidence provided by data. Citizen attitudes, levels of tolerance, and needs will also influence the rate of implementation and success of this plan. Through regular assessment checks, discussed in Section 6, course corrections, and adaptations will be made.

Landowner and citizen involvement, along with the critical loading areas, has helped to create loose management areas to address the problems. Sand Creek is a complex system and due to the complexity and limitations of watershed work, prioritization is necessary to its success. Areas, such as highly erodible land (HEL) contribute a large amount of sediment to the system. These areas are targeted to be addressed through soil health initiatives and erosion management through implementing agricultural BMPs. Implementation of the BMPs are heavily influenced by the willingness of landowners and others to participate. Some of the ongoing implementation strategies included here apply to management areas, and others are targeted to specific focus areas and water quality issues. Substantial work in this watershed has occurred prior to this planning effort.

The initial resource priorities in the watershed address:

- The lake recreational impairments due to excessive phosphorus.
- The aquatic life impairments associated with elevated total suspended solids in Sand Creek and its tributaries.

Much work has been invested to reduce phosphorus to the lakes and TSS in Sand Creek, and positive trends are being realized. Phosphorus concentration goals have been met for McMahon (Carl's) Lake, and positive trends are being seen in lower TSS concentrations in Sand Creek. Local partners wish to maintain and build on this progress while there is momentum.

The management focus for the other pollutants is as follows:

- Local partner's efforts to ramp up efforts to address increasing chloride concentrations will begin over the next few years.
- Efforts directed toward *E. coli* impairments will largely focus on maintaining existing programs. Tracking shows that septic system compliance is increasing, replacement loan programs are successful, and other efforts addressing feedlots and land application of manure are in place.

Based on the above priority issues, the initial geographic priority areas for focused implementation under the Section 319 Small Watershed Focus Grant Workplan are described in Table 8 and mapped in Figure 7. Grant funding will be used for cost-share, incentives, and technical assistance for these efforts. Prioritization for implementation will be for areas that are identified as impaired and, within those areas, further prioritized to include the areas identified as contributing the highest pollutant sources. These areas are identified as the management areas with highest loading and critical sources and will have the highest impact on water quality improvement.

2.1 Critical areas

Critical areas represent specific portions of the watersheds that contribute the largest pollutant loads to the waterbodies. These areas were identified through the use of multiple models and tools including SWAT, Revised Universal Soil Loss Equation (RUSLE2), Minnesota Board of Soil and Water Resources (BWSR) pollution reduction calculator spreadsheets, and BATHTUB in conjunction with professional knowledge about the watershed and field reconnaissance. These areas are identified in figures 9-11, 26 and 27. Subwatershed analyses (SWA) are completed for the Focus Areas with site specific BMPs and locations for the individual waterbodies based on the critical areas (see figure 30 for an example). These locations account for pollutant delivery potential and site-specific constraints and characteristics.

2.2 Management areas

Sand Creek Watershed is a large HUC10 watershed with 25 impaired waterbodies, with 55 listed parameters. To make this process more manageable, it has been broken down into six rough management areas (MAs). These selections have to do with the prioritization of work determined by the citizens and the LGUs, and also the scope and the scale of need. These management areas are approximate, and may differ or overlap based on the needs of the implementation/approach and water bodies. The management areas are to help associating the text with the particular water bodies the information in the WMO Plan and the SWAs.

Prioritized areas will become focus areas (FAs) within the management areas. Lakesheds will be their own focus areas as they float to the top of the prioritization and their subwatershed assessments are completed. Specific implementation for these areas will be described in Section 7.

Table 7. Management areas for Sand Creek Watershed

Management Area	Focus Area	Impaired Reaches/Lake	WIDs	Description
MA1 Picha Creek	FA1 FA1	Picha Creek Picha Creek	-579 -580	2.1.1
MA2 Middle Sand Creek	FA2	Cedar Lake Pleasant Lake Sand Creek Sand Creek	70-0091-00 70-0098-00 -538 -840	2.1.2
MA3 Upper Sand Creek	FA3 FA3 FA4	Cody Lake Phelps Lake Sanborn Lake Pepin Lake Hatch Lake Sand Creek	66-0061-00 66-0062-00 40-0027-00 40-0028-00 66-0063-00 -839	2.1.3
MA4 Lower Sand Creek		Sand Creek Unnamed Creek	-513 -732	2.1.4
MA5 Porter Creek		Cynthia Lake St. Catherine Lake McMahon (Carl's) Lake Porter Creek Porter Creek Upper Porter Creek	70-0052-00 70-0029-00 70-0050-00 -817 -815 -849	
MA6 Raven Stream		SC Ditch 10 Raven Stream W. Raven Stream East Raven Stream Unnamed Creek	-628 -716 -842 -819 -822	

The management areas are loosely defined by drainage areas; however, they may not follow precise delineations of geography. These are areas of concern that are broken into manageable pieces that can have an impact on water quality in shorter amount of time. This is to show improvement in a shorter amount of time rather than spreading efforts throughout an entire area without prioritization. Use of the Management Areas allows the idea of measuring, reacting and responding to change through targeted adaptive management.

2.1.1 Management Area 1 - Picha Creek

MA1 is the Unnamed Tributary (Picha Creek) drainage area, including impaired stream reaches -579 and -580. This stream is a direct tributary to Sand Creek and has been identified as a FA by the Sand Creek partners and citizens. The entire MA is represented by FA1.

FA1: Picha Creek has a completed in-depth Subwatershed Analysis (SWA) report that will inform the management practices for this plan (Table 8).

2.1.2 Management Area 2 – Middle Sand Creek

MA2 encompasses the middle of the Sand Creek Watershed, including impaired water bodies -538 and -840, 70-098-00, and 70-0091-00.

WQ issues in this MA involve elevated TSS and lake eutrophication. A primary source of excess sediment in this stream has been identified as near-channel sources affected by increased stream flows. A key management approach will be to reduce stream flows through upper watershed management practices including soil health and perennial cover. Channel restoration has been included in the capital improvement plans (CIP) plans for SWMO and will focus on high priority infrastructure affected areas. It is too expensive to do it everywhere.

Cedar Lake is impaired for eutrophication and mercury. Cedar Lake has been prioritized by the Sand Creek partners and citizens.

FA2: Cedar Lake has a completed, in-depth SWA report that will inform the management practices for this plan (Table 8).

2.1.3 Management Area 3 – Upper Sand Creek

MA3 encompasses the upper portion of Sand Creek, including impaired water bodies -839, 66-0061-00, 66-0062-00, 40-0027-00, 40-0028-00, and 66-0063-00.

This MA was created, in part, the intention of this delineation is to capture the land above the escarpment, where the land breaks in topography trends downward to the Minnesota River Valley.

Focus areas in MA3 include Cody and Phelps Lakes (FA3) and Sanborn Lake (FA4). These two FAs have been identified for this work by the Sand Creek partners and citizens. Subwatershed assessments are planned for fall 2019 (Table 8).

2.1.4 Management Area 4 – Lower Sand Creek

MA4 encompasses the lower portion of Sand Creek and a small tributary located in the Minnesota River floodplain, terraces, and bluff. This area includes impaired stream reaches -513 and -732.

This MA was created to manage the area below the city of Jordan.

2.1.5 Management Area 5 – Porter Creek

MA5 encompasses the Porter Creek drainage area, including impaired water bodies -817, -815, -849, 70-0052-00, 70-0029-00, and 70-0050-00.

This MA was created to address the water bodies in the drainage area and the near channel erosion in MA2.

2.1.6 Management Area 6 – Raven Stream

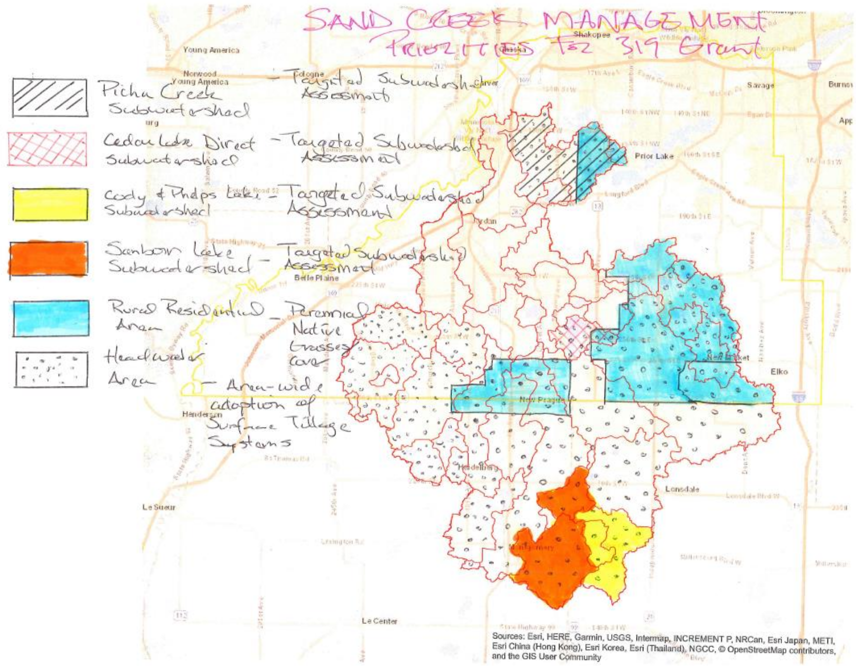
MA6 encompasses the Raven Stream drainage area, including impaired stream reaches -628, -716, -842, -819, and -822.

This MA was created to address the water bodies in the drainage area and the near-channel erosion in MA2.

Table 8. Priority areas

General Focus	Area	Rationale	Focus and Targeting Information
General Focus	MA3 MA5 MA6	Various studies including the draft Lower Minnesota River WRAPS (MPCA 2019) have identified wide scale changes needed to vegetative surface cover in agricultural systems. Thus, system-wide change needed. For Sand Creek promote these in MAs, which are also the areas where agriculture will continue long-term.	Focus on adoption of surface tillage systems (and by extension TSS, TP, and runoff) through incentive and cost share: 1. Incentives for reduced tillage 2. Incentives for cover crops 3. Cost share for alternative tile surface intakes 4. Incentives for nutrient management
	MA1 MA3 MA5 MA6	Various studies have identified increasing perennial cover as key to achieving water quality outcomes. Areas guided for Rural Residential Expansion development provide a unique opportunity to convert large landscape areas to native perennial cover.	Focus of runoff reduction and by extension TSS and TP reduction. Add additional 100 acres of perennial cover annually
	FA1	Picha Creek is a unique tributary discharging to the lower reaches of Sand Creek, Louisville Swamp and the Minnesota Valley National Wildlife Refuge.	Focus on TSS and runoff reduction. Practices identified in a subwatershed assessment completed 2014 include 36 potential practices where property owners are yet to be contacted. This will be augmented with additional study of the upper part of the subwatershed in 2020. The future study will address stormwater management, and may identify additional nonpoint management opportunities.
Priority Areas	FA2	Cedar Lake is a significant recreational lake with public access and Cedar Lake Farm Regional Park.	Phosphorus reduction according to TMDL completed in 2010, and subwatershed assessment completed in 2013. Landowners of potential projects have all been contacted. Local partners anticipate that projects will continue to trickle in because of these contacts.
	FA3	Cody and Phelps Lakes have public accesses, and are part of the headwaters area of Sand Creek.	Focus on TP, TSS, and runoff reduction. Subwatershed assessment scheduled for completion in 2019 will be used for targeting.
	FA4	Sanborn Lake, Wildlife Management Area, and part of the headwater area of Sand Creek.	Focus on TP, TSS, and runoff reduction. Subwatershed assessment scheduled for completion in 2019 will be used for targeting.

Figure 7. Priority management areas for the Section 319 Small Watershed Focus Grant Workplan



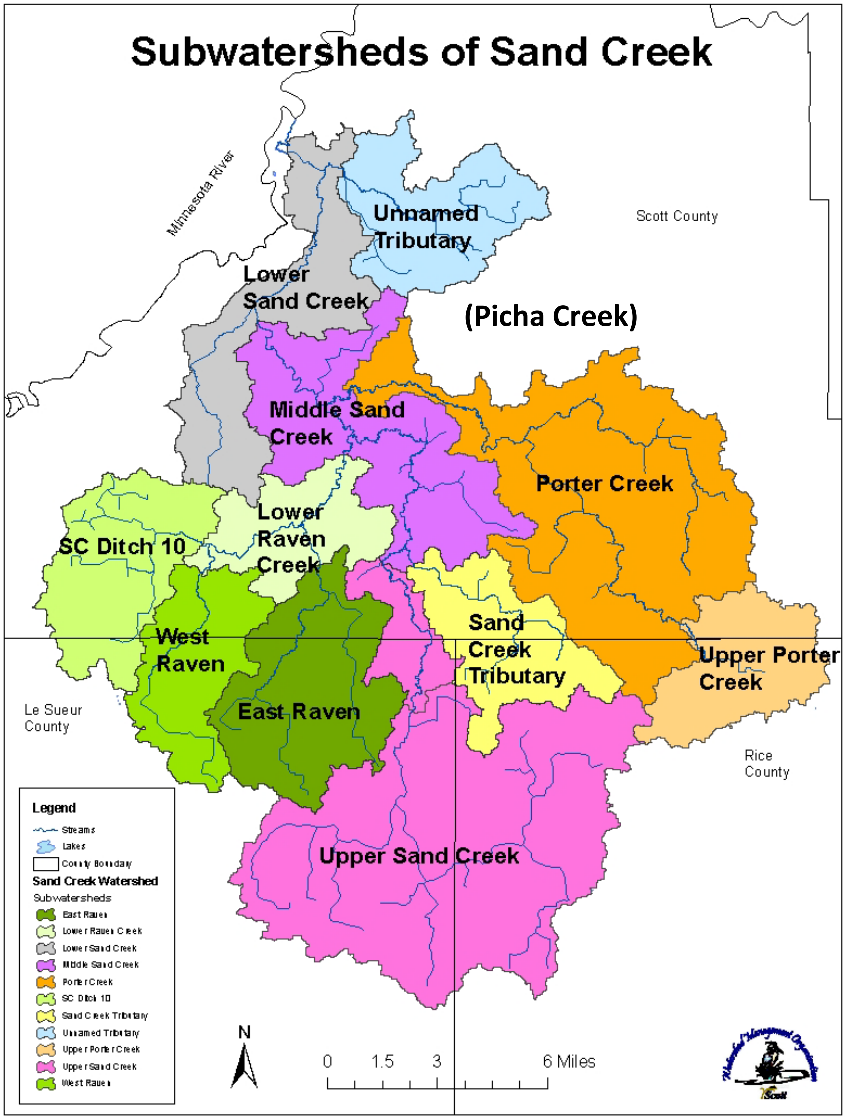
3. Watershed description

Sand Creek is a tributary of the Minnesota River. The Sand Creek Watershed is 271 square miles in size and covers portions of Scott, Rice, and Le Sueur Counties in Minnesota (Figure 8). The creek has a total channel length of approximately 230 miles and is fed by several tributaries. Porter Creek drains the east section of the watershed; Raven Stream (which is further divided into West Raven Stream and County Ditch 10) drains the west portion of the watershed; and Picha Creek drains a small section of the northeast watershed.

The headwaters of Sand Creek start in northwestern Le Sueur and northeastern Rice County, just west of the rural community of Lonsdale. The headwaters are laden with small pothole lakes and wetlands that are interconnected and discharge to Sand Creek. While channelized in its headwaters, Sand Creek quickly transitions back to its natural meanders flowing northwest towards Jordan, gaining the flow of Raven Stream and Porter Creek. Sand Creek gains gradient as it descends the Minnesota River bluff and enters Jordan. Upon leaving Jordan, Sand Creek's gradient decreases as it moves through the Minnesota River's floodplain in the Minnesota Valley National Wildlife Refuge, ultimately discharging to the Minnesota River one mile southeast of Carver.

Raven Stream and Porter Creek are the major tributaries to Sand Creek. Raven Stream's headwaters lie in northeastern Le Sueur County and southwestern Scott County. Raven Stream begins with two branches; the West Branch starts two miles northwest of Heidelberg, and the East Branch starts roughly three miles north of Montgomery. Both branches flow north merging a few miles northwest of New Prague where they transition to Raven Stream, ultimately joining Sand Creek about four miles north of New Prague. Porter Creek's headwaters begin in southeastern Scott County near the small community of Cedar Lake and flows in a northwesterly direction. The small watershed has several small lakes and wetlands, which are interconnected with the creek. Porter Creek joins Sand Creek one mile northwest of Raven Stream's confluence with Sand Creek and a few miles southeast of Jordan.

Figure 8. Sand Creek Watershed and subwatersheds

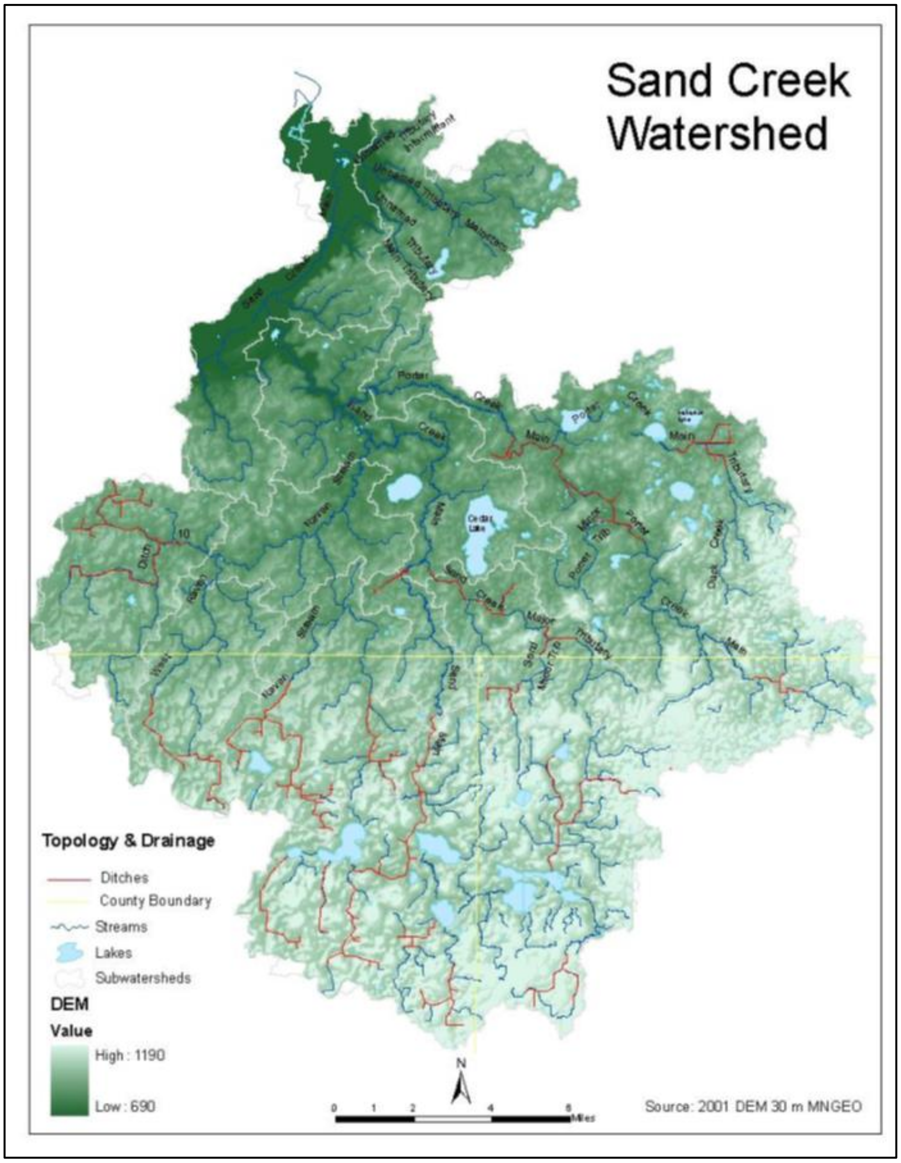


While many of the watershed's wetlands have been ditched and drained, a number of small lakes and open water wetlands still exist in the portion of the watershed above the Minnesota River bluff line. Cedar and McMahon (Carl's) lakes are located near the confluence of Porter Creek and the Sand Creek main channel. A number of large, shallow, highly eutrophic lakes are located near the city of Montgomery in the upper watershed, including Lake Pepin, Cody Lake, Rice Lake, and Sanborn Lake.

3.1 Topography and drainage

The valley form of Sand Creek is rooted in its postglacial history. Sand Creek drains through steep slopes at the edges of the Minnesota River valley (Figure 9).

Figure 9. Sand Creek Watershed Topography & Drainage (from SWMO 2010a)



There is little variation in topography through much of the Sand Creek Watershed. The topographic features that are present are primarily glacial in origin. Kettle ponds are the main feature that have resulted in the occurrence of land-locked bodies of water. Many of the small ponds in the Sand Creek Watershed historically had no overland outlet and were dependent on precipitation to maintain their form and function. Through ditching practices, many of these are now hydrologically connected. The rolling topography, particularly in the Porter Creek Watershed, provides for generally good drainage.

The channels in the Sand Creek Watershed are low gradient for much of their lengths. The only sections with distinctly higher gradients are where the mainstems flow through the steep bluffs of the old glacial river terrace. This occurs on Sand Creek between about 9.5 and 17 miles from its mouth. The Porter Creek and Raven Stream reaches closest to Sand Creek also feel the effects of the steep bluffs and generally have higher gradients than reaches closer to the headwaters. The 9.5 miles of Sand Creek closest to its mouth flow along the historic Minnesota River floodplain and are therefore lower in gradient.

In the headwaters of Sand Creek located in Rice County, typical landforms are rounded, flat-topped hills, separated by poorly drained flats, wetlands, and lakes. Wetlands make up a large part of the landscape. Most of the streams have been straightened into ditches in the headwaters of Rice and Le Sueur counties and the land use is largely agriculture. The watershed area in Le Sueur County has a largely flatter topography and the tributary streams are mostly straightened ditches. The headwaters drainage in Le Sueur and Rice counties is typically from south to north into Scott County.

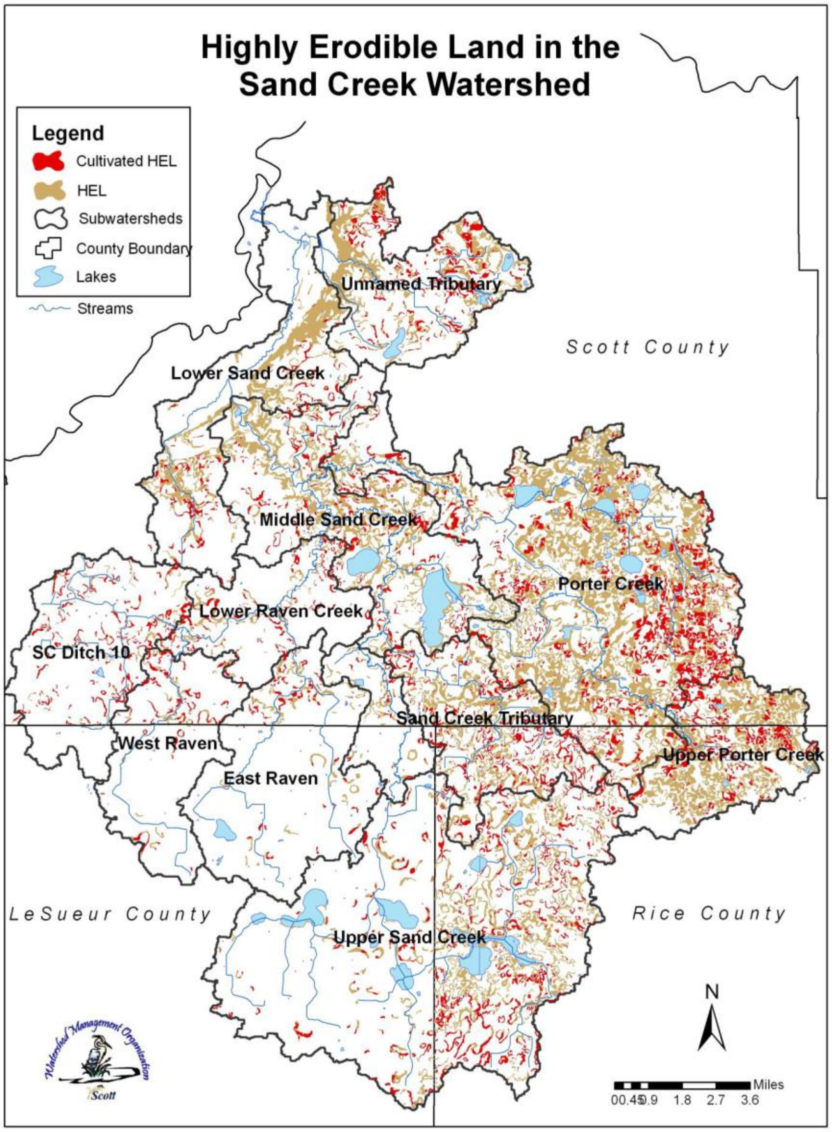
3.2 Geology and soils

SWMO (2019, 2010a) describes the geology of the watershed from the Minnesota Geologic Atlases for Scott County. The surficial geology is primarily glacial till with the exception of alluvium and terrace deposits located along the Minnesota River. The underlying bedrock is primarily Upper Cambrian sandstone and siltstone in the St. Lawrence Formation. The silts and clays of the glacial till provide a layer of protection for the county's aquifers that lie in the sedimentary rock below. As such, the groundwater vulnerability to contamination is very low-to-low in most of the watershed. Susceptibility to contamination is higher in the areas along the Minnesota River with alluvial deposits.

The soils in the Sand Creek Watershed are composed primarily of sand, silt, and loam. More than two-thirds (70%) of soils in the Sand Creek Watershed are Type B, which are moderately well drained. The primary Type B soil association is Lester-Le Sueur-Cordova, covering the western portion of the watershed. Other Type B soils are Lester-Hamel, Muskego-Lester-Hayden, and Kilkenny-Caron. The majority of the rest of the soils are poorly drained Type C soils (Lerdal-Kilkenny-Hamel), which are located in the eastern part of the watershed. Detailed soils information can be accessed from the USDA Web Soil Survey (https://websoilsurvey.nrcs.usda.gov/app/).

The Sand Creek Watershed, particularly in the Scott County portion, has large amounts of highly erodible land (HEL). The eastern portion of the watershed holds the larger concentration of HEL particularly in the Porter Creek and Upper Porter Creek Watersheds (Figure 10). While the map shows a lower amount of HEL in the Le Sueur area, it may be the definition of HEL that varies the amount identified, rather than actual less erodible soils.

Figure 10. Highly Erodible Land & Cultivated Land in Sand Creek Watershed (from SWMO 2010a)



3.3 Streams

A reconnaissance level geomorphic assessment of Sand Creek and its tributaries was completed by Inter-Fluve, Inc. as part of the Clean Water Partnership project. The channel condition of the streams is generally poor to fair (Table 9), but conditions do vary along each stream. Most of the streams have small dams, beaver dams, and perched culverts along with a waterfall in Jordan that affect channel condition and fish passage. The following text provides a brief summary of the assessment report (Inter-Fluve, Inc. 2008). Poor to fair conditions is one of the reasons that the partners focused on improving the riparian corridor as part of the overall Sand Creek sediment strategy.

Table 9. Sand Creek Watershed Channel Condition Summary

Stream/Tributary	Channel Quality*	Stability
Sand Creek Mainstem	Poor to Fair	Fairly stable/degrading slightly
Sand Creek Major Tributary	Poor	Degrading
Porter Creek Mainstem	Poor to Fair	Fairly stable/degrading slightly
Porter Creek Major Tributary	Poor	Stable/slight degradation
Raven Stream Mainstem	Poor to Fair	Fairly stable, one reach degrading
West Raven Stream	Poor	Stable/aggrading slightly

*With respect to channel stability, riparian, and habitat conditions

Sand Creek Mainstem

The geomorphology, channel stability, riparian zone, and habitat of Sand Creek have been negatively impacted by agriculture, industry, and commercial and residential development for the last 150 years. The quality of the channel, riparian, and habitat conditions throughout the mainstem of Sand Creek are generally poor or fair, but they do improve slightly in the upstream half of the watershed.

Sand Creek Major Tributary

Most of the Major Tributary has been straightened into a ditch through active agricultural fields with only a narrow, or no, riparian buffer. The channel, riparian, and habitat conditions are poor throughout the Major Tributary with the exception of 0.5 miles from the mouth and 0.7 miles of tributary near the Scott/Rice border, which fared slightly better as they maintained sinuous channels with some riparian buffer. The channel is degrading throughout because of the historic straightening and channelization.

Porter Creek Mainstem

The channel, riparian, and habitat conditions are poor or fair throughout Porter Creek with conditions worsening in the middle reaches due to the straightening of the channels. The central reaches have a reduced riparian zone, channel complexity, and habitat potential. Upstream and downstream from these reaches, the channels are generally more sinuous and the riparian zone is wider, both of which provide somewhat greater habitat. The mainstem of Porter Creek is relatively stable though slightly degrading.

Porter Creek Major Tributary

Most of the Major Tributary of Porter Creek has been straightened and ditched resulting in poor channel, riparian, and habitat conditions. A small stretch inlet to St. Catherine Lake is in slightly better condition, because its sinuous planform is intact creating some channel complexity, but the vast majority of the Major Tributary is in extremely poor condition. The Major Tributary is stable with slight degradation as a result of channelization.

Raven Stream Mainstem

The channel, riparian, and habitat conditions of Raven Stream worsen with upstream distance. The sinuous planform and channel complexity from the mouth of Raven upstream to the confluence of West Raven Stream have remained relatively intact providing aquatic organisms with some desirable habitat. This habitat is not particularly diverse with only a few types of instream fish cover and invertebrate habitat. Upstream from the confluence of West Raven Stream, however, conditions diminish rapidly. Raven Stream is fairly stable except the reach impacted by cattle.

West Raven Stream

All but the lower half mile of West Raven Stream has been channelized resulting in extremely poor channel, riparian, and habitat conditions. The riparian zones are thin or nonexistent and the channel complexity is low. Conditions become slightly worse with upstream distance, but the condition of the entire channel is poor. The channel is relatively stable but aggrading slightly.

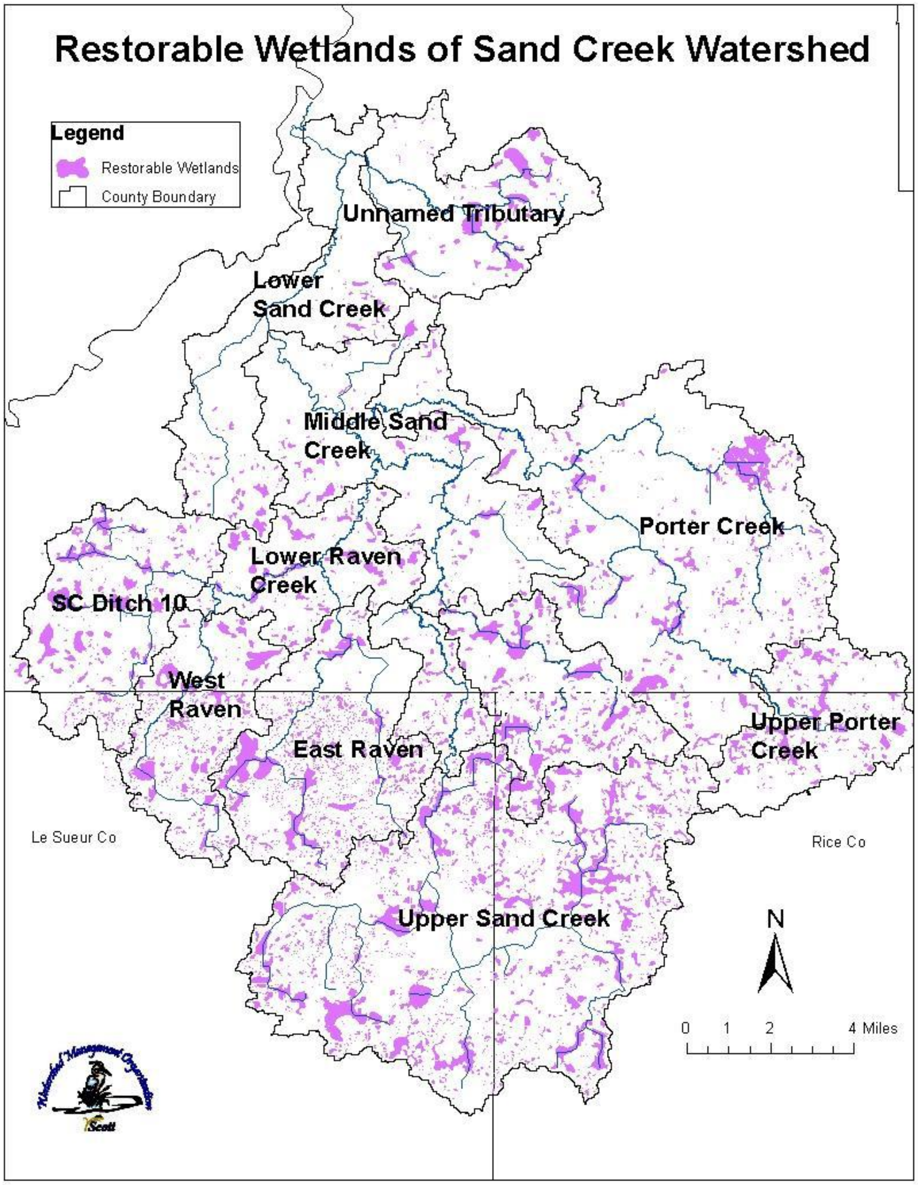
3.4 Lakes

A number of shallow lakes are located in the watershed. The SWMO (2019) lists the characteristics of eight lakes. Fourteen lakes had sufficient data to be assessed by the MPCA for aquatic recreation use (see Section 3.2.2). Cedar and McMahon (Carl's) Lakes have received considerable attention through the completion of TMDLs and BMP implementation activities. Cedar Lake is one of the largest lakes in Scott County with a surface area of 779 acres, a maximum depth of approximately 13 feet, and a mean depth of 6.9 feet. The lake is used primarily for motor boating, canoeing, fishing, picnicking, and aesthetic viewing. McMahon (Carl's) Lake is a shallow lake with a surface area of 130 acres and maximum and mean depths of 14 feet and 8.5 feet, respectively. McMahon (Carl's) Lake is used primarily for canoeing, fishing, picnicking, and aesthetic viewing and the lake provides wildlife habitat as well. Additional information describing Cedar and McMahon (Carl's) Lakes is included in the TMDL report (SWMO 2011) and TMDL implementation plan (SWMO 2012).

3.5 Aquatic habitat and wetlands

Ditching and wetland drainage have affected aquatic habitat and wildlife. Channelization and ditching of streams removes much of the complex in-stream habitat such as riffles and pools. Draining of wetlands changes the hydrology and ability of the wetlands to support aquatic plants that in turn support aquatic wildlife. Thousands of wetlands have been drained for agricultural production. There are approximately 8,731 acres of restorable wetlands in the Sand Creek Watershed with much of those acres located in the headwaters (Figure 11).

Figure 11. Restorable wetlands by subwatershed of the Sand Creek Watershed (from SWMO 2010a)



Ninety percent of historic wetlands in the watershed have been removed from the landscape to improve agricultural productivity. Eighty-percent of the remaining wetlands in the watershed are in poor to fair condition (MPCA 2017b). The loss of wetlands in this watershed has limited the amount of water storage capacity on the landscape. Finding ways to increase the storage and infiltration of water throughout the watershed will help mitigate streamflow alteration.

3.6 Groundwater

Groundwater from various aquifers underlying the watershed is the source of all public and private drinking water in the watershed. Municipal water supplies for the cities of Jordan and New Prague have defined Drinking Water Supply Management Areas approved by the Minnesota Department of Health (MDH) that are managed by the cities to protect the water supplies from contamination. A vulnerability assessment by the MDH of the likelihood for a potential contaminant source within the drinking water supply management area to contaminate the public water supply wells found the two areas to have a low vulnerability to contamination. A groundwater susceptibility to contamination map developed in conjunction with the Minnesota Geologic Atlas for Scott County indicates that much of the watershed also has a low susceptibility to contamination with areas along the Minnesota River and the lower portion of Sand Creek having a moderate or high susceptibility to surficial aquifer contamination.

The *Scott County Groundwater Report* (Scott SWCD 2016) noted that monitoring of the municipal wells has not shown violation of federal drinking water standards, and limited monitoring of private wells and monitoring wells indicates relatively low pollutant concentrations. Results of Minnesota Department of Agriculture Nitrate Clinic analyses of private well samples in Scott County showed that 0 to 3% of the results reported had nitrate concentrations above 10 mg/L between 1998 and 2006. The results of 2011 and 2012 sampling were slightly higher with about 4 and 6% of the reported samples exceeding the nitrate drinking water standard. Results from a monitoring effort completed in early 2019 found a number of wells that exceed the arsenic limit through natural causes.

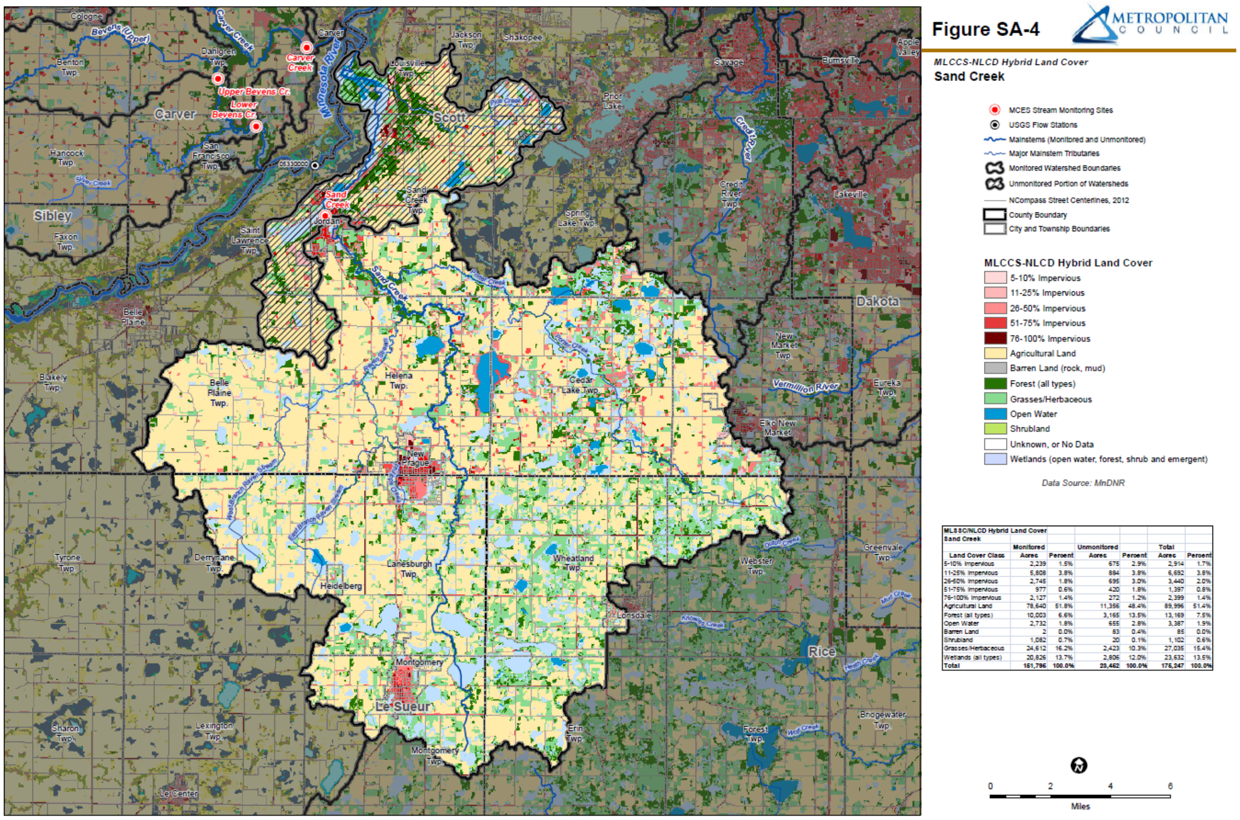
3.7 Land use

The watershed is 51% agricultural land and slightly less than 10% developed urban land, including the cities of Montgomery, Heidelberg, New Prague, and Jordan, and portions of Lonsdale, Elko New Market, Prior Lake, and Shakopee. Of the agricultural land, 34% is planted in corn, 35% in soybeans, and 21% is pasture/hay. About a quarter of the cropland may be drain tiled, based on a soils and slope analysis. Other primary land covers in the watershed are forest, grasses/herbaceous, and wetlands. Table 10 and Figure 12 show the land cover classes for the watershed. The table and figure are based on the 2008 Minnesota Land Cover Classification System data (Metropolitan Council 2014).

Table 10. Sand Creek Watershed Land Cover Classes (adapted from Metropolitan Council 2014).

Land Cover Class	Area (Acres)	Area (Percent)
Agricultural land	89,996	51.4
Grasses/herbaceous	27,035	15.4
Wetlands	23,632	13.5
Forest	13,169	7.5
Open water	3,387	1.9
5–10% impervious	2,914	1.7
11–25% impervious	6,692	3.8
26–50% impervious	3,440	2.0
51–75% impervious	1,397	0.8
76–100% impervious	2,399	1.4
Barren land/ Shrub land	1,187	0.6
Total	175,247	100.0

Figure 12. Sand Creek Watershed land cover (from Metropolitan Council 2014)



Future land use is expected to change little in the Le Sueur and Rice Counties portion of the watershed. More change is expected for parts of the Scott County portion of the watershed. The Scott County 2040 Comprehensive Plan Update (Scott County 2019) describes five broad designations of land use for the county: agricultural, urban, rural, commercial, and park/open space. The plan provides for urban expansion areas around the cities of Jordan and New Prague. An agricultural transition area has been designated for the southern halves of Belle Plaine and Helena Townships and protects agricultural uses as an interim land use before eventual urbanization occurs beyond 2040. Rural residential growth areas are planned for the southern portion of Credit River Township and west covering part of Spring Lake Township and an area north of Elko New Market. These areas are categorized to encourage reasonable residential growth which will likely never be served by a regional or sanitary sewer system. Thus, some urban growth is expected in areas directly tributary to Sand Creek from growth of the two cities, and to East Raven Stream where much of the city of New Prague drains. Little change is expected in the Ditch 10 and West Raven watersheds which are guided for agriculture. Porter Creek and Sand Creek watersheds will see a decrease in agriculture and an increase in large lot rural residential (2.5 to 10 acre lots). Estimated future 2040 land use acreages by watershed are listed in the Scott County 2040 Comprehensive Plan Update (Scott County 2019).

3.8 Wastewater

Wastewater management in the rural areas of the Sand Creek Watershed is primarily provided by subsurface sewage treatment systems (SSTS) (Table 12). Additionally, there are six permitted wastewater discharges in the watershed. Permit conditions for these discharges are presented in Table 11.

Table 11. Point sources in the Sand Creek Watershed.

Point Source	Watershed	Design Flow (mgd)	TSS Effluent Limit[3] (mg/L)	TP Effluent Limit[3] (mg/L)
Montgomery WWTP[1]	Upper Sand	0.968	30	1
Seneca Food Cooling Water, Montgomery	Upper Sand	0.65	30	N/A
New Prague WWTP	East Raven	2.5	30	1
New Prague WTP[2]	East Raven	0.005	30	N/A
B&F Manufacturing, New Prague	East Raven	N/A	N/A	N/A
Jordan WWTP	Lower Sand	1.289	30 59	1 4,000

[1] WWTP = wastewater treatment plant

[2] WTP = drinking water treatment plant

2 Total suspended solids and total phosphorus effluent limits.

Table 12. Nonpoint SSTS sources estimated by Le Sueur County, Rice County, and Scott County and reported to MPCA

LGU	Total #s of SSTS	Estimated % Failing to protect groundwater	Estimated % systems that are imminent threat to public health and safety	Estimated percent compliant systems
Le Sueur County	8801	3	1	96
Rice County[1]	7829	18	18	65
Scott County	8640	2	0	98.0

[1]The estimate for Rice County is based on reports from additional LGUs (cities/townships) within their jurisdiction.

3.9 Climate/precipitation

The climate of the Sand Creek Watershed is typical of southcentral Minnesota. The long-term average annual precipitation is 28 inches per year based on records from the Minneapolis/St. Paul International Airport weather station which is located about 10 miles northeast of the watershed. Most of the precipitation (85%) occurs between March and October with the remainder (15%) falling between November and February as mostly snow. The average annual snowfall is about 50 inches. Figure 13 shows the monthly normal precipitation at Jordan.

The normal average annual temperature in the watershed is 45 degrees Fahrenheit (F) with the winter and summer normal average temperatures being 17 degrees and 70 degrees F, respectively. The normal monthly minimum, average, and maximum temperatures are also shown in Figure 13. The typical growing season is about 139 days.

Figure 13. Weather data summary for weather station at Jordan (Climograph Portal at http://climate.umn.edu).

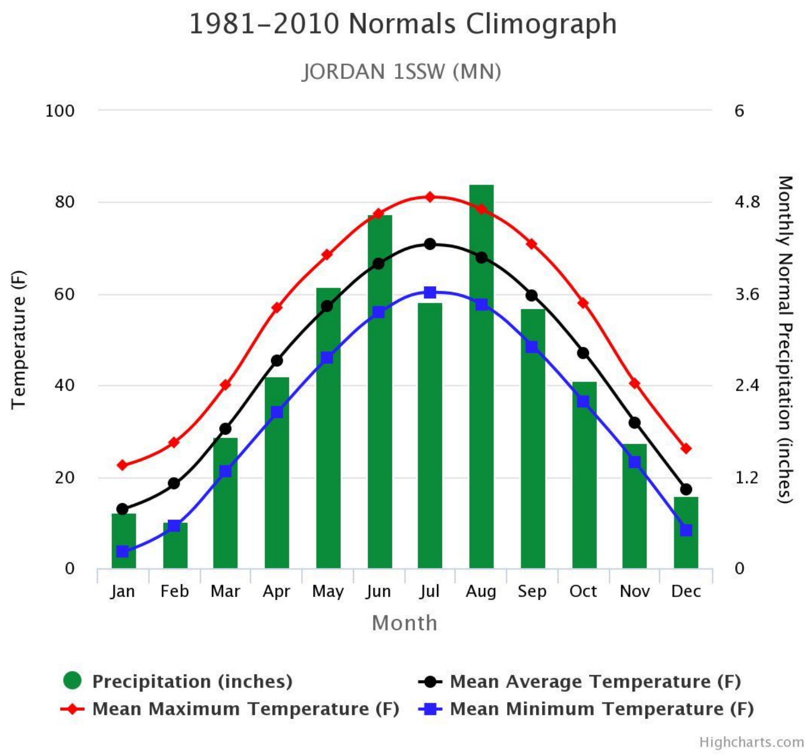
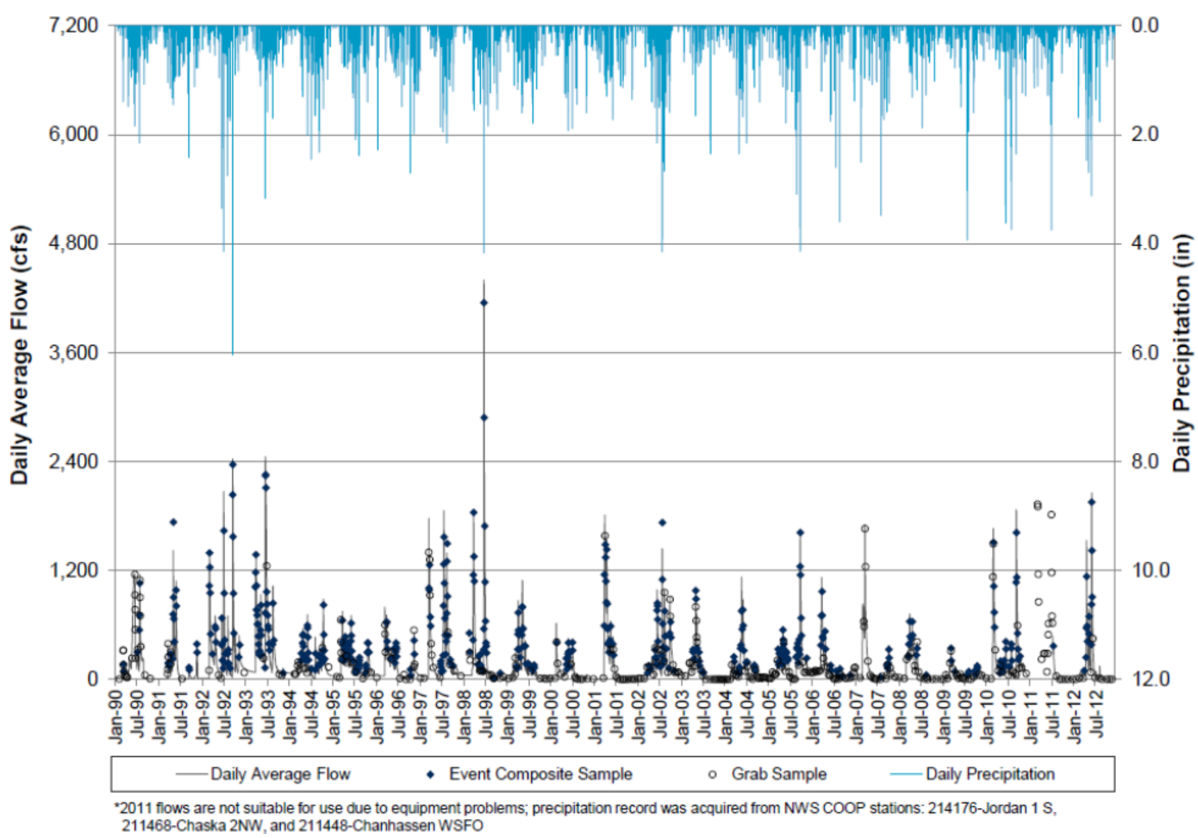
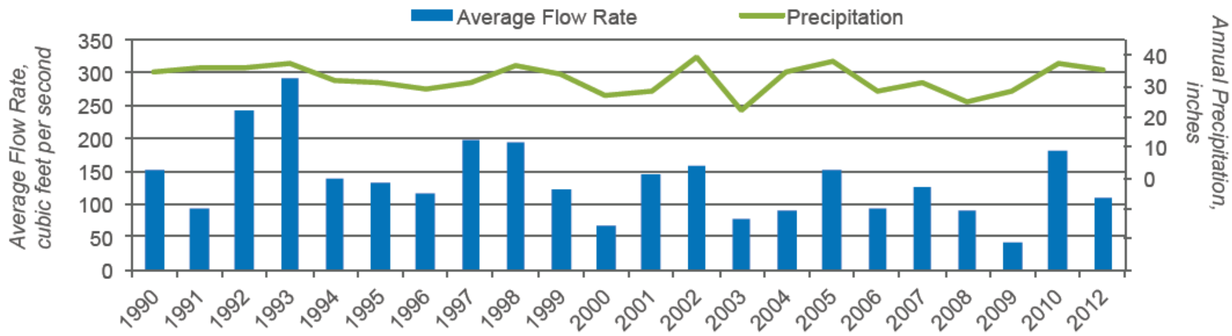


Figure 14. Average daily flows and precipitation for Sand Creek Watershed, SA8.2 (from Metropolitan Council 2014)



Detailed weather data for the airport station along with other weather stations and volunteer observation sites are available at http://climate.umn.edu.

Figure 15. Sand Creek annual flows and precipitation (from Metropolitan Council 2014)



Precipitation data are available from the Minnesota Climatology Working Group, Jordan Station Number 214176 (Metropolitan Council 2014a). Daily and average annual precipitation is shown in Figure 14 and Figure 15.

4. Water quality and quantity

4.1 Water quality standards

The federal Clean Water Act requires states to designate beneficial uses for all waters and develop water quality standards 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).

4.1.1. 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.

4.1.2. 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; and
- 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).

General use waters harbor “good” assemblages of fish and macroinvertebrates that can be characterized as having an overall balanced distribution of the assemblages and with the ecosystem functions largely maintained through redundant attributes. Modified use waters have been extensively altered through legacy physical modifications, which limit the ability of the biological communities to attain the general use. Currently the modified use is only applied to streams with channels that have been directly altered by humans (e.g., maintained for drainage, riprapped).

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

4.1.3. 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:

A. Existing uses and the level of water quality necessary to protect existing uses shall be maintained and protected.

B. Degradation of high water quality shall be minimized and allowed only to the extent necessary to accommodate important economic or social development.

C. Water quality necessary to preserve the exceptional characteristics of outstanding resource value waters shall be maintained and protected.

D. 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.

4.1.4. Standards and criteria in Sand Creek Watershed

The streams and lakes in the Sand Creek Watershed are primarily designated as class 2B waters. The water quality standards and criteria used in assessing the streams and lakes in the Sand Creek Watershed 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 10% 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 – 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.
- Chloride
  - Chronic: 230 mg/L
  - Maximum standard: 860 mg/L
  - Final acute value: 1,720 mg/L
- 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.

    * The values listed here are the water quality standards approved by EPA. However, the MPCA made a transcription error in the promulgation of Minn. R. 7050.0222, resulting in the following slightly different values currently in rule for the South River Nutrient Region: ≤ 40 µg/L chl-a, ≤ 5.0 mg/L DO flux, and ≤ 3.5 mg/L BOD. The MPCA intends to make a correction to the rule at some point in the future.
- Lake eutrophication – based on summer average values for shallow lakes in the North Central Hardwood Forest (NCHF) Ecoregion

    - Total phosphorus concentration less than or equal to 60 µg/L and
    - Chlorophyll-*a* concentration less than or equal to 20 µg/L or
    - Secchi disk transparency not less than 0.7 meter (2.3 feet).
- 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. Appendix 3.1 in the Lower Minnesota River Watershed Monitoring and Assessment Report (MPCA 2017b) provides the IBI numeric thresholds.

4.2 Streamflow

Streamflow data for Sand Creek has been collected by the Metropolitan Council Environmental Services (MCES) since 1989. The MCES monitoring station (SA8.2) is located 8.2 miles upstream from the creek's confluence with the Minnesota River. The streamflow data record is complete since 1990 with the exception of 2011 when the station was damaged by flooding. Streamflow monitoring was also conducted on two tributaries to Sand Creek (West Raven Stream and Scott County Ditch 10) by MCES and Scott SWCD as part of a paired-watershed study between 2004 and 2009.

Streamflow data for Sand Creek site SA8.2 for the period 1990–2012 is shown in Figure 14. The average annual daily flow in Sand Creek between 2003 and 2012 was nearly 107 cubic feet per second (cfs). The lowest and highest average annual flows were 42 cfs in 2009 and 290 cfs in 1993, respectively. Sand Creek flows year-round due to groundwater, lake, and drain tile discharges. The variation in flow is influenced by the amount and timing of precipitation in any given year. Figure 15 shows the average annual flow rates and precipitation for the watershed. The lowest 10^{th} percentile daily average flows were less than 7 cfs, while the highest 10^{th} percentile daily average flows were greater than 700 cfs. Time-series flow data for SA8.2 is available from the Metropolitan Council Environmental Information Management Systems (https://eims.metc.state.mn.us/).

4.3 Water quality data summaries

Water quality monitoring of streams and lakes in the watershed is conducted by MCES, SWMO, citizen volunteers, and MPCA along with others. The MCES initiated monitoring at their site on Sand Creek at Jordan in 1989 and continue to monitor the site as part of their long-term, automated stream monitoring program for streams in the Twin Cities Metropolitan Area. The SWMO began their monitoring program in 2005 and continue their program in conjunction with MCES and MPCA. Lake monitoring in the watershed dates back to 1980 and continues today as part of the Metropolitan Council's Citizen-Assisted Monitoring Program (CAMP). Table 13 provides a chronology of the monitoring and technical reports for the work completed. Many of these reports can be accessed on the Reports and Documents page of the SWMO webpage: https://www.scottcountymn.gov/752/Reports-Documents.

Table 13. Water quality and related reports for the Sand Creek Watershed

Title of Report	Reference
SWMO Water Quality Monitoring Report 2005	SWMO 2007
SWMO Water Quality Monitoring Report 2006	SWMO 2008
Sand Creek, MN Final Report – Fluvial Geomorphic Assessment	Inter-Fluve 2008

Title of Report	Reference
Sand Creek Watershed and Impaired Waters Resource Investigations; Volume 1 - Diagnostic Study	SWMO 2010a
Cedar Lake and McMahon (Carl's) Lake Total Maximum Daily Load Report	SWMO 2011
Cedar Lake and McMahon (Carl's) Lake Total Maximum Daily Load Implementation Plan	SWMO 2012
Cedar Lake Implementation Plan Executive Summary	2012
Sand Creek near channel sediment reduction feasibility report	SWMO 2015
Analysis of hydrologic change and sources of excess sediment in Scott County, MN	Belmont et al. n.d.
Comprehensive Water Quality Assessment of Select Metropolitan Area Streams - Sand Creek	Metropolitan Council 2014
Scott County Groundwater Report: A Review of Local Monitoring Efforts	Scott SWCD 2016a
Twin Cities Metropolitan Area Chloride Management Plan	MPCA 2016
Subwatershed Analysis for Cedar Lake	Scott SWCD 2013
Scott WMO Water Quality Monitoring Report: Picha Creek 2015	Scott SWCD 2016b
Final Carp Study for Cedar Lake	Carp Solutions 2017
Lower Minnesota River Watershed Monitoring and Assessment Report	MPCA 2017b
Lower Minnesota River Watershed Streams Stressor Identification Report	MPCA 2018
Lower Minnesota River Watershed TMDLs: Part I – Southern and Western Watersheds, Draft	MPCA 2019

This section summarizes the monitoring data for the Sand Creek Watershed, followed by water quality summaries of water bodies in the focus areas (Table 8).

Phosphorus in lakes: The MPCA's trend analysis on lakes in the Sand Creek Watershed found no apparent trend in Cedar Lake and Mill Pond, and an increasing water clarity trend in McMahon (Carl's) Lake (Table 14). McMahon (Carl's) Lake had been listed as impaired in 2002. After taking corrective actions, it was determined to be meeting standards and the lake was delisted in 2018. Table 15 presents water quality summaries of the lakes that have completed TMDLs.

Table 14. Trend analysis of lakes in the Sand Creek Watershed (MPCA 2019)

Lake Name	Lake ID	Water clarity trend [a]
Cedar	70-0091-00	→
McMahon (Carl's)	70-0050-00	↗
Mill Pond	70-0113-00	→

a. Secchi disk trends using available data from 1972–2016 from MPCA's Citizen Lake Monitoring Program: ↗ = increasing; → = no apparent trend; blank = insufficient information (MPCA 2019)

Table 15. Summary of lake water quality data (SWMO 2011 and Tetra Tech 2019)

Lake Name	Lake ID	Years of Data	Average of Annual Growing Season Means (Jun–Sep)		
			Total Phosphorus (µg/L)	Chlorophyll-*a* (µg/L)	Secchi Transparency (m)
Cedar	70-0091-00	1999–2008	170	71	1.3
McMahon (Carl's)	70-0050-00	1999–2008	85	70	0.9
Hatch Lake	66-0063-00	2010–2011	493	315	0.3
Cody Lake	66-0061-00	2007, 2010	356	79	0.6
Phelps Lake	66-0062-00	2010, 2014	417	60	0.9
Lake Pepin	40-0028-00	2007, 2014	328	58	0.8
Lake Sanborn	40-0027-00	2013–2015	185	54	0.9
Pleasant Lake	70-0098-00	2010, 2014, 2015	100	62	0.7
St. Catherine Lake	70-0029-00	2014–2015	288	148	0.6
Cynthia Lake	70-0052-00	2014–2015	342	108	0.9

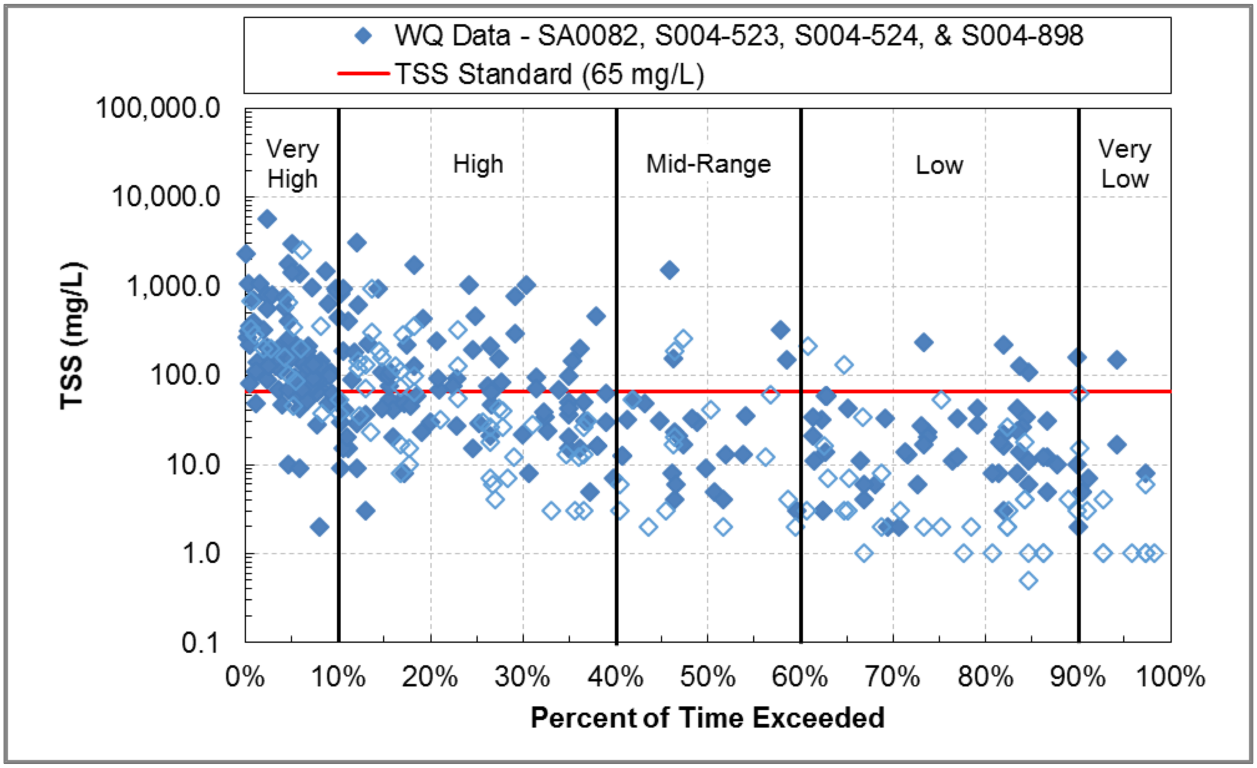
Phosphorus in streams: Three segments of Sand Creek have aquatic life impairments based on exceedances of the river eutrophication standards. Phosphorus mean concentrations are similar among all three streams, but chlorophyll concentrations vary more widely among streams (Table 16).

Table 16. Summary of river eutrophication data for impaired stream reaches (Tetra Tech 2019)

Reach Name and Description	AUID (07020012-xxx)	Years of Data	Average of Annual Growing Season Means (Jun–Sep)		
			Total Phosphorus (µg/L)	Chlorophyll-*a* (µg/L)	BOD (mg/L)
Sand Creek, T112 R23W S23, south line to -93.5454 44.5226	839	2007–2008	453	132	No data
Sand Creek, -93.5454 44.5226 to Raven Str	840	2006–2014	458	85	5.4
Sand Creek, Porter Cr to Minnesota R	513	2006–2015	456	35	3.0

TSS: Total suspended solids concentrations in Sand Creek vary seasonally, with higher concentrations in the spring and early summer when flows are typically higher (Metropolitan Council 2014). The highest TSS concentrations are typically observed under higher flows (Figure 16). TSS data of impaired reaches are summarized in Table 17.

Figure 16. Total suspended sediment concentration duration plot, Sand Creek (AUID 07020012-513; Tetra Tech 2019)



2006–2015. Hollow points indicate samples during months when the standard does not apply.

Table 17. Summary of TSS data for impaired reaches (April–September; Tetra Tech 2019)

Reach Name and Description	AUID (07020012-xxx)	Years of Data	Sample Count	90th Percentile (mg/L)	Mean (mg/L)	Maximum (mg/L)	Number of Exceedances	Frequency of Exceedances
Sand Creek, T112 R23W S23, south line to -93.5454 44.5226	839	2006 - 2015	30	89	50	152	6	20%
Sand Creek, -93.5454 44.5226 to Raven Str	840	2006 - 2015	86	165	72	315	34	40%
Sand Creek, Raven Str to Porter Cr	538	No TSS data *						
Porter Creek, Fairbanks Ave to 250th St E	815	2006 - 2015	48	163	44	356	8	17%
Porter Creek, Langford Rd/MN Hwy 13 to Sand Cr	817	2006 - 2015	74	123	77	1,800	14	19%
Sand Creek, Porter Cr to Minnesota R	513	2006 - 2015	263	616	223	5,620	126	48%

* Reach listed as impaired for turbidity

E. coli: In many of the impaired streams in the Sand Creek Watershed, *E. coli* concentrations are high across many flow zones, indicating a mix of sources or pathways (Tetra Tech 2019). Concentrations on average are highest in August, when flows are typically low and water temperatures are higher than earlier in the season (Figure 17). *E. coli* data of impaired reaches are summarized in Table 18.

Figure 17. *E. coli* monthly geometric means of streams in the Sand Creek Watershed with *E. coli* impairments

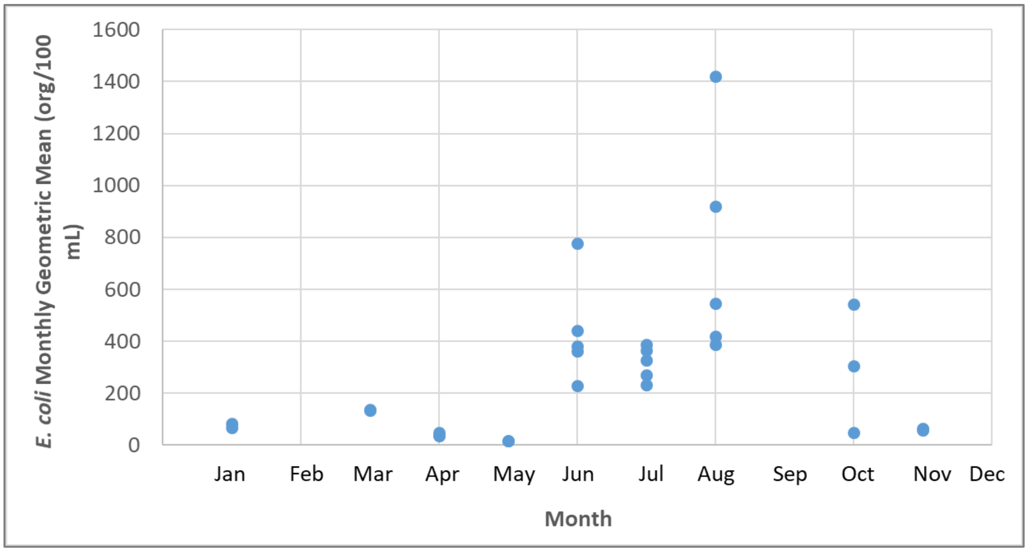


Table 18. Summary of *E. coli* data for impaired reaches (April–October; Tetra Tech 2019)

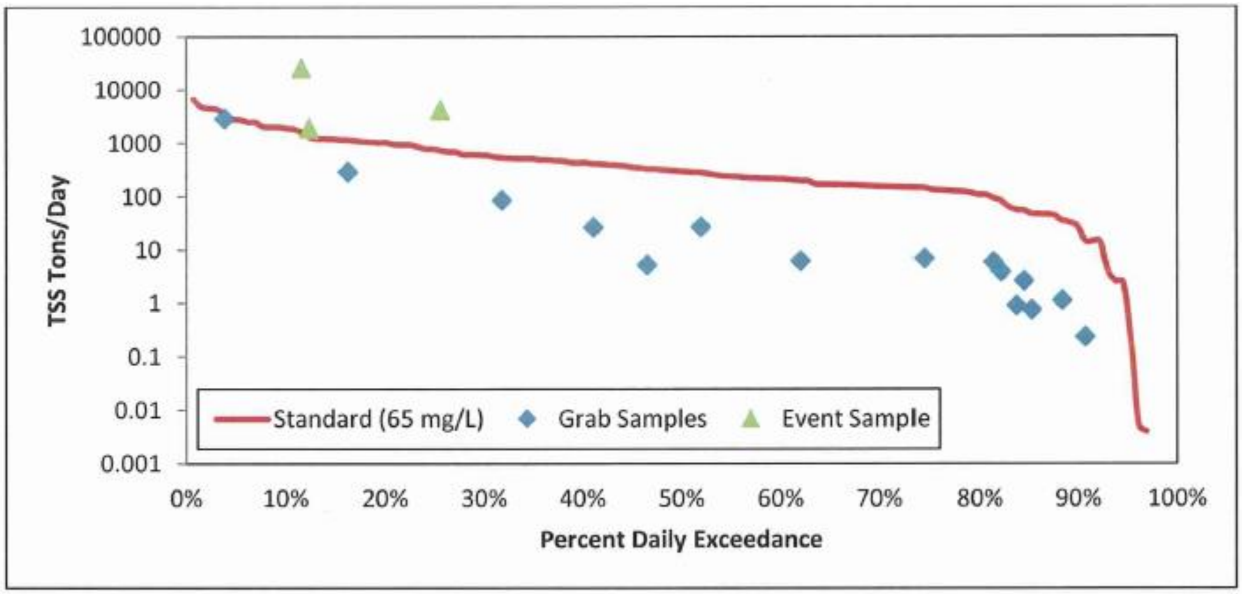
Reach Name and Description	AUID (0702 0012-xxx)	Years of Data	Sample Count	Maximum [a]	Geometric Mean	Number of Individual Standard Exceedances	Percent of Individual Sample Standard Exceedances
County Ditch 10, CD 3 to Raven Str	628	2007–2008	20	≥ 2,420	199	4	20%
Raven Stream, West Branch, 270th St to E Br Raven Str	842	2007–2008	14	≥ 2,420	291	4	29%
Raven Stream, E Br Raven Str to Sand Cr	716	2014–2015	15	1,120	454	0	0%
Porter Creek, Langford Rd/MN Hwy 13 to Sand Cr	817	2014–2015	15	921	352	0	0%
Sand Creek, Porter Cr to Minnesota R	513	2006, 2014–2015	15	1,553	315	1	7%

a. The maximum recordable value for *E. coli* concentration depends on the extent of sample dilution and is often 2,420 org/100 mL. Concentrations that are noted as ≥ 2,420 org/100 mL are likely higher, and the magnitude of the exceedance is not known.

FA1 – Picha Creek

The Picha Creek 2015 monitoring report (Scott SWCD 2016b) evaluates recent water quality data in Picha Creek. The average TSS concentration in the creek was 86 mg/L, and the 90th percentile (Apr–Sep) was 254 mg/L, well above the 65 mg/L TSS standard. These statistics were substantially influenced by three storm event samples; there were no base flow samples that exceeded the TSS standard.

Figure 18. Percent exceedances and TSS monitoring data in Picha Creek (Scott SWCD 2016b)



The red line represents TSS loading at the state TSS criterion (65 mg/L); samples that plot below the line have concentrations that are below the state criterion.

The summer (Jun–Sep) average TP concentration was 0.415 mg/L (Table 19), well above the standard of 0.150 mg/L for the South River Nutrient Region. Because there was not enough information to assess the eutrophication response variables, the stream was not assessed as impaired based in the river eutrophication standards.

There are no state standards for total Kjeldahl nitrogen (TKN) or nitrate in Picha Creek. Concentrations are summarized in Table 19.

Table 19. Average nutrient concentrations (mg/L) in Picha Creek (Scott SWCD 2016b)

Parameter	Picha Creek (Jun–Sep)
TP, June–September	0.431
TKN	1.52
Nitrate + nitrite	2.88

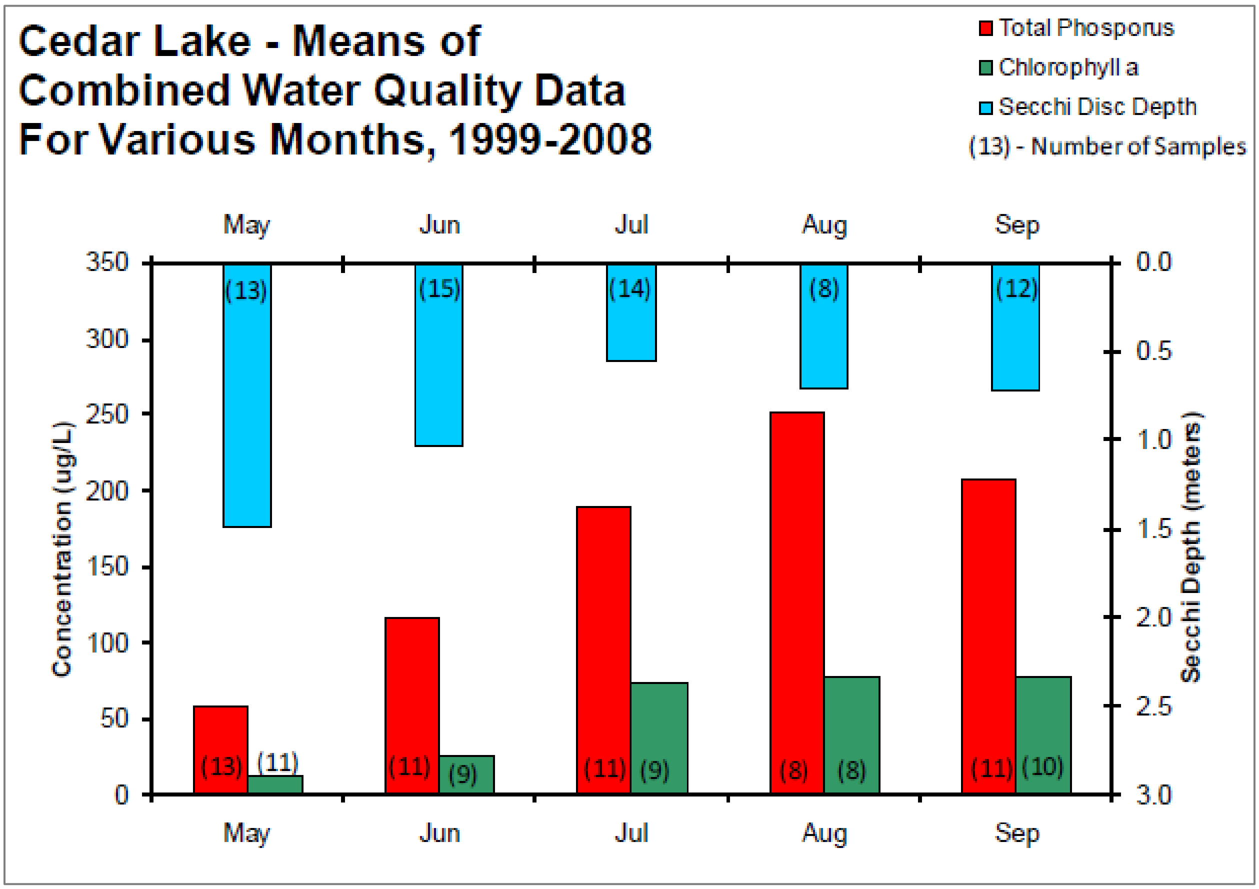
FA2 – Cedar Lake

The water quality of Cedar Lake is described in the TMDL report (Table 20; SWMO 2011). Water quality overall is typically poorest in July and August (Figure 19).

Table 20. Summary of Cedar Lake water quality data through 2008 (SWMO 2011)

Parameter	TP (µg/L)	Chlorophyll a (µg/L)	Secchi disk transparency (m)
Lowest growing season mean (year)	118 (1990)	39 (2005)	0.6 (1989)
Highest growing season mean (year)	439 (1979)	151 (2001)	2.6 (1984)
Growing season mean (1999–2008)	170	71	1.28
Historical growing season mean (1976–2008)	236	71	1.36

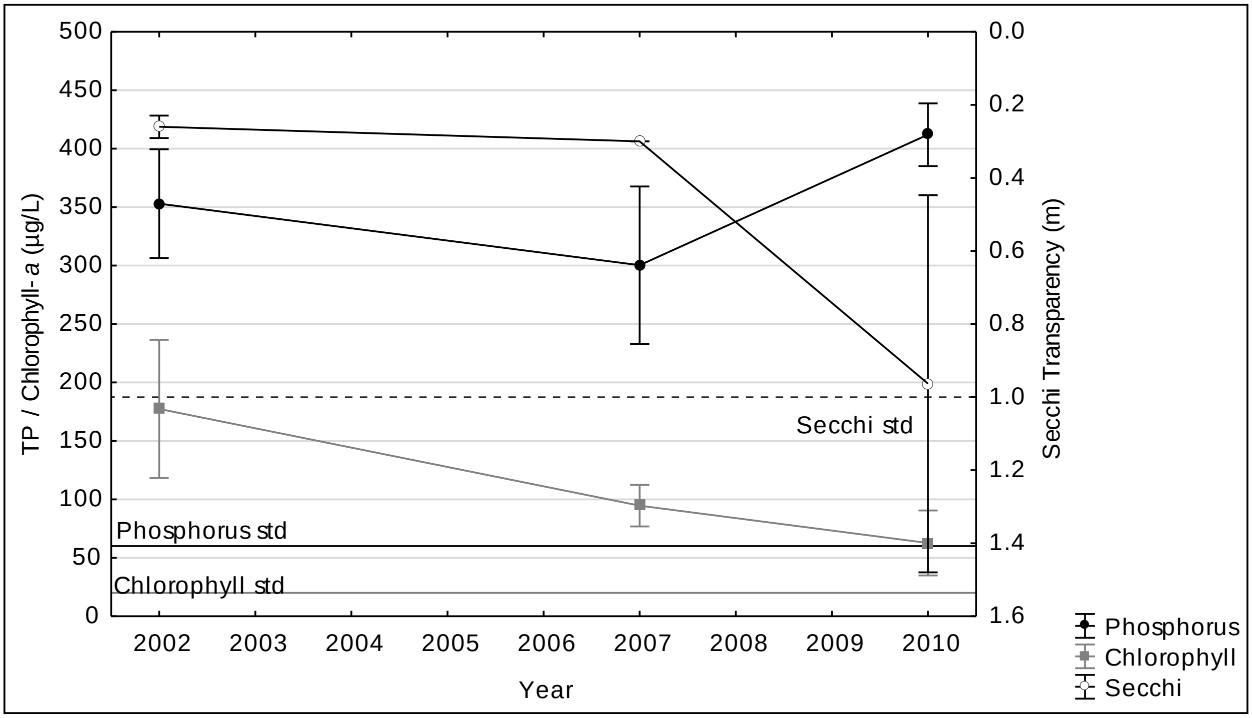
Figure 19. Cedar Lake seasonal water quality, 1999–2008 (SWMO 2011)



FA3 – Cody Lake and Phelps Lake

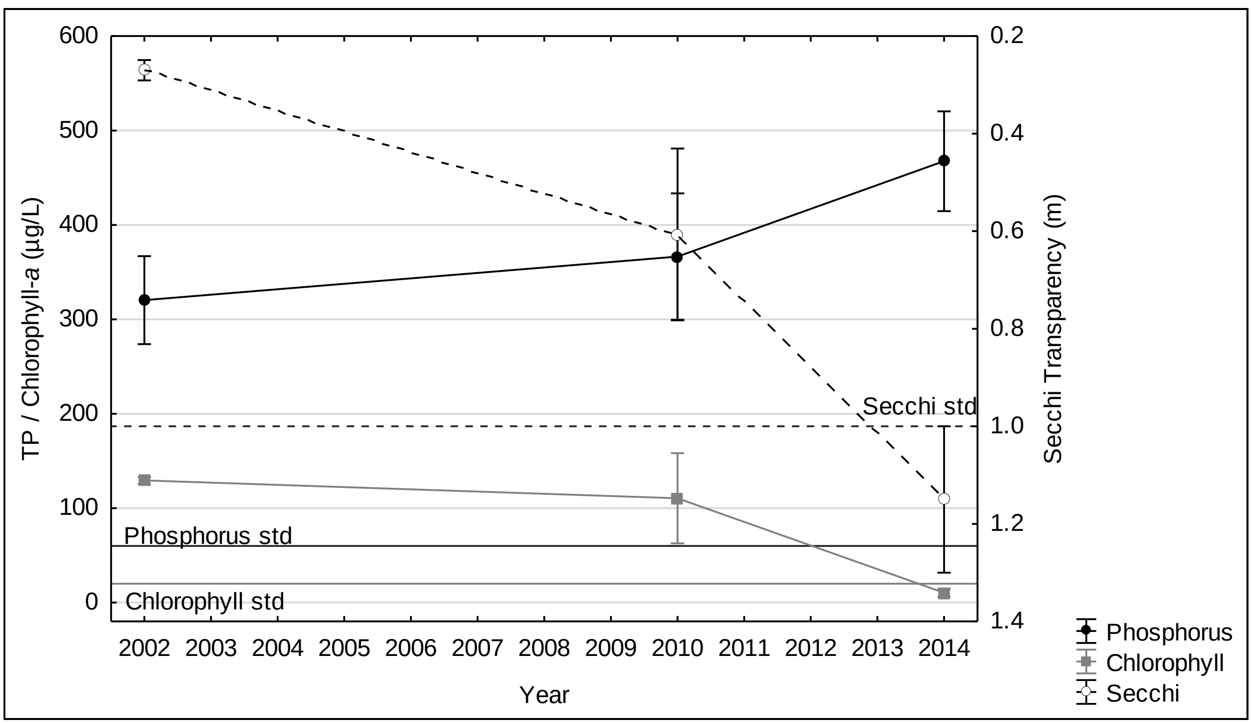
Cody Lake and Phelps Lake are adjacent to one another, with the outlet from Cody flowing into Phelps. Hatch Lake is in the headwaters region of the Cody Lake Watershed. Water quality in all three lakes is poor; with growing season mean phosphorus concentrations greater than 300 µg/L (Table 15). The chlorophyll concentrations and Secchi transparency in Cody and Phelps Lakes are similar to one another and are poorer in Hatch Lake (Table 15). Due to their close hydrologic connection, growing season means in Cody and Phelps Lakes are similar to one another (Figure 20 and Figure 21). Only two years of data are available for Hatch Lake (Figure 22). Hatch Lake drains into Cody Lake, although partners believe that is unlikely that it meets the physical definition of a lake as it has no depth greater than 6 ft.

Figure 20. Cody Lake water quality data (Tetra Tech 2019)



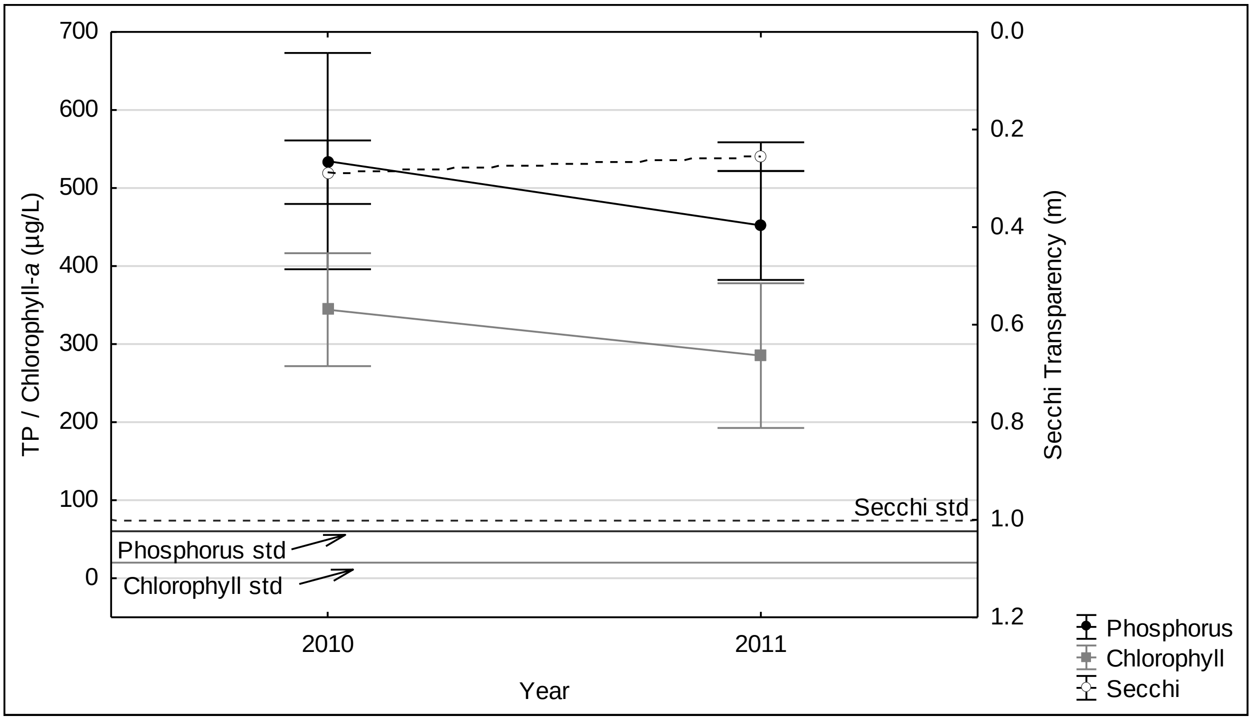
2002, 2007, and 2010; growing season means + / - standard error; site 66-0061-00-201 (2002 and 2010) and -451 (2007)

Figure 21. Phelps Lake water quality data (Tetra Tech 2019)



2002–2014; growing season means + / - standard error; site 66-0062-00-201

Figure 22. Hatch Lake water quality data (Tetra Tech 2019)

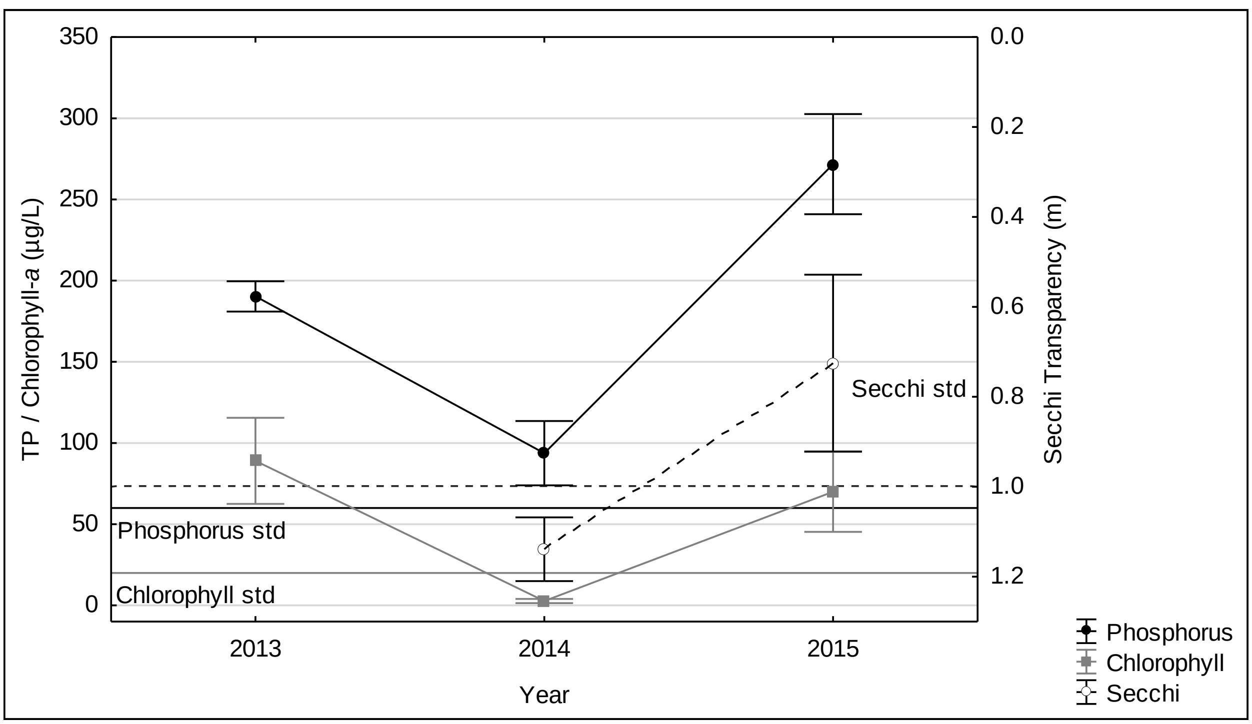


2010–2011; growing season means + / - standard error; site 66-0063-00-201

FA4 – Sanborn Lake

Water quality in Sanborn Lake has fluctuated over the years that were monitored (Figure 23).

Figure 23. Lake Sanborn water quality data (Tetra Tech 2019)



2014–2015; growing season means + / - standard error; site 40-0027-00-201 (2014–15) and -202 (2013)

4.4 Sand Creek Watershed water quality impairment assessments

The MPCA assesses the use support of individual water bodies in Minnesota. A water body is defined as an individual stream reach, lake, or wetland and is identified as an assessment unit. Each assessment unit is assigned an assessment unit identification (AUID). Stream AUIDs are delineated using the 1:24,000 scale National Hydrography Dataset (NHD). Streams and rivers often contain more than one stream reach based on the presence of tributaries, lakes and wetlands, and other landscape changes. Lake and wetland AUIDs are based on the DNR's Protected Waters Inventory.

Assessment of aquatic life in streams is derived from the analysis of fish and macroinvertebrate assemblages, dissolved oxygen, total suspended solids, chloride, pH, total phosphorus, chlorophyll-*a*, biochemical oxygen demand, and un-ionized ammonia data, while the assessment of aquatic recreation in streams is based solely on fecal indicator bacteria (*Escherichia coli*) data. The assessment of aquatic recreation in lakes is based on total phosphorus, chlorophyll-*a*, and Secchi depth, and the assessment of aquatic life in lakes is based on chloride and fish data, where available. Where applicable and where sufficient data exist, other designated uses (e.g., limited resource value water, drinking water, and aquatic consumption) are assessed.

The descriptions of the water quality data and use assessments for the Sand Creek Watershed are from the *Lower Minnesota River Watershed Monitoring and Assessment Report* (MPCA 2017b). The assessment results focus on the 2016 Intensive Watershed Monitoring, but also include data from the previous ten years. Impairment listings from previous assessment cycles are included.

Figure 24 shows the stream and lake impairments in the 2018 303(d) list.

4.4.1. Stream assessments

There are 33 stream WIDs in the Sand Creek HUC-10 watershed. Of these, 17 WIDs had enough biological, chemistry, and/or *E. coli* data to be assessed for use support. Two reaches are identified as limited resource value waters and 12 reaches were determined to have insufficient information for assessment. Of the 17 AUIDs, only two AUIDs were found to be fully supporting of aquatic life and no AUIDs were found to be supporting of aquatic recreation. Aquatic life and recreation use impairments were identified on 15 and 5 of the 17 AUIDs, respectively. No change in previously identified use impairments was identified (i.e., no impairment delistings).

The stream aquatic life and aquatic recreation assessments for the assessable stream reaches in the watershed are summarized by aggregated HUC-12 watershed in Table 22 through Table 24.

Table 21 describes the abbreviations and color shading used in the tables. Assessable stream reaches are defined as reaches where sufficient information was available to make an assessment. The aquatic life indicator evaluations were used in making the final use support determination for each reach.

Table 21. Key for abbreviations and color-coding in Table 22 through Table 25

Aquatic Life Indicator Evaluations:	**MTS** = Meets Standard **EX** = Fails Standard **IF** = Insufficient Information
Use Support Determinations:	-- = No Data **NA** = Not Assessed **IF** = Insufficient Information **SUP** = Full Support (Meets Criteria) **IMP** = Impaired (Fails Criteria)
Cell Shading:	[light pink] = existing impairment, listed prior to 2014 reporting cycle [dark pink] = new impairment [green] = full support of designated use [white] = insufficient information
Use Class:	**2Bg** = Warmwater general **2Bm** = Warmwater modified

Sand Creek aggregated HUC-12 watershed (HUC-12s 07020001208-01, -02, -07)

Nine stream reaches had sufficient biological and/or water quality data to be assessed for aquatic life or aquatic recreation use in the Sand Creek aggregated HUC-12 watershed. Seven of the reaches were identified as impaired for aquatic life. One reach was determined not to be assessable per MPCA procedures. Only one of the nine reaches was found to be fully supporting aquatic life. One reach was also identified as being impaired for aquatic recreation.

The remaining reaches in the watershed were assessed for aquatic life using the TALU general use threshold. New aquatic life impairments were proposed for the four reaches of Sand Creek, as both fish and macroinvertebrate communities failed to meet general use thresholds on each of the natural reaches. The reaches were also listed or proposed to be listed as impaired for chloride and TSS and have high nutrient concentrations, but data were not available to assess the reaches for eutrophication.

Table 22. Aquatic life and recreation assessments for stream reaches in the Sand Creek aggregated HUC-12 watershed (0702001208-01, -02, and 07).

Reaches are organized upstream to downstream.

Reach Name, Reach Description	AUID	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (*E. coli*)**
County Ditch 48, Headwaters to Eggert Lk	**07020012 -773**	14MN029	3.41	2Bg	NA	NA	IF	IF	IF	--	IF	IF	--	NA	NA	--
Sand Creek, *T112 R23W S23, south line to -93.5454 44.5226*	**07020012 -839**	14MN119	3.12	2Bm	EX	MTS	IF	EX	IF	EX	MTS	IF	--	EX	IMP	--

Sand Creek, *-93.5454 44.5226 to Raven Str*	**07020012 -840**	07MN056, 14MN129	17.60	2Bg	EX	EX	IF	EX	IF	EX	MTS	IF	--	EX	IMP	--
Unnamed creek, Unnamed cr to Sand Cr	**07020012 -684**	14MN128	2.03	2Bm	MTS	MTS	NA	MTS	MTS	MTS	MTS	IF	--	IF	SUP	--
Sand Creek, Raven Str to Porter Cr	**07020012 -538**	07MN055, 90MN116	1.77	2Bg	EX	--	IF	IF	EX	--	IF	IF	--	IF	IMP	--
Sand Creek, Porter Cr to Minnesota R	**07020012 -513**	01MN044, 00MN006, 07MN033, 07MN034	13.39	2Bg	EX	EX	IF	EX	MTS	EX	MTS	MTS	IF	EX	IMP	IMP
Unnamed creek, Headwaters to Sand Cr	**07020012 -732**	10EM103	9.04	2Bg	EX	EX	IF	IF	IF		IF	IF	--	IF	IMP	--
Unnamed creek (Picha Creek), Unnamed cr to Unnamed cr	**07020012 -579**	01MN058, 14MN200	3.98	2Bg	EX	EX	IF	IF	IF	--	MTS	IF	--	IF	IMP	--
Unnamed creek (Picha Creek), Unnamed cr to Sand Cr	**07020012 -580**	15EM078, 14MN096	0.97	2Bg	EX	--	IF	MTS	MTS	MTS	MTS	IF	--	IF	IMP	--

Porter Creek aggregated HUC-12 watershed (HUC-12s 0702001208-05, -06)

Three stream reaches had sufficient biological and/or water quality data to be assessed for aquatic life or aquatic recreation use in the Porter Creek aggregated HUC-12 watershed. The three reaches were identified as impaired for aquatic life and one reach was identified as impaired for aquatic recreation. Two of the reaches were previously listed for turbidity with newer data confirming the impairment. The downstream reach is listed as impaired due to eutrophication given elevated phosphorus and chlorophyll-*a* concentrations.

Table 23. Aquatic life and recreation assessments for stream reaches in the Porter Creek aggregated HUC-12 watershed (0702001208-05, -06) (Reaches are organized upstream to downstream in the table.)

Reach Name, Reach Description	AUID	Biological Station ID	Reach Length (miles)	Use Class	**Aquatic Life Indicators:** Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (*E. coli*)**
Porter Creek, *Fairbanks Ave to 250th St E*	**07020012 -815**		7.92	2Bg	--	--	IF	EX	MTS	MTS	MTS	IF	--	IF	IMP	--
Unnamed creek, *Unnamed ditch to -93.4251 44.6206*	**07020012 -849**	14MN078	1.13	2Bm	EX	--	IF	IF	IF		IF	IF	--	IF	IMP	--
Porter Creek, *Langford Rd/MN Hwy 13 to Sand Cr*	**07020012 -817**	99MN004	10.45	2Bg	EX	EX	MTS	EX	MTS	MTS	MTS	MTS	--	EX	IMP	IMP

Raven Stream aggregated HUC-12 watershed (HUC-12s 0702001208-03, -04)

Five stream reaches had sufficient biological and/or water quality data to be assessed for aquatic life or aquatic recreation use in the Raven Stream aggregated HUC-12 watershed. The TALU general aquatic life use criteria was used for biological assessments in three channel reaches. The other reaches were assessed as TALU modified aquatic life use streams. Three of the reaches were identified as impaired for aquatic life due to biological condition. The other two reaches met the biological criteria for their use class (one general and one modified use). The East and West Branches of Raven Stream were previously identified as being impaired for aquatic recreation due to elevated *E. coli* concentrations. The East Branch was also previously listed as impaired due to high chloride concentrations.

Table 24. Aquatic life and recreation assessments for stream reaches in the Raven Stream aggregated HUC-12 watershed (0702001208-03, -04) (Reaches are organized upstream to downstream in the table)

					Aquatic Life Indicators:											
Reach Name, *Reach Description*	**AUID**	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia $-NH_3$	Pesticides	Eutrophication	**Aquatic Life**	**Aquatic Rec. (*E. coli*)**
Raven Stream, West Branch, *270th St to E Br Raven Str*	**07020012 -842**	14MN133, 14MN132,	6	2Bg	EX	EX	IF	MTS	MTS	MTS	MTS	MTS	--	IF	IMP	IMP
County Ditch 3, *Unnamed ditch to CD 10*	**07020012 -738**	14MN135	1.30	2Bg	MTS	MTS	IF	IF	IF		IF	IF	--	IF	SUP	--
County Ditch 10, *CD 3 to Raven Str*	**07020012 -628**	14MN134	2.10	2Bm	MTS	EX	IF	MTS	MTS	MTS	MTS	MTS	--	IF	IMP	IMP
Raven Stream, East Branch, *-93.6106 44.5532 to 255th St W*	**07020012 -819**	14MN131	2.77	2Bm	MTS	MTS	IF	MTS	MTS	EX	MTS	IF	--	IF	IMP	--
Unnamed creek, *RR bridge to E Br Raven Str*	**07020012 -822**	03MN029	0.98	2Bg	EX	EX	IF	IF	IF	--	IF	IF	--	IF	IMP	--

4.4.2. Lake assessments

Table 25 summarizes the lake aquatic life and recreation assessments. The Sand Creek Watershed contains 14 lakes that are greater than 10 acres in size. All had data available for them to be assessed for aquatic recreation use impairment. The lakes were assessed as shallow lakes following MPCA lake assessment procedures. Cedar and McMahon (Carl's) Lakes were listed as impaired in 2002. Cedar Lake continues to be impaired, while the quality of McMahon (Carl's) Lake has improved through watershed restoration activities and is no longer impaired. Eight lakes are impaired based on recent water quality data with the remaining four lakes identified as having insufficient information to make an aquatic recreation use determination.

Four lakes had fish community data available for assessment of aquatic life use by the DNR. McMahon (Carl's) Lake was assessed as fully meeting the aquatic life use criteria. The other three lakes were not assessed due to fish winterkills (Cody and Phelps Lakes) and manipulation of water levels (Cedar Lake). Cedar and McMahon (Carl's) Lakes are listed as impaired for aquatic consumption (mercury in fish tissue) and are included in Minnesota's Statewide Mercury TMDL (MPCA 2007).

Table 25. Lake assessments in Sand Creek HUC-10 watershed.

Aggregated HUC-12	Lake Name	DNR ID	Area (acres)	Max Depth (ft)	Secchi Trend	Aquatic Life Indicators: Fish IBI	Aquatic Life Indicators: Chloride	Aquatic Life Indicators: Pesticides	Aquatic Recreation Indicators: Total Phosphorus	Aquatic Recreation Indicators: Chlorophyll-a	Aquatic Recreation Indicators: Secchi	Aquatic Life Use	Aquatic Recreation Use
Sand Creek	Sanborn	40-0027-00	309	4	Insufficient Data	--	--	--	EX	EX	EX	--	NS
	LeMay	66-0056-00	66	--	Insufficient Data	--	--	--	IF	--	IF	--	IF
	Cody	66-0061-00	245	10	Insufficient Data	NA	--	--	EX	EX	EX	NA	NS
	Phelps	66-0062-00	291	6	Insufficient Data	NA	IF	--	EX	EX	EX	NA	NS
	Hatch	66-0063-00	64	--	Insufficient Data	--	--	--	EX	EX	EX	--	NS
	Cedar	70-0091-00	788	15	Decreasing Trend	NA	IF	--	EX	EX	EX	NA	NS
	Mill Pond	70-0113-00	17	6	Insufficient Data	--	--	--	--	--	MTS	--	IF
Porter Creek	St. Catherine	70-0029-00	118	7	Insufficient Data	--	--	--	EX	EX	EX	--	NS
	Nash	70-0043-00	50	--	Insufficient Data	--	--	--	--	--	IF	--	IF
	McMahon (Carl's)	70-0050-00	121	13	Increasing Trend	MTS	IF	--	IF	EX	MTS	FS	FS
	Cynthia	70-0052-00	189	10	Insufficient Data	--	--	--	EX	EX	EX	--	NS
	Pleasant	70-0098-00	276	5	Insufficient Data	--	IF	--	EX	EX	EX	IF	NS
Raven Stream	Pepin	40-0028-00	392	12	Insufficient Data	--	MTS	--	EX	EX	EX	IF	NS
	Mitchell	70-0128-00	19	--	Insufficient Data	--	--	--	IF	IF	IF	--	IF

4.4.3. Stream habitat assessment

Stream habitat condition was documented during each IWM fish sampling visit through the use of the Minnesota Stream Habitat Assessment (MSHA) survey. The MSHA score consists of five scoring categories including adjacent land use, riparian zone, substrate, fish cover, and channel morphology. Scores for each category are summed for a total MSHA score and rating based on a 100-point scale.

The stream habitat condition of the stream reaches in the Sand Creek Watershed are generally fair to poor. Only three reaches received a good habitat rating. The average MSHA rating for the three aggregated HUC-12 watersheds within the Sand Creek HUC-10 watershed was fair.

Habitat quality in the streams was determined using the Minnesota Stream Habitat Assessment (MSHA) form developed by the MPCA (2017). The MSHA is based on the Qualitative Habitat Evaluation Index (QHEI) and scores the habitat based on the surrounding land use, riparian zone (riparian width, bank erosion, and shade), instream zone (substrate, embeddedness, cover type, cover amount), and channel morphology (channel depth variability, channel stability, velocity type, sinuosity, the ratio of pool width to riffle width, and channel development).

Table 26. Average MSHA results

Aggregated HUC-12	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
Sand Creek	1.75	9.4	13.48	7.63	15.88	48.14	Fair
Porter Creek	2.34	10.34	17.29	10.17	15.5	55.62	Fair
Raven Stream	0.62	9.23	12.85	8.8	14.33	45.82	Fair

4.5 Impairments 303(d) listings

Water quality impairments are identified in the Minnesota's 303(d) list. The most recent approved updates of the 303(d) list occurred in 2018; however, Sand Creek Watershed has listed impairments dating back to 2002. Figure 24 shows the impairments and Table 27 describes the criteria and date of listing. Table 28 shows the current status of TMDL development.

Figure 24. Impairments in Sand Creek Watershed (2018 303d list)

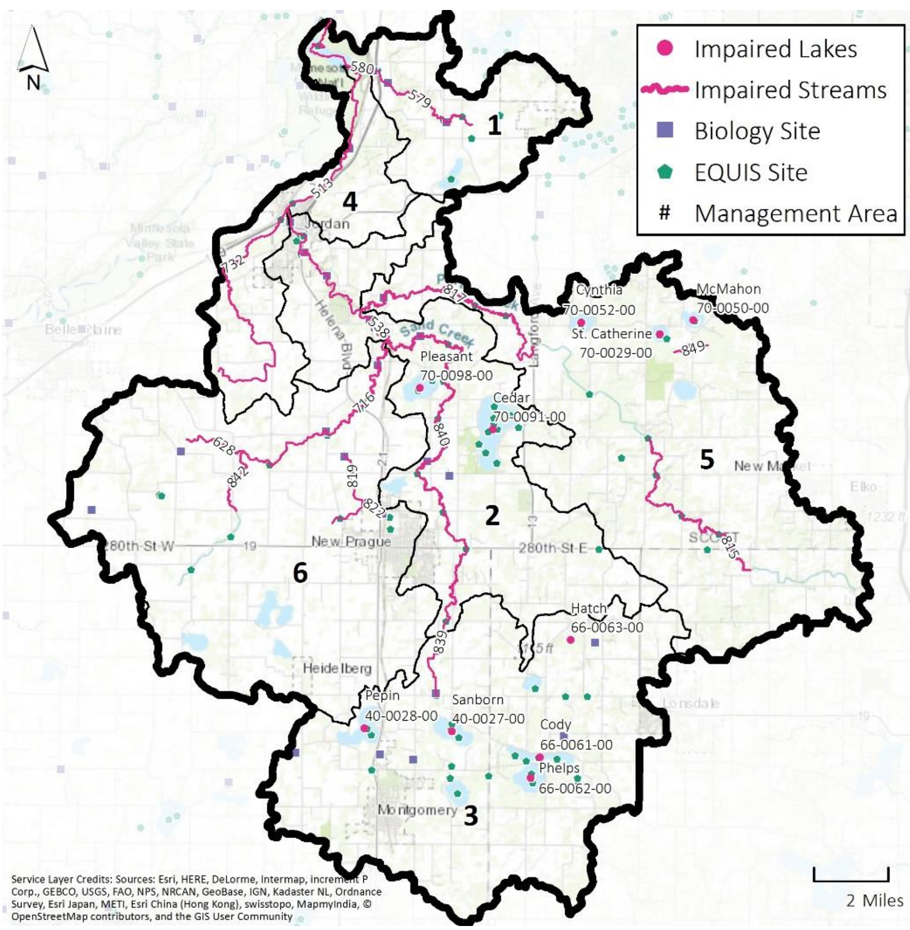


Table 27. Sand Creek Watershed Stream and Lake Impairments

Reach Name (AUID) and Reach Description	Numeric Criteria/Pollutant and Year Added to Impaired Waters List						
	E. coli	TSS	Nutrient / Eutrophication	Chloride	Mercury	MIBI	FIBI
Sand Creek (839) T112 R23W S23, south line to -93.5454 44.5226		2010	2016	2010			2018
Sand Creek (840) -93.5454 44.5226 to Raven Str		2010	2016	2010		2018	2018
County Ditch 10 (628) CD 3 to Raven Str	2008		2018			2018	
Raven Stream, West Branch (842) 270th St to E Br Raven Str	2008		2018			2018	2018
Raven Stream, East Branch (819) -93.6106 44.5532 to 255th St W				2010			
Unnamed creek (822) RR bridge to E Br Raven Str						2018	2018
Raven Stream (716) E Br Raven Str to Sand Cr	2018			2010		2018	2018
Sand Creek (538) Raven Str to Porter Cr		2010					2018
Porter Creek (815) Fairbanks Ave to 250th St E		2010					
Porter Creek (817) Langford Rd/MN Hwy 13 to Sand Cr	2018	2010	2016			2018	2018
Unnamed creek (849) Unnamed ditch to -93.4251 44.6206							2018
Unnamed creek (732) Headwaters to Sand Creek						2018	2018
Picha Creek (580) Unnamed cr to Sand Cr							2018
Unnamed creek (Picha Creek) (579)						2018	2004

Reach Name (AUID) and Reach Description	Numeric Criteria/Pollutant and Year Added to Impaired Waters List						
	E. coli	TSS	Nutrient / Eutrophication	Chloride	Mercury	MIBI	FIBI
Unnamed cr to Unnamed cr							
Sand Creek (513) Porter Cr to Minnesota R	2018	2002	2016	2014		2018	2004
Cedar Lake 70-0091-00			2002		1998		
McMahon Lake 70-0050-00			2002		2012		
Hatch Lake 66-0063-00			2018				
Cody Lake 66-0061-00			2018				
Phelps Lake 66-0062-00			2018				
Lake Pepin 40-0028-00			2018				
Lake Sanborn 40-0027-00			2018				
Pleasant Lake 70-0098-00			2018				
St. Catherine Lake 70-0029-00			2018				
Cynthia Lake 70-0052-00			2018				

Table 28. Sand Creek Watershed lake and stream TMDL status

Reach Name (AUID) and Reach Description	Numeric Criteria/Pollutant TMDL Completed						
	E. coli	TSS	Nutrient / Eutrophication	Chloride	Mercury	MIBI	FIBI
Sand Creek (839) T112 R23W S23, south line to -93.5454 44.5226		Draft	Draft	Yes			No
Sand Creek (840) -93.5454 44.5226 to Raven Str		Draft	Draft	Yes		No	No
County Ditch 10 (628)	Draft					No	

Reach Name (AUID) and Reach Description	Numeric Criteria/Pollutant TMDL Completed						
	E. coli	**TSS**	**Nutrient / Eutrophication**	**Chloride**	**Mercury**	**MIBI**	**FIBI**
CD 3 to Raven Str							
Raven Stream, West Branch (842) 270th St to E Br Raven Str	Draft					No	No
Raven Stream, East Branch (819) -93.6106 44.5532 to 255th St W				Yes			
Unnamed creek (822) RR bridge to E Br Raven Str						No	No
Raven Stream (716) E Br Raven Str to Sand Cr	Draft			Yes		No	No
Sand Creek (538) Raven Str to Porter Cr		Draft					Draft (TSS)
Porter Creek (815) Fairbanks Ave to 250th St E		Draft					
Porter Creek (817) Langford Rd/MN Hwy 13 to Sand Cr	Draft	Draft				Draft (TSS)	Draft (TSS)
Unnamed creek (732) Headwaters to Sand Creek						No	No
Picha Creek (580) Unnamed cr to Sand Cr							No
Unnamed creek (Picha Creek) (579) Unnamed cr to Unnamed cr						No	No
Sand Creek (513) Porter Cr to Minnesota R	Draft	Draft	Draft	Yes		Draft (TSS)	Draft (TSS)
Cedar Lake 70-0091-00			Yes		Yes		
McMahon Lake 70-0050-00			Yes, delisted		Yes		
Hatch Lake			Draft				

Reach Name (AUID) and Reach Description	Numeric Criteria/Pollutant TMDL Completed						
	E. coli	TSS	Nutrient / Eutrophication	Chloride	Mercury	MIBI	FIBI
66-0063-00							
Cody Lake 66-0061-00			Draft				
Phelps Lake 66-0062-00			Draft				
Lake Pepin 40-0028-00			Draft				
Lake Sanborn 40-0027-00			Draft				
Pleasant Lake 70-0098-00			Draft				
St. Catherine Lake 70-0029-00			Draft				
Cynthia Lake 70-0052-00			Draft				

4.6 Stressor identification for biological impairments

The MPCA conducts a stressor identification process to identify the likely stressors causing the impairments. The stressor identification report for the Lower Minnesota River Watershed contains the stressor identification information for the 12 stream reaches in the Sand Creek Watershed that are impaired based on fish and macroinvertebrate monitoring (MPCA 2018). Table 29 contains the summary of stressors for the 12 reaches from the report. Habitat was identified as a stressor in all 12 reaches with channelization, excess sediment, and lack of shading being habitat factors. Flow alteration and connectivity were the next most common stressor with agricultural drainage, channel erosion, and a dam being factors. Eutrophication and low dissolved oxygen levels resulting from elevated phosphorus in the stream system are also common stressors. Elevated nitrate and chloride concentrations were identified as stressors in a few reaches.

Based on the impairments for biota in Sand and Picha Creeks that were listed in 2004 303(d) list, a SID investigation (Barr Engineering 2009) was completed for the Clean Water Partnership (CWP) project report in 2009. A stressor identification investigation and report completed for the CWP project identified habitat fragmentation as the probable cause of impairment for the Sand Creek reach on the 2004 303(d) list (Barr Engineering 2009). The overriding probable cause of impairment for the Picha Creek reach on the 2004 303(d) list was inadequate baseflow followed by habitat fragmentation, then habitat, and sediment. Multiple lines of evidence indicate Picha Creek is naturally intermittent and incapable of supporting an unimpaired fish assemblage due to natural causes. The study also determined the probable stressors for a reach of Porter Creek that was not listed until 2018. The probable cause of stress was habitat fragmentation followed by inadequate baseflow, habitat, sediment, and low dissolved oxygen.

Table 29. Stressors for the Sand Creek Watershed stream reaches.

Stream Name	AUID	Stressors: Dissolved Oxygen	Eutrophication	Nitrate	Suspended Sediment	Habitat	Flow Alteration/Connectivity	Chloride
Sand Creek	07020012-513	o	●	---	●	●	●	o
Sand Creek	07020012-538	---	o	---	●	o	---	o
Sand Creek	07020012-839	●	●	---	●	●	●	---
Sand Creek	07020012-840	●	●	---	●	●	o	o
Unnamed Creek (Picha Creek)	07020012-579	●	●	---	---	●	●	o
Unnamed Creek (Picha Creek)	07020012-580	o	o	---	---	●	o	o
County Ditch 10	07020012-628	---	o	●	---	●	o	---
Raven Stream	07020012-716	---	●	●	●	●	---	o
Porter Creek	07020012-817	---	●	---	●	●	o	o
Unnamed Creek	07020012-822	o	●	---	---	●	●	●
West Branch Raven Stream	07020012-842	●	●	●	---	●	o	o
Unnamed Creek	07020012-849	●	o	o	o	●	o	o

● = stressor; o = inconclusive stressor; --- = not an identified stressor

4.7 Watershed TMDLs

Various TMDLs address multiple impairments in the Sand Creek Watershed. Table 30 describes which TMDL reports apply to each water body, and where applicable, the required reductions.

Table 30. TMDL reports addressing Sand Creek Watershed impairments and recommended reductions/TMDLs

Report	Water body name	WID	% Phosphorus Reduction	% TSS reduction	% *E. coli* reductions	Chloride	Mercury
Draft Lower Minnesota River	Hatch Lake	66-0063-00	96				
	Cody Lake	66-0061-00	91				
	Phelps Lake	66-0062-00	89				
	Lake Pepin	40-0028-00	91				
	Lake Sanborn	40-0027-00	80				
	Pleasant Lake	70-0098-00	66				
	St. Catherine Lake	70-0029-00	90				

Report	Water body name	WID	% Phosphorus Reduction	% TSS reduction	% *E. coli* reductions	Chloride	Mercury
	Cynthia Lake	70-0052-00	94				
	Sand Creek	839	67	27			
	Sand Creek	840	67	61			
	Sand Creek	513	67	89	68		
	Sand Creek	538		– [a]			
	Porter Creek	815		60			
	Porter Creek	817		47			
	County Ditch 10	628			65		
	Raven Stream, West Branch	842			– [b]		
	Raven Stream	716			77		
	Porter Creek	817			70		
Cedar Lake and McMahon (Carl's) Lake TMDL Report	Cedar Lake	70-0091-00	68 [c] 85 [c]				
	McMahon (Carl's) Lake	70-0050-00	Delisted				
TCMA Chloride TMDL	Raven Stream	716				94,558 [e]	
	Raven Stream, East Branch	819 (543) [d]				34,969 [e]	
	Sand Creek	513				382,821 [e]	
	Sand Creek	840 (662) [d]				Included in 513 [f]	
Minnesota Statewide Mercury TMDL	McMahon (Carl's) Lake	70-0050-00					Statewide reductions [e]
	Cedar Lake	70-0091-00					Statewide reductions [e]

[a] TSS data not available during TMDL time period (2006–2015).

[b] Not enough samples to estimate percent reduction.

[c] Reductions are calculated for both Western Corn Belt Plain (68%) and Northern Central Hardwood Forest (85%) standards

[d] WIDs in parentheses are old WIDs that have been resegmented. The chloride TMDL was based on this older WID, but also applies to the newer WID.

[e] Percent reductions were not calculated for chloride TMDLs. Chloride loading capacities (lb/day) are presented here instead. Reductions for chloride impairments are planned in the TCMA Management Plan.

[e] The Statewide Mercury TMDL (MPCA 2007) and Implementation Plan present statewide mercury load reduction goals that are not specific to individual water bodies.

[f] Reach -662 is in the watershed of reach -513.

5. Pollutant Source Assessments

The most current pollutant source information is the draft Lower Minnesota River Watershed TMDL part one (2019). Although this is the most current TMDL, there have been many projects and resulting reports provide additional information about the pollutant sources affecting the lakes and streams in the Sand Creek Watershed. This section compiles the source information from the various studies and reports.

5.1 Source assessment studies

5.1.1. Watershed TMDLs

Section 3.6 of the draft Lower Minnesota River Watershed TMDLs report (Tetra Tech 2019) describes the pollutant sources to the impaired water bodies in the Sand Creek Watershed. Nonpoint sources of pollutants include upland watershed runoff, runoff from non-permitted animal feeding operations, wildlife, septic systems, internal loading, near-channel sources, and atmospheric deposition. Watershed runoff may consist of soil particles, crop and lawn fertilizer, decaying vegetation (leaves, grass clippings, etc.), and domestic and wildlife waste. Point sources of pollutants include sources regulated through National Pollutant Discharge Elimination System (NPDES) permits and include wastewater effluent, stormwater runoff from permitted Municipal Separate Storm Sewer Systems (MS4s), construction stormwater, industrial stormwater, and concentrated animal feeding operations (CAFOs). Pollutant loads from the different sources were estimated using various models and data sources including Hydrological Simulation Program – FORTRAN (HSPF), Spreadsheet Tool for Estimating Pollutant Load (STEPL), MPCA's registered feedlot database, published estimates and assumptions, surveys, and NPDES permits. The pollutant load estimates as a percent for each impaired water body are shown in Table 31 to **Table** 33 (Tetra Tech 2019).

Table 31. Estimated annual phosphorus loads and source assessment (percent) for impaired lakes (adapted from Table 27 in Tetra Tech 2019)

Lake Name	Annual load (lb/yr)	Percent of total load					
		Cropland	Feedlots	SSTS	Internal Load	Upstream Lakes	Other
Hatch Lake	1,488	2%	3%	<1%	88%	0%	6%
Cody Lake	17,368	13%	10%	<1%	47%	19%	11%[a]
Phelps Lake	18,659	2%	3%	<1%	43%	49%	2%
Lake Pepin	14,411	19%	5%	<1%	69%	0%	6%
Lake Sanborn	2,727	30%	<1%	<1%	46%	0%	22%[b]
Pleasant Lake	1,039	10%	7%	4%	63%	0%	16%[c]
St. Catherine Lake	9,927	16%	8%	<1%	66%	0%	9%
Cynthia Lake	20,809	<1%	<1%	<1%	84%	13%	<1%

[a] Pasture – 7%, Developed – 4%

[b] Pasture – 15%, Developed – 3%, Atmospheric Deposition – 4%

[c] Pasture – 3%, Atmospheric Deposition – 11%

Internal loading was identified as a substantial source of phosphorus to the impaired lakes. The next highest loading occurred from cropland. Both sources are priorities for targeting the implementation of practices to reduce the loading.

On an average annual loading basis, the primary phosphorus sources to the streams with eutrophication impairments are agricultural lands and loads from upstream water bodies. The sources of phosphorus to rivers vary considerably across various flow conditions. During low flow conditions, loads from wastewater, groundwater, and upstream lakes and wetlands typically represent a greater proportion of loading than under average annual conditions. Under high flow conditions, loads from watershed runoff and near-channel sources are typically more dominant. The river eutrophication standards apply from June through September, and 70 to 80% of the annual phosphorus load generally moves through the river systems in Minnesota from mid-March to mid-July (MPCA 2014).

Table 32. Estimated annual phosphorus loads and source assessment (percent) for impaired streams with eutrophication impairments (adapted from Table 31, Tetra Tech 2019)

Water Body Name (AUID)	Annual load (lb/yr)	Percent of total load [a]							
		Agriculture [b]	Natural [c]	Permitted MS4 Developed Areas	Non-Permitted Developed Areas	SSTS	Permitted Wastewater	Near-Channel	Upstream Water Bodies
Sand Creek (839)	18,593	16%	<1%	0%	3%	1%	2%	6%	72%
Sand Creek (840)	26,571	18%	<1%	0%	2%	2%	0%	6%	72%
Sand Creek (513)	82,394	40%	<1%	<1%		3%	2%	12%	39%

[a] Loads from groundwater were not explicitly quantified but are incorporated into the other source categories.

[b] Cultivated crops and hay/pasture lands identified in NLCD, in addition to loading from feedlots.

[c] Forest, shrub/scrub, herbaceous, water, and wetlands identified in NLCD. Wetlands identified in NLCD include undisturbed and disturbed wetlands.

Table 33. Estimated TSS load and source assessment (percent) to the Sand Creek Watershed at the Jordan monitoring site (1995–2012 average) (adapted from Table 32 in Tetra Tech 2019)

Annual load (lb/yr and percentage)	Source					
	Agriculture [a]	Natural [b]	Permitted MS4 Developed Areas [c]	Non-Permitted Developed Areas	Permitted Wastewater	Near-Channel [d]
116,343	41,911	125	7	754	– [e]	73,546
100%[f]	36%	<1%	<1%	1%	– [e]	63%

[a] Cultivated crops and hay/pasture lands identified in NLCD.

[b] Forest, shrub/scrub, herbaceous, water, and wetlands identified in NLCD. Wetlands identified in NLCD include disturbed and undisturbed systems.

[c] Loads from permitted MS4s were estimated from pervious and impervious developed land covers within municipalities and townships that were permitted MS4s at the time of HSPF model development (2014).

[d] Load estimates of near-channel sources were not directly derived from the HSPF model. The percent of loading from near-channel sources was estimated from multiple sources, and the average annual load for each impaired reach / tributary system was calculated based on the percent distribution.

[e] Permitted wastewater sources in the Lower Minnesota River Watershed downstream of the USGS gauge near Jordan were not integrated into the HSPF model (RESPEC 2014); loads from these sources are assumed to make up a small portion of the overall TSS loading.

[f] Percentages do not add up to exactly 100% due to rounding

Table 34. Summary of *E. coli* sources in impaired watersheds (adapted from Table 33 in MPCA 2019)

Water body name	AUID	Source [a]			
		Livestock	Stormwater runoff, regulated and unregulated (Including wildlife and domestic pets) [a]	IPHT	Permitted wastewater
County Ditch 10	628	●	–	○	–
Raven Stream, West Branch	842	●	–	○	–
Raven Stream	716	●	○ New Prague	●	○ New Prague WWTP

Water body name	AUID	Source [a]			
		Livestock	Stormwater runoff, regulated and unregulated (Including wildlife and domestic pets) [a]	IPHT	Permitted wastewater
Porter Creek	817	●	○ Wildlife	○	–
Sand Creek	513	●	● Jordan Wildlife	○	○ Jordan WWTP Montgomery WWTP New Prague WWTP

- *E. coli* source that is a higher priority for targeting; ○ *E. coli* source that is a lower priority for targeting; – Not a priority *E. coli* source

[a] The cities identified as stormwater *E. coli* sources represent current pollutant sources of both regulated and unregulated stormwater. The wasteload allocations developed for the TMDLs address current and future pollutant sources. Therefore, the list of cities and townships in this table does not directly reflect the entities that receive wasteload allocations. Areas of potential *E. coli* contribution from wildlife are noted in Figure 35 of the draft TMDL report (Tetra Tech 2019).

5.1.2 Special studies

Special studies have been completed as part of the Clean Water Partnership project and more recent efforts to provide direction in identifying sources of and solutions to water quality problems in the watershed. Summaries of the studies follow and data from these studies is informing the development of this planning document.

Cedar Lake and McMahon (Carl's) Lake Total Maximum Daily Load Implementation Plan (SWMO 2012)

The TMDL implementation plan includes a list of implementation options and estimates of potential load reductions to address the TMDLs for the two lakes. It also provides recommendations to fund and accomplish implementation activities. The primary problems identified for the lakes include 1) an overabundance of phosphorus, which feeds algae blooms; 2) the presence of non-native invasive plants and animals, particularly curly-leaf pondweed and common carp; and 3) the shallow nature of the lake. The study identifies where the phosphorus is coming from, explains why carp and curly-leaf pondweed are problems, and describes the implementation plan for improving the lakes. Most of the phosphorus comes from within the lakes—lake sediments are a reservoir of past phosphorus pollution to the lake. These internal sources can be due to sediment resuspension caused by carp or wind energy, recycling from curly-leaf pondweed, and re-release from lake sediments under certain chemical conditions.

Sand Creek, MN Final Report - Fluvial Geomorphic Assessment (Inter-Fluve 2008)

The Fluvial Geomorphic Assessment study identified channel stability problems, assessed overall stream conditions and attempted to address the concerns of landowners regarding erosion, flooding and threats to infrastructure. The report discusses the study's findings and provides information to begin project identification for funding and completion.

Sand Creek Impaired Water Resources Investigation – Biological Stressor Identification (Barr Engineering 2009)

The stressor identification study was completed as part of the Sand Creek CWP diagnostic project. The report is part of Volume 4 (Appendices) of the overall project report. Probable causes for the biological impairments in the four reaches listed as impaired for biota prior to 2008 were found to be as follows:

- Sand Creek (-513) – habitat fragmentation
- Le Sueur County Ditch Number 54 (-661) – inadequate baseflow and poor habitat with some evidence of low dissolved oxygen and ionic strength
- Picha Creek (-579) – inadequate baseflow with some evidence of habitat fragmentation, poor habitat, and sediment
- Porter Creek – habitat fragmentation followed by inadequate baseflow with some evidence of poor habitat, sediment, and low dissolved oxygen

Multiple lines of evidence indicate Picha Creek is naturally intermittent and incapable of supporting an unimpaired fish assemblage due to natural causes. Flow monitoring is recommended to discern the respective roles of natural limitation and anthropogenic land use changes as causes of inadequate baseflow in County Ditch 54.

Sand Creek Near Channel Sediment Reduction Feasibility Report (Inter-Fluve 2015)

The feasibility study and report was completed by Inter-Fluve, Inc. to identify eroding bluffs or ravines that contribute large amount of sediment to Sand Creek. The study developed a rubric to prioritize sites for erosion control based on erosion and sediment yield, project cost and complexity, and infrastructure risk. The primary focus area for the study was direct bluff and ravine erosion in the Middle Sand Creek and Picha Creek Watersheds.

The report specifies the desktop and field based site selection process and describes conceptual treatments at six sites that were prioritized for potential pilot projects. The primary goal of the desktop assessment was to identify candidate sites where channel, ravine, and/or bluff toe stabilization will significantly reduce erosion and therefore reduce sediment loads to Sand and Picha Creeks. The identified sites were later ranked, largely based on estimated sediment production, and used to prioritize field assessment activities and project planning. Much of the highest rank projects have been or are being completed.

Analysis of Hydrologic Change and Sources of Excess Sediment in Scott County (Belmont et al. n.d.)

The report documents the methods and synthesizes results for a variety of analyses designed to understand hydrologic and geomorphic factors controlling sediment loading in Scott County, Minnesota with a focus on Sand Creek. Results indicate that runoff ratios and river flows in Sand Creek decreased markedly over the past 20 years. The fact that runoff ratios have not increased is possibly due in part to the installation of many water retention structures during the 1990s and early 2000s. Conversion from row crops to perennial vegetation may have also kept runoff ratios from increasing, despite significant increases in very high and extreme rainfall. Moderate to low hourly rainfall intensities have not changed significantly over the past six decades. However, the highest hourly rainfall intensities (top 1% of events) have increased considerably since the early 1970s.

The relationship between streamflow and TSS concentrations for Sand Creek at Jordan shows a threshold relation, indicating that the stream has a substantial sediment supply even under low flow conditions. Compound topographic index identified flat-lying areas within the watershed and may be useful for planning of key sites for surface water and/or sediment storage. Normalized steepness and stream power identified locations with anomalously high or low capacity to perform geomorphic work (i.e., erosion or deposition), with the knick zones of each watershed again being highlighted as high energy environments. Channel migration rates were fastest in the low gradient reach below the knick zone on Sand Creek, which is an indicator of the river attempting to deal with a sediment load that is relatively large compared to its sediment transport capacity.

This study reinforces the position that above a certain flow threshold, the TSS increases significantly as typical of a stream with significant near-channel sources, versus a steady and continuous contribution of sediment at all flow regimes.

Sand Creek: Comprehensive Water Quality Assessment of Select Metropolitan Area Streams (Metropolitan Council 2014)

The report is part of an assessment of stream water quality in the Twin Cities Metropolitan Area based on long-term monitoring sites operated by the Metropolitan Council Environmental Services. The report documents the characteristics of Sand Creek and its watershed that are most likely to influence stream flow and water quality, and presents the results of flow, water quality, and biological data assessments. The report draws conclusions about possible effects of landscape features, climatological changes, and human activities on flow and water quality and makes general recommendations for future assessment activities, watershed management, partnerships, and other potential actions to remediate water quality or flow concerns.

The water quality in Sand Creek is affected by several factors: agricultural activity, WWTP effluent, loss of wetlands and upland storage, and the instability of the area geology. TSS in the stream (both flow-weighted mean concentration and load) was high, in comparison to the Minnesota River and the other MCES-monitored metro area tributaries. Previous studies (Scott County 2010) indicate that TSS is dominated by knickpoint migration at the Minnesota River bluff (location of the formation glacial River Warren channel) (Jennings 2010). Increase in stream flow, whether from increased density of agricultural drain tiles, loss of upland storage, or from increased precipitation due to climate change, likely exacerbated the knickpoint migration through streambank, gully, and ravine erosion and led to heightened TSS loads and concentrations.

The nitrate loads and concentrations are likely driven by agricultural activity in the watershed. The concentration and loads in Sand Creek are lower than those in the Minnesota River (which carries runoff from the intensely farmed area of western Minnesota), but are higher than most of the other MCES-monitored metro area tributaries. Trend analysis indicates periods of increasing and decreasing flow-adjusted concentration in the creek, although the most recent trend appears to be decreasing (and thus indicating improving water quality).

Sand Creek TP loads and concentrations are likely affected by agricultural activity and effluent discharge from the Montgomery and New Prague wastewater treatment plants (WWTPs). The concentration in Sand Creek is higher than that in Minnesota River and is generally higher than the MCES-monitored tributaries in the Mississippi and St. Croix River basins. Trend analysis indicates a decrease in TP flow-adjusted concentration since 1990 (thus indicating improving water quality), with an accelerated decrease since about 2005. Changes in TP are likely due to increased implementation of agricultural best management practices and implementation of phosphorus removal at the New Prague and Montgomery WWTPs.

The chloride loads and concentrations in Sand Creek were lower than in the highly urbanized watersheds monitored by MCES, reflecting the low level of development and road density in the watershed and thus the relatively low input of chloride as road de-icer.

Trend analysis indicates both upward and downward trends in TSS flow-adjusted concentration since 1990; the most recent trend is of increasing TSS flow-adjusted concentration and thus declining water quality. This increase may have been caused by a series of unusual, short, and intense storms that occurred in 2011 and 2012. Both TP and nitrate flow-adjusted concentration trends were decreasing, thus indicating increasing water quality. This improvement may reflect the level of management practices, including conservation tillage, agricultural buffer strips, field terracing, and other practices implemented by local farmers with support from SWMO, Rice County, Le Sueur County and others, and phosphorus removal at the watershed's municipal WWTPs.

Analysis of macroinvertebrate samples indicates complicated F-IBI, POET, and M-IBI levels in Sand Creek. High-flow events appear to have reduced the number and diversity of macroinvertebrates some years; however, the median value of M-IBI is above the MPCA's threshold, which suggests that habitat in this stream reach and water quality were typically more able to sustain the needs for aquatic life.

Twin Cities Metropolitan Area Chloride Management Plan (MPCA 2016)

There are two primary sources of chloride to the Twin Cities Metropolitan Area (TCMA) water resources: 1) salt applied to roads, parking lots, and sidewalks for deicing; and 2) water softener brine discharges to municipal WWTPs. The Twin Cities Metropolitan Area Chloride Management Plan incorporates water quality assessment, source identification, implementation strategies, monitoring recommendations, and measurement and tracking of results into a performance-based adaptive approach for the TCMA. The goal of this plan is to develop the framework to assist local partners in minimizing salt (chloride) use and provide safe and desirable conditions for the public.

Subwatershed Analyses for Cedar Lake (Scott SWCD 2013) and Picha Creek (Scott SWCD 2014)

Subwatershed analyses were developed to proactively identify and prioritize BMP projects based on performance and cost effectiveness. The reports provide a detailed analysis that identifies specific best management practices (BMPs) that could be applied to meet the watershed goals at the field level by maximizing the value of each dollar spent. The Cedar Lake and Picha Creek reports focus on identifying and evaluating BMPs based on their potential to reduce phosphorus in the watersheds draining to the two water bodies.

Estimating the abundance and biomass of common carp in Cedar Lake and developing a sustainable management strategy for carp using integrated pest management strategies (Carp Solutions 2017)

A study was completed by Carp Solutions for the SWMO to estimate the abundance and biomass of common carp in Cedar Lake for use in evaluating the contribution of carp to the phosphorus concentrations in the lake. Using a mark-recapture technique and two open water seines, the biomass of common carp in the lake was estimated to be 75.5 kg/ha (67.2 lb/acre). The study identified areas in the lake that the carp formed seasonal aggregations as possible sites for fish removal by seining and evaluated the age structure of the carp population to assess annual recruitment. The study then simulated the carp abundance and biomass in a population dynamics model to estimate the effect of removing 10% of the carp each year. The results indicated that systematic removal of even a low percentage of the population each year should lead to a substantial decline in common carp biomass over time. Three potential removal strategies for carp were then discussed in the report—seining, baited boxes, and the Carp Kabob tournament.

SWMO Water Quality Monitoring Report Picha Creek 2015 (Scott SWCD 2016b)

The report presents and discusses the results of streamflow and water quality monitoring at a site on Picha Creek in 2015. Picha Creek is an intermittent flowing stream that discharges into Sand Creek west of Highway 169 between Jordan and Shakopee. TSS concentrations were greater than the TSS water quality standard for the South Nutrient Region (65 mg/L) only for the three storm event samples collected. The base flow sample TSS concentrations were all less than the standard. With three out of 18 sample concentrations greater than 65 mg/L, 17% of the samples exceeded the standard. The minimum observed dissolved oxygen concentration when streamflow was present was 7.1 mg/L with measurements being made between 7:00 and 11:00 am (times rounded to the nearest hour). Low dissolved oxygen is not expected in the stream at the monitoring site given the steep slope of the stream upstream of the monitoring site, which should result in water turbulence and reaeration. Total phosphorus concentrations were relatively high. The summer average TP concentration was 0.415 mg/L, well above both the Central and South Nutrient Region standards (0.100 and 0.150 mg/L, respectively). Data were not collected for chlorophyll-*a*, five-day biochemical oxygen demand, diel dissolved oxygen, and pH; therefore, a comparison with the stream eutrophication standard could not be made. Streamflow was measured over 129 days from July 15 to November 19, 2015. Streamflow during the spring was low and was dry on several occasions as the area experienced drought conditions from fall 2014 through spring 2015. Additional information, data summaries, and graphs are in the report.

5.1.3 Clean Water Partnership Diagnostic Study

Water quality and streamflow monitoring conducted in 2007 and 2008 for the CWP diagnostic study was used to calculate TSS yields and flow-weighted concentrations for the main stem and subwatershed monitoring sites. The load estimates indicate that less than 35% of the TSS load at the Jordan site originated in the subwatersheds even though the watershed area above the stations represents 89% of the total watershed area at Jordan. TSS yield estimates by subwatershed (Figure 25 and

Figure 26) indicate that Jordan Middle Sand Creek subwatershed, downstream of the four major tributary monitoring stations, contributed TSS yields that were approximately 5 to 10 times higher than the remaining areas of the Sand Creek watershed in 2007 and 2008 (SWMO 2010a).

The diagnostic study report goes on to compare load duration curves for the monitoring sites along with the load and yield estimates. The comparisons "indicate that near-channel sources of sediment in the lower portions of the watershed are more significant contributors to the higher turbidity levels observed in Sand Creek. The higher stream gradients in this portion of the watershed suggest that the streambed and banks are contributing a significant portion of the near-channel sources of sediment, but other assessments indicate that gully and ravine erosion have the potential to contribute significant sediment loadings, as well. This subwatershed is where the creek cuts through the Minnesota River valley bluff, and there are a number of steep narrow gullies that discharge to this reach of Sand Creek. It is also likely that the conditions associated with these sources of sediment are further exacerbated by hydrologic alterations in the upstream portions of the watershed. Schottler (2002) estimated that streambank and near-channel sources accounted for greater than 70% of the sediment exported from the Raven Stream Watershed, which is in a part of the same overall watershed without as much stream gradient or ravine and gully erosion. As a result, it would not be unexpected that near-channel processes would be even more dominant in the middle subwatershed where there is more potential for erosion from bluffs and numerous ravines, and the gradient of Sand Creek is much steeper." (SWMO 2010a)

The diagnostic study reports that the highest TSS loads generally occurred during the months of March through June. The higher loads were also primarily associated with water samples collected during higher streamflow's associated with snowmelt or spring rainfall runoff events prior to the development of a full crop canopy in the watershed.

A evaluation of the water quality data upstream of the Louisville Swamp (Sand Creek at Jordan) and its outlet to the Minnesota River indicates that there were often periods of time with a net export of solids from Louisville Swamp relative to the incoming load in contrast to an expected decrease in load due to sediment settling in the swamp with lower water velocities. Further investigation determined that the increase in loading was the result of a combination of algal growth and carp under low flow conditions (SWMO 2010a).

The TSS load from the point sources in the watershed was found to be negligible relative to the nonpoint source loads.

Watershed runoff modeling

The MCES completed a watershed model for the Sand Creek Watershed using the Soil and Water Assessment Tool (SWAT) model to provide additional analysis of the sources and transport of TSS along with identifying a list of management practices to reduce sediment loading with estimates of the potential TSS reductions for the practices. The model simulated TSS using hydrologic response units to describe the unique combinations of land cover, land use, soils and slopes in the watershed. Estimated TSS yields from the SWAT model are shown in

Figure 26. As a calibrated model, the yield estimates parallel those determined through the diagnostic study monitoring. The results of the SWAT modeling suggest that the biggest TSS reductions could occur by using a combination of wetland restorations to restore upland hydrology, field-scale sediment control practices, and stream stabilization (MCES 2010).

Figure 25. 2008 Sand Creek Watershed TSS Yield (from SWMO 2010a)

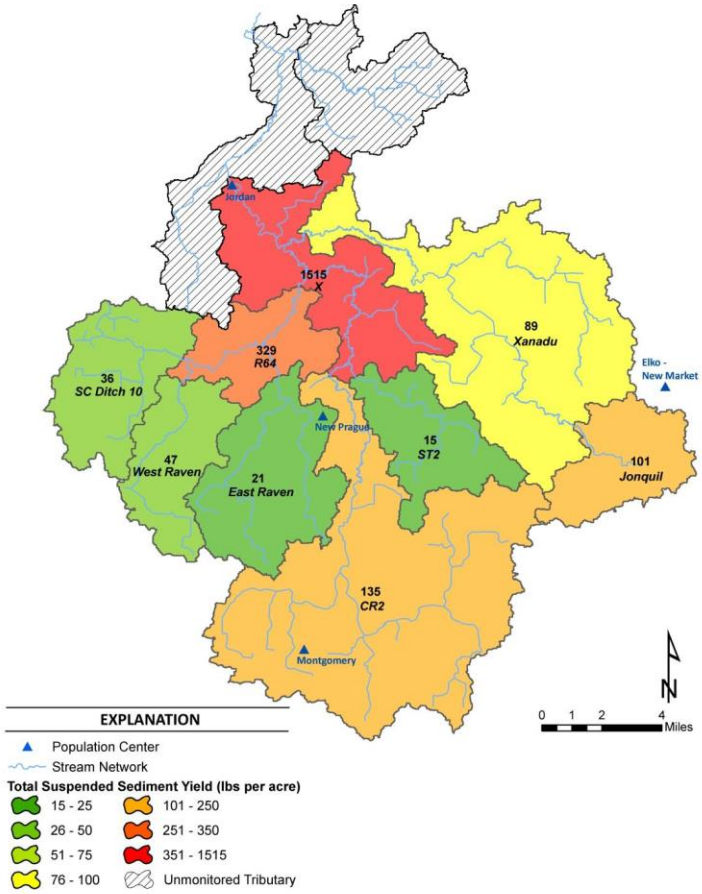
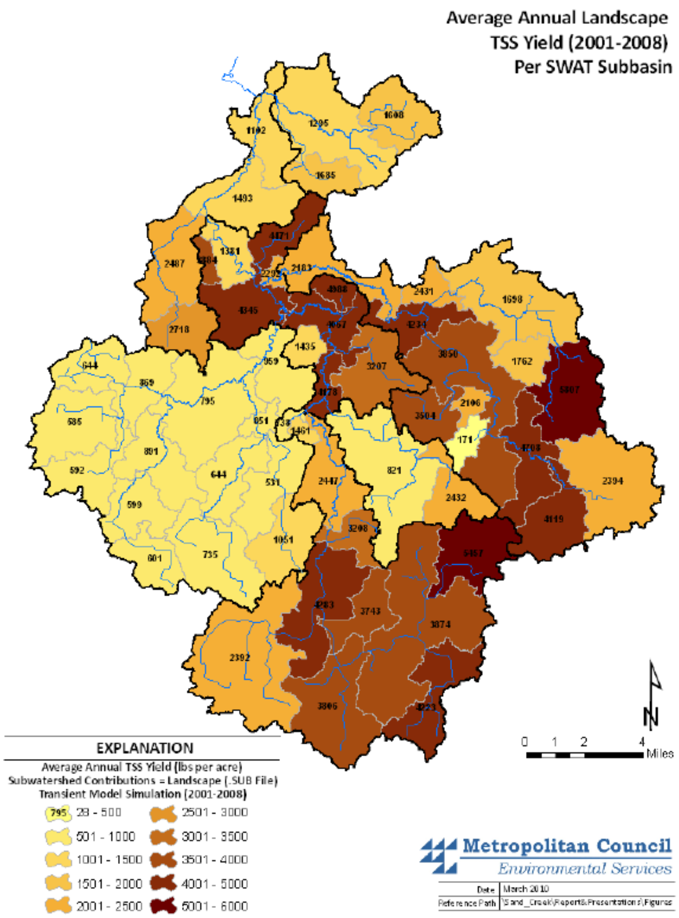


Figure 26. Simulated TSS yields using the SWAT model (MCES 2010)



Stressor identification for biological impairments from CWP study

A stressor identification process was completed for the diagnostic study to identify the probable stressors affecting the biological communities in the two stream reaches identified as impaired for biota on the 2004 303(d) list. The reaches were Picha Creek and Sand Creek from its mouth to the confluence with Porter Creek. In addition to these reaches, the diagnostic study found the upstream reach of Porter Creek and the County Ditch 54 reach to be impaired for fish. The probable causes of impairment for the four stream reaches included various combinations of habitat fragmentation, sediment, inadequate baseflow, and poor habitat. Low dissolved oxygen and altered ionic strength were possible stressors as well. Evidence indicated that sediment was only a stressor when combined with one or more of the other stressors. Details of the stressor identification are included in the diagnostic study (SWMO 2010a).

Cedar and McMahon (Carl's) lake phosphorus findings from CWP study

Phosphorus sources for Cedar Lake and McMahon (Carl's) Lake were identified in the TMDL report for the two lakes using a combination of modeling approaches. The approaches included the P8 Urban Catchment Model, watershed yield and land use based runoff coefficients, and an in-lake mass balance model. The TMDL study determined that internal loading of phosphorus to the lakes in 2007 and 2008 accounted for 96 and 93% of the phosphorus load to Cedar Lake, respectively, and 80 and 85% of the phosphorus load to McMahon (Carl's) Lake. The internal load was primarily from bottom sediment phosphorus releases and bioturbation and excretion from carp. A small amount of the internal load was attributed to the growth and decomposition of curly-leaf pondweed. The remaining phosphorus load was from external watershed sources and precipitation. The external load for Cedar Lake amounted to about 5% of the total phosphorus load while precipitation accounted for just under 2% of the load. The external load for McMahon (Carl's) Lake amounted to about 15% of the total phosphorus load while precipitation accounted for 5% of the load. A small portion of the external load to Cedar Lake was from a wetland and diversion weir. Detailed numbers and further description of the loads are in the TMDL report (MCES 2010).

There are no municipal wastewater treatment systems in the watersheds of the two lakes. While McMahon (Carl's) Lake is located in a permitted MS4 community (Spring Lake Township), the area is unincorporated and there are no regulated conveyance systems within the McMahon (Carl's) Lake subwatershed. The lake TMDLs assumed that 1% of the watersheds' area was subject to construction or industrial activities associated with regulated stormwater runoff. No permitted concentrated animal feeding operations (AFOs) and no known straight pipe septic systems were present in the lakes' watersheds.

5.2 Pollutant sources

5.2.1 Feedlots

Feedlots can be a source of phosphorus and *E. coli* to the lakes and streams in the Sand Creek Watershed.

The Sand Creek Watershed has 334 active registered feedlots with a total of about 19,000 animal units (AUs). Registered feedlots may or not be active feedlots may have fewer animals than are registered. Table 35 shows the animal numbers for feedlots in the impaired lakes' watersheds. There are no permitted CAFOs in the watershed.

Animal waste from AFOs can be delivered to surface waters from failure of manure containment, runoff from the AFO itself, or runoff from nearby fields (including from tile drainage water) where the manure is applied. In Minnesota, feedlots with greater than 50 AUs, or greater than 10 AUs in shoreland areas, are required to register with the state. For the Sand Creek Watershed, the MPCA administers the state feedlot program[1]. Registered feedlots that follow the feedlot program guidance are not likely to be a source of nutrients or bacteria. MPCA staff conducts regular inspections and interacts with the registered feedlot farmers, including technical assistance and advice to fix problems as they arise. The greater issue associated with feedlots is the land application of manure. The feedlot guidance includes proper land application of manure procedures.

The MPCA Data Desk provided the feedlot locations and numbers and types of animals in registered feedlots. This estimate includes the maximum number of animals that each registered feedlot can hold; therefore, the actual number of livestock in registered facilities is likely lower. Livestock in non-registered, smaller operations (e.g., hobby farms) likely contribute *E. coli* to surface waters through watershed runoff from fields and direct deposition in surface waters. Smaller operations, those under the registration threshold, will be encouraged to implement all the guidelines established for their registered counterparts. In this plan, the *E. coli* numbers are based off animal unit counts in registered feedlots (including permitted feedlots and CAFOs) was estimated based on animal type (Table 35). Additionally, Table 31 describes the percentage of phosphorus loading to the lakes by feedlots in the Sand Creek Watershed. Unregistered feedlots are assumed to be a minimal source of pollutant loading in this watershed.

Figure 27. Feedlots by animal type and size in the Sand Creek Watershed (adapted from Tetra Tech 2019)

[1] https://www.pca.state.mn.us/water/county-feedlot-program

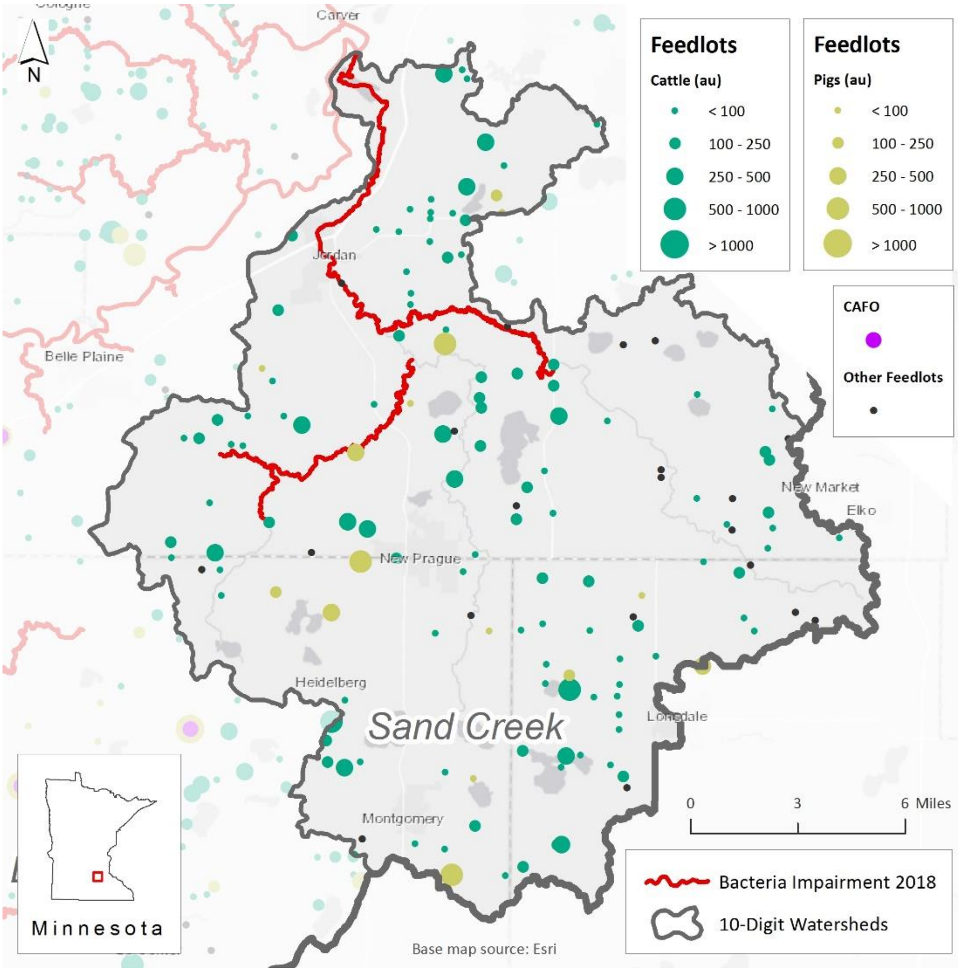


Table 35. Feedlot inventory by impaired lake* (adapted from Table 20 in Tetra Tech 2019)

Lake name	Management areas	Number of animal units	Number of animals	Beef cattle	Dairy cattle	Swine (Hog)
Hatch Lake	MA3	121	155	155	0	0
Cody Lake**	MA3	2,234	6,092	169	1,923	3,706
Phelps Lake**	MA3	703	1,312	272	740	50
Lake Pepin**	MA3	1,452	2,162	206	1,001	540
Lake Sanborn	MA3	10	10	10	0	0
Pleasant Lake	MA2	105	405	0	0	405
St. Catherine Lake**	MA5	1,930	2,193	1,489	645	0
Cynthia Lake**	MA5	33	33	0	0	0
Cedar Lake	MA2, FA2	126	207	205	0	2

** Animal numbers represent maximum numbers registered; actual numbers are likely lower.

Table 36. *E. coli* production by livestock animal type in Sand Creek Watershed (adapted from Table 21 in Tetra Tech 2019)

Impairment group	Percent of *E. coli* production (%) [a]					*E. coli* production (billion cfu/day)
	Cattle	Poultry	Goats/Sheep	Horses	Pigs	
Sand/Scott [b]	30%	3%	5%	< 1%	62%	$9.9\text{x } 10^{13}$

[a] Production rates for cattle (2.7×10^9), poultry (1.3×10^8), goats and sheep (9.0×10^9), and pigs (4.5×10^9) are from Metcalf and Eddy (1991). The production rate for horses (2.1×10^8) is from American Society of Agricultural Engineers (1998). The production rates are provided in the literature as fecal coliform organisms produced per animal per day; these rates were converted to *E. coli* production rates by multiplying by 0.5 (Doyle and Erickson 2006). Production rate units are organisms per day per head.

[b] Estimate made for all stream impairments within Scott County and includes some stream reaches outside of the Sand Creek Watershed.

5.2.2. Upland agricultural areas

Watershed runoff from upland areas, which transports and delivers pollutants to surface waters, is generated during precipitation events. The sources of pollutants in watershed runoff are many, including soil particles, crop and lawn fertilizer, decaying vegetation (leaves, grass clippings, etc.), and domestic and wildlife waste. Because cropland is the dominant land cover in the Sand Creek Watershed (Table 10) pollutant loads from cropland and from agricultural areas in general represent up to 40% of total loads in the Sand Creek Watershed (Table 31, Table 32, and Table 33).

5.2.3. Near channel erosion

Near-channel sources of sediment are those in close proximity to the stream channel, including bluffs, banks, ravines, and the stream channel itself. Hydrologic changes in the landscape and altered precipitation patterns driven by climate change can lead to increased TSS and sediment-bound phosphorus in surface waters. Subsurface drainage tiling, channelization of waterways, land cover alteration, and increases in impervious surfaces all decrease detention time in the watershed and increase flow from fields and in streams. Draining and tiling wetland areas can decrease water storage on the landscape, which can lead to lower evapotranspiration and increased river flow (Schottler et al. 2014).

The straightening and ditching of natural rivers increases the slope of the original watercourse and moves water off the land at a higher velocity in a shorter amount of time. These changes to the way water moves through a watershed and how it makes its way into a river can lead to increases in water velocity, scouring of the river channel, and increased erosion of the river banks (Schottler et al. 2014, Lenhart et al. 2013).

Near-channel loads of phosphorus and TSS from ravines, bluffs, and streambanks were estimated with an HSPF watershed model (Tetra Tech 2019). Where available, near-channel TSS load estimates from previous investigations were incorporated into the analysis. In the Lower Minnesota River Watershed as a whole, near-channel sources account for 83% of the TSS load to the river. In addition to the estimates of near-channel sources from the basin-wide modeling of the Minnesota River Watershed, previous investigations of the Sand Creek Watershed have evaluated sediment loading from near-channel sources:

- A 2005 and 2006 survey of Sand Creek and its tributaries found that "much of the creek had slight to moderate erosion with a few areas of severe erosion" (SWMO 2010a). Stream bank erosion was documented in 12.2 miles of Sand Creek, 13.6 miles of Porter Creek, and 5.8 miles of Raven Stream (a tributary of Sand Creek).
- A sediment study of Raven Stream found that "erosion of streambanks accounted for greater than 70% of the TSS measured during eight storm events in 2000 and 2001" (Schottler and Engstrom 2002, cited in SWMO 2010a).
- Loads from near-channel sources are thought to be a higher proportion of sediment load downstream of the Sand Creek knickpoint, which is located between the city of Jordan and the confluence of Porter Creek with Sand Creek.
    - The Sand Creek Impaired Waters Diagnostic Study (SWMO 2010a) found that near-channel sediment sources in the lower part of the Sand Creek Watershed contribute to high turbidity. This part of Sand Creek cuts through the Minnesota River valley bluff, and there are steep gullies in this region that are directly connected to Sand Creek. Erosion associated with gullies is likely worsened by hydrologic alterations in the upstream portion of the watershed. High stream gradients suggest that sediment from streambed and bank erosion contributes a significant portion of the near-channel sources, but gully and ravine erosion likely contribute as well. The estimated 70% of TSS from streambank erosion in Raven Stream occurred in a watershed with a smaller gradient and fewer ravines and gullies than Sand Creek; therefore, Sand Creek might experience higher amounts of TSS from near-channel sources (SWMO 2010a).
    - An analysis in Sand Creek Total Suspended Solids Model and Analysis of Potential Management Practices (MCES 2010) of sediment fingerprint studies (Schottler and Engstrom 2002, MPCA 2009, and personal communication with Patrick Belmont, as cited in Tetra Tech 2019) differentiates the sediment load apportionment upstream and downstream of the Sand Creek knickpoint. Below the knickpoint (AUID 513), approximately 75% of the sediment is from non-field sources (channel, bank, gully, and ravine) with 25% from field sources. Above the knickpoint, (the remaining Sand Creek impaired reaches), sediment loads are estimated to be approximately 60% non-field sources and 40% field sources (MCES 2010).

Additional information on channel stability in the Sand Creek Watershed is provided in the *Sand Creek Fluvial Geomorphic Assessment* (Inter-Fluve, Inc. 2008). The goal of the assessment was to locate problems of channel stability, assess stream condition, and address landowner concerns regarding erosion, flooding, and threats to infrastructure. The effort evaluated 86 stream reaches in the Sand Creek Watershed, with an average reach length of 1.3 miles. The analysis concludes that:

> The Sand Creek Watershed is generally in poor condition. Though some reaches provide variable habitat conditions, have wide riparian zones with active floodplains, and have water flowing year round, many of the channels have been altered significantly. The impacts observed in the Sand Creek Watershed include channelization through urban and agricultural areas, dams of various heights, perched culverts, the removal of riparian vegetation, and cattle grazing. ... The channels throughout the Sand Creek Watershed are generally stable with some natural channel migration. There is slight overall degradation that can be observed in a few locations in which new inset floodplains have been built (Inter-Fluve, Inc. 2008).

In the source assessment for the TMDL, it was assumed that near-channel sources in the Sand Creek Watershed represent 60% of total loads upstream of the knickpoint and 75% of total loads downstream of the knick point, for a weighted average of 63% of loading from near-channel sources. Overall, it is estimated that 63% of the TSS load to Sand Creek is from near-channel sources (Table 33).

Phosphorus: In the Lower Minnesota River Watershed as a whole, including main stem Minnesota River reaches, simulated near-channel sources account for 20% of the phosphorus load to the river. To provide a load estimate for near-channel sources for each of the impaired reaches in the Sand Creek Watershed, it was assumed that near-channel sources account for 20% of the phosphorus load to each impaired reach. Estimates of phosphorus loading from near-channel sources to impaired streams are provided under the TMDL summary in Table 32.

5.2.4. Wastewater

Domestic, commercial, and industrial wastewaters are collected and treated by municipalities before being discharged to waterbodies as municipal wastewater effluent. Treated industrial wastewaters and cooling waters from industries, businesses, and other privately owned facilities may also be discharged to surface waters. Both municipal and industrial wastewater dischargers must obtain NPDES permits. There are six permitted wastewater discharges in the Sand Creek Watershed (see Section 3.8, Table 11).

There are no municipal or industrial treatment facilities that are permitted to discharge treated wastewater in the impaired lake watersheds. On an average annual basis, phosphorus loads from permitted wastewater to streams with eutrophication impairments ranges from 0 to 2% Table 16)

. Loads from permitted wastewater sources are assumed to make up a small portion of the overall TSS loading.

5.2.5. Stormwater

Stormwater runoff from permitted Municipal Separate Storm Sewer Systems (MS4s), construction stormwater, and industrial stormwater are regulated through National Pollutant Discharge Elimination System (NPDES) permits. Table 37 lists the current and likely future MS4 permitted entities in the watershed. Figure 28 shows the regulated and unregulated areas contributing to runoff in the watershed.

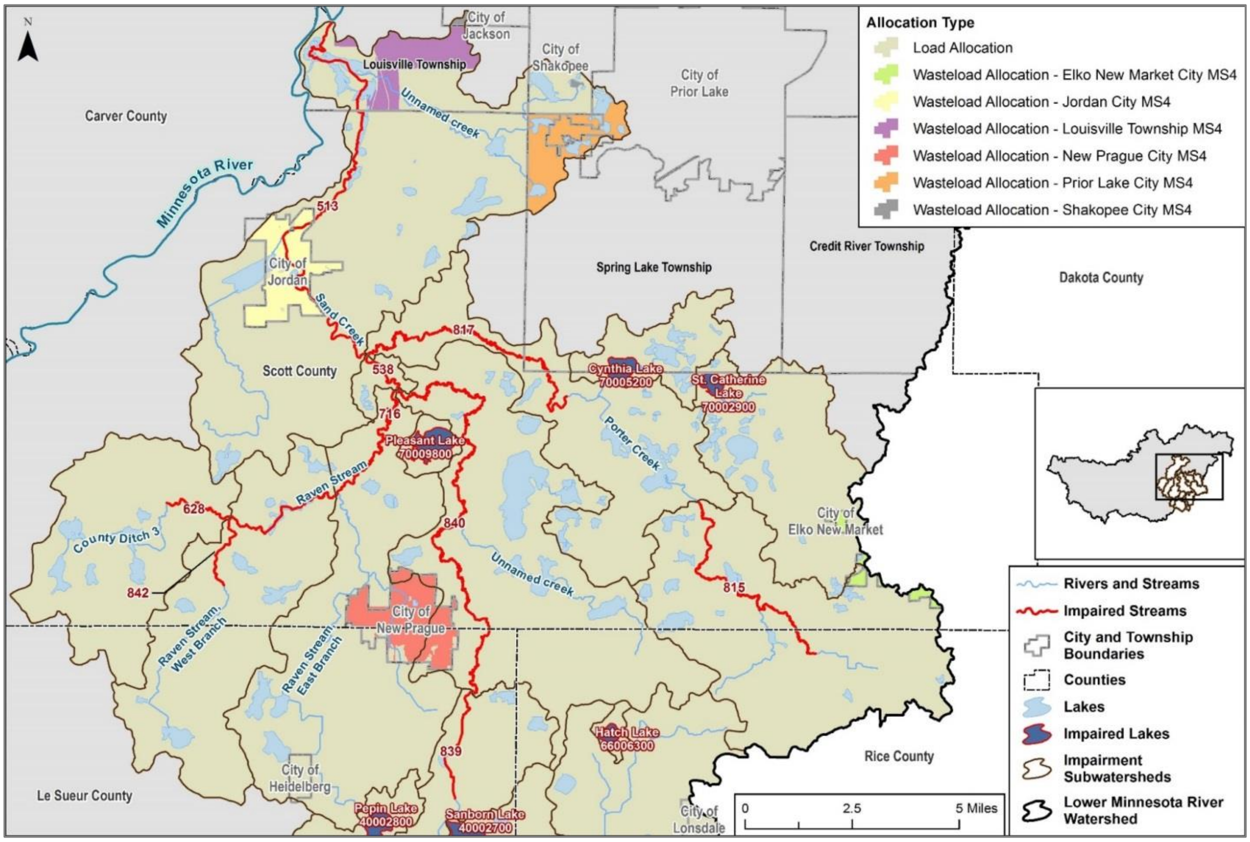
Phosphorus and TSS loading from construction and industrial stormwater is inherently incorporated in the watershed runoff estimates. On average, based on county-wide data, less than 0.5% of the watershed area is permitted under the construction stormwater permit in any given year (average of approximately 2010–2015; Minnesota Stormwater Manual contributors 2017), and construction stormwater is not considered a significant source of phosphorus or sediment. It is estimated that only a small percent of the watershed is permitted through an industrial stormwater permit, and industrial stormwater is not considered a significant source.

MS4 stormwater was estimated to contribute less than 1% of the phosphorus load to AUID -513. No MS4 areas are located in the watersheds of the other two reaches (Sand Creek, AUID -839 and -840) listed as impaired for eutrophication. MS4 stormwater was estimated to contribute less than 1% of the TSS load to the TSS-impaired stream reaches in the Sand Creek Watershed (AUIDs -513, -538, -815, -817, -839, and -840).

Table 37. Current and likely future MS4 permitted entities draining to impaired water bodies in the Sand Creek Watershed (adapted from Table 20 in Tetra Tech 2019).

Impairment (AUID)	MS4 Name (Permit #)				Likely Future MS4		
	Elko New Market City (MS400237)	Louisville Township (MS400144)	Prior Lake City (MS400113)	Shakopee City (MS400120)	Jordan	New Prague	Spring Lake Township (MS4)
Sand Creek (513)	✓	✓	✓	✓	✓	✓	
Sand Creek (538)						✓	
Sand Creek (840)						✓	
County Ditch 10 (628)							
Raven Stream (716)						✓	
Raven Stream, West Branch (842)							
Porter Creek (815)	✓						✓
Porter Creek (817)	✓						✓
Lake St. Catherine (70-0029-00)	✓						
Picha 578 and 580		✓	✓	✓			

Figure 28. Sand Creek Watershed areas of regulated and unregulated runoff (Tetra Tech 2019)



5.2.6. Hazardous and solid waste

Hazardous and solid waste sites are regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Minnesota Environmental Response and Liability Act (MERLA), and Resource Conservation and Recovery Act (RCRA). The MPCA maintains a list of the various program sites and provides information on them through the "What's in My Neighborhood" online application. Table 38 lists the activities and number of sites in the watershed. The sites included in the application include contaminated sites that have been cleaned up, potentially contaminated sites, sites being investigated or being cleaned up, and sites that have various permits and registrations required by MPCA. Most of the sites are located near the cities of Jordan, New Prague, and Montgomery.

The information in this table does not directly affect water quality and is not a primary identified concern for the Sand Creek Watershed stakeholders. This plan will not specifically address the hazardous and solid waste in Sand Creek. These are not sources of phosphorus, chloride, TSS, or *E. coli* impairments.

Table 38. Waste activities in the Sand Creek Watershed.

MPCA Activity	Number of Sites
Hazardous Waste (most are minimal to small quantity generators)	206
Petroleum Remediation	24
Brownfields	6
Site Assessment	8
Solid Waste	9
Above Ground Storage Tanks	14
Underground Tanks	26
Multiple Activities (combination of two or more activities)*	101

* May include air quality and Stormwater activities

5.3. Conclusions

From all of these assessments, with an emphasis on the watershed TMDLs as the most recent information, pollutant sources by pollutant are sediment primarily near channel with some upland contributions, lakes are largely internal phosphorus loading, and the subwatershed assessments done on specific catchments indicate that lots of work has been done starting with catchments making this progress and current state are that these are the remaining issues.

Discussion of assessments are both watershed wide and by individual water bodies, reflecting the priorities of the Sand Creek stakeholders. This work, combined with different program requirements and approaches, including MPCA assessments and listings, stressor identifications, TMDLs, Scott County WMO planning process, citizen input, Rice and Le Sueur SWCD's efforts; we therefore, present this summary.

Detailed information is provided for Picha and Cedar, as these are two areas identified as initial work areas for nonpoint work for the Section 319 Small Watershed Focus areas. These areas have been selected for targeting through loading, placement within the watershed, and through cost benefit analysis, including landowner interest and citizens' priorities in Sand Creek Watershed. The other Management Areas' sources and pollutants are addressed at a less detailed level, such as recommended suites of BMPs that will achieve water quality standards over time. Part of this overall strategy will be to develop targeted and precise approaches to these areas.

6. Watershed goals

The Sand Creek Watershed spans three counties, with the approximately half of the watershed in Scott WMO boundaries. Rice and Le Sueur Counties each govern approximately a quarter of the watershed. Through their local county water management plans, Rice and Le Sueur counties have identified working with the Scott WMO in planning for and addressing concerns in the Sand Creek Watershed. In general, the intent of these policies and the goal is to preserve unimpaired water bodies, and restore impaired water bodies such that they meet state standards or the appropriate condition for the region.

The overall resource goals for the Scott County portion of Sand Creek are encompassed by the goals of the SWMO Water Resources Management Plan. The resource goals are to:

1. Protect and enhance wetland ecosystems and ensure/encourage a measurable net gain of wetland functions and acreage;
2. Protect and improve surface water quality;
3. Protect groundwater and supplies; and
4. Protect human life, property, and surface water systems that could be damaged by flood events

In addition to planning for specific resource goals, the SWMO also has three goals that prioritize the social aspect that support the changes necessary to achieve behavioral changes.

1. Increase public participation and land and water stewardship
2. Improve communication
3. Optimize public expenditures

The SWMO's goals embrace an overall vision that is:

> *To compile a system of well-buffered watercourses, wetlands and lakes surrounded by an upland where stormwater runoff is managed to reduce volumes, control peak flows and their timing, and minimize pollutant generation and export; and where aquatic resources meet local expectations.*

This vision developed out of the WMO's planning process as it became apparent that the WMO did not and will not have the financial and staffing resources to address the issues by just using capital improvement projects and government fixes. Rather, it was recognized that a long-term vision and a sustainable way to meet that vision was needed.

The overall goals are further defined by descriptions of the goals, and policies in Section 3, and strategies in Section 4 of the WMO Plan. These were developed with consideration and priorities of the issues and management gaps identified in Section 2 of the WMO Plan.

Although the WMO Plan only addresses the portion of the Sand Creek Watershed within Scott County, the general principles extend to its drainage areas in Le Sueur and Rice Counties.

Le Sueur County has identified the following goals (list orientation does not denote a hierarchy of concerns). (Le Sueur County Water Plan 2016)

1. Protected, restored, and improved surface water quality in lakes, rivers, and streams
2. All SSTS brought into compliance
3. Minimized impacts from runoff of development areas and agricultural land that alter surface water hydrology
4. Diminished issues caused by urban and development stormwater runoff
5. Achieved no net loss of existing natural shoreline
6. Achieved a net natural shoreline gain through shoreline restorations

7. Protected groundwater quality and quantity
8. Maintained drainage systems while sustaining agricultural productivity. Improved artificial drainage water quality, as we as understood that the system is part of a watershed.
9. Reduced water quality issues from agricultural sources to surface water.

Sand Creek is an identified priority for impaired water concerns (Le Sueur County Water Plan 2016, p. 12).

Rice County Local Water Management Plan 2010-2014, which is the most recent water plan, identified six priority concerns through engagement with other LGUs, agencies, and citizens. A citizen survey was conducted to solicit input from citizens in January of 2008. The six broad priorities of concern are erosion, stormwater, waste disposal/management (including proper disposal and management of septic and feedlot/milk house waste), ground water, surface water, and coordination/special concern. Rice County is participating in the Cannon River 1W1P, which will replace the local county planning efforts. In the Rice County Local Water Management Plan Implementation Update 2014-2019, these priority concerns are more targeted.

In both Rice and Le Sueur County water plans, Sand Creek has targeted work identified explicitly in their plans.

The Scott County WMO has long-term and short-term water quality goals.

6.1 Recommended TMDL reductions

As discussed in Section 4.7, there are multiple TMDL recommendations for needed reductions. Table 30, in Section 4.7, summaries all the needed reductions for all impaired stream reaches and lakes within the Sand Creek Watershed and informs the reader from which plan they are drawn.

Achieve positive water quality data trends by 2025 (SWMO).

The Le Sueur County Local Water Management Plan has made it a goal to incorporate TMDL and WRAPS actions into their local water plans (e.g., county plan, 1W1P, lake management plans, etc.) by 2021, following the completion and approval of the reports. The draft Lower Minnesota TMDLs and WRAPS are currently on public notice. Le Sueur County plans to partner with the lake association, environmental services, agricultural organizations and the SWCD to accomplish this goal.

Le Sueur County has created an aggressive ordinance/procedure to address failing or substandard SSTS by requiring residents that have been notified of noncompliance to be upgraded, repaired, replaced or abandoned within one year of the notice. Le Sueur County began updating their ordinances in 2008 to address this problem, including inspections at sale/transfer, any zoning permit applications, property use change, or if deemed appropriate, upon receipt of a complaint or other notification of malfunctioning SSTS. Between 2010 and 2015, 576 SSTS were replaced or upgraded in the county. To support the residents, the county has a low interest loan program.

Lakes

All of the natural lakes in the SWMO are shallow and subject to the standards for North Central Hardwood Forest (NCHF) Ecoregion as shown in Table 39. Cedar Lake, while also shallow, is not a natural lake, having had significant alterations made to its depth and watershed. For Cedar Lake, the SWMO has set the goal to achieve the Western Corn Belt Plains (WCBP) standard, also shown in Table 39, which they have determined to be a more reasonable goal. If that can be met without the lake becoming un-useable due to submerged aquatic plant growth, the SWMO will consider a more aggressive goal.

Table 39. Long Term Water Quality Goals for Natural Lakes (adapted from Scott WMO 2018).

Parameter	Ecoregion	
	North Central Hardwood Forest	Western Corn Belt Plains
Total Phosphorus (µg/L)	60	90
Chlorophyll-a (µg/L)	20	30
Secchi Disk Transparency (meters)	> 1	> 0.7

Rivers and Streams

The goal is to meet state water quality standards in Minn. R. ch. 7050. State agencies consider this watershed to be in the South River Nutrient Region for TSS and the Central River Nutrient Region for the other parameters. The MPCA has assessed Sand Creek streams for or against the Central River Nutrient Region for TP, DO, and *E. coli* parameters and the South River Nutrient Region for TSS. The goals for the Scott WMO are to achieve the South River Nutrient Region for all parameters (Table 40). The overall goal is that fish and macroinvertebrate IBIs will improve with other parameter improvements.

Table 40. Long Term Water Quality Goals for Stream Water Quality (adapted from Scott WMO 2018).

Parameter	Target/Goal
TSS	Less than 10% of observation between April 1 and September 30 exceeding 65 mg/L
Total phosphorus	Average concentration less than or equal to 150 µg/L
Dissolved oxygen	Daily minimum of 5 mg/L
E. coli	Not to exceed 126 org. per 100 ml as a geometric mean of not less than five samples representative of conditions within any calendar month or shall more than 10% of all samples taken during any calendar month individually exceed 1,260 org. per 100 ml. the standard applies between April 1 and October 31.

Milestones

The short-term goals for the SWMO are summarized in Table 41. Milestones, assessments, and goals will be found following each of the implementation practices section of each MA.

Table 41. Interim (2025) Water Quality Goals for the Sand Creek Watershed (adapted from Scott WMO 2018).

Situation	Interim Goal by 2025
Waters currently meeting state standards	Continue to meet standards
Impaired Waters with detailed study or TMDL complete	**Sand Creek at Jordan**—achieve 40% of the load reduction necessary to achieve the TSS equivalency concentration for meeting the turbidity standard based on the 2010 study. Estimated mass of this reduction is 300 Tons/day under high flows. **Cedar Lake**—100% of the watershed LA reduction for total phosphorus or 81lbs/year TP[1]
Impaired Waters without detailed study of TMDL	Create an improving trend for the parameters (total suspended solids, total phosphorus, water clarity, chlorophyll-a, *E. coli*) considered impaired.

[1] Achieved; however, practices have design life and adding is beneficial. Actual carp estimate was lower than assumed with the TMDL in 2010. Thinking internal may have been over estimated and it would not hurt to complete a few more LA practices.

6.2 Assessment of progress

Success in any plan or project requires assessment and milestones. Milestones and goals set forth in Section 7 will include two-year milestones to help measure the success and change the trajectory of the plan as needed. The milestones are identified to help watershed partners determine if their actions are helping to achieve goals or whether the entities need to adapt plans. The milestones are intended to support the adaptive management and iterative approach of the nine-element plan. They are not meant to evaluate the success or failure of the plan in its entirety for contractual obligations, but only to serve as guidance to improve the likelihood of achieving measurable water quality improvements. These should not be confused with contractual deliverables that will measure the successful completion of specific project work tied to a specific grant award.

The Scott WMO has developed metrics for most of its programs for the purposes of being accountable for its work and as a means of continuous improvement for learning and adapting quickly. “It has also developed several overall resource based metrics.” The metrics “are called Key Program Indicators (KPIs) and are generally of two types: 1) those that measure how much is being accomplished, and 2) those that reflect how effectively cumulative outcomes are being achieved. Table 42 presents both types of KPIs for the SWMO as a whole, as well as for specific programs.”

“The KPIs will be calculated annually (with the exception of stream water quality trends, and landowner survey responses). They will be used by the SWMO to learn how to improve and adapt, for annual budget decisions, as information for writing education and outreach stories, and reported in the Annual Report and Newsletter. Stream trends as discussed previously will be updated by the Metropolitan Council every 5 to 10 years. Water clarity as a percent of the state Secchi transparency standard for Cedar has also been selected by the County as one of its Community Indicators and will be reported to County residents and businesses annually in the County’s Public Report.

In addition to annual assessment of KPIs as discussed above, the SWMO will complete more detailed program assessments every two to three years. These assessments will compare progress made on the various strategies and programs, with what is listed and scheduled in the Plan.”

Table 42. Program Measures (adapted from Scott WMO Comprehensive Plan)

Program	How much are we doing?	How well are we doing?
Overall Resource Outcomes	• Lbs of TP reduced • Tons of Sediment reduced • Acre-feet of runoff reduced	• Runoff yield (Sand Creek) • Pollutant concentrations compared with applicable standards • % water clarity standard for Cedar and McMahon Lakes • Fraction of % load allocation reduction goals achieved* • Concentration trends for Sand Creek** • # of new AIS infestations
Administration	• Administrative cost	• % Administrative cost/entire SWMO annual budget

Education & Outreach	• # of events/workshops • # of participants • Number of articles • # of WPC meetings	• % surveyed responding "yes" as having personal responsibility*** • % surveyed responding they have adopted conservation***
Inventory & Assessment	• # of studies/assessments completed	• % of studies completed as scheduled
Land & Water Treatment	• Lbs of TP reduced • Tons of Sediment reduced • Acre-feet of runoff reduced • Acres of curly-leaf pondweed (selected waterbodies) • Number of types of landowner assistance requests • Number and types of practices approved/implemented	• $/lb of TP reduced • $/Ton of TSS reduced • $/acre-foot of runoff reduced • % area nuisance curly-leaf pondweed coverage (selected lakes)
Maintenance	• # of inspections • Cost of maintenance	• Design life of practices achieved without major re-investment/design life planned
Monitoring	• Completion of monitoring as scheduled	• Completion in accordance with QA/QC protocol of the SWMO

7. Management strategies and activities

The following sections provide additional information on each of the priority areas listed in Section 2.

Prioritized work in the FAs will have more implementation detail and will have more specific details. These critical areas have foundational work (specific loading areas, willing landowners, priorities set) that have allowed for a more granular approach. This work will continue to be done as more areas are identified as FAs in the future. Work in these Management Areas will be prioritized for areas with impaired waters and will target critical loading areas as the highest priority for implementation.

The adoption of the suggested BMPs and the CIPs will get these water bodies to water quality standards. This may not occur in the next 10 years; however, it is the intent to continue adoption and to adapt the management strategies to reach water quality standards.

7.1 Implementation Strategies applicable to all watersheds

As discussed in Section 2, there are several varying level of planning detail in this plan. The Sand Creek Watershed is a complex system. Implementation practices will address the MA needs as well as having additional benefits in downstream MAs. The selected FAs have been through extensive prioritization among the partners and the watershed residents/stakeholders. This process of drilling further into critical areas will continue through time in additional areas based on critical loading. In some of the MAs, there are general suites of BMPs to help achieve water quality that are appropriate to the impairment, land area, land use, and the residents.

Some management strategies that apply to the Sand Creek Watershed include activities that will be targeted to the headwater watersheds and to areas designated as rural residential expansion areas. These activities will have additional impact in management areas downstream of where they are implemented. These activities will be addressed as specific BMP activities, followed by specific MA implementation plans.

The characteristics of the Sand Creek Watershed, including pollutants, stressors, and land uses, overall lend themselves to be fixed through the implementation of general agricultural BMPs. Four critical areas have been identified, as described in Section 2, which have greater detail and specific practices developed.

The general suite of BMPs available for implementation are listed below. Goals and assessment criteria for the various reaches are found in each management area subsection (Sections 7.2.1 through 7.2.6). In addition to specific CIPs and focus areas priority practices, BMPs will also be implemented across the watershed based on landowner participation and willingness. New and innovative practices will be considered on an ad-hoc basis.

Table 43. Examples of BMPs for the Sand Creek Watershed with broad applicability

Practice
Cover Crops
Buffers
Bio-retention Basin
Contour Farming
Critical Area Planting
Diversion
Filter Strip

Grade Stabilization
Grassed waterways
Native Grasses
Shoreline Restoration/Stabilization
Nutrient Management
Prescribed Burning
Riparian Buffer
Terracing
Underground Outlet
Vegetative Treatment Area
Waste Storage Facility
WASCOB
Well Sealing
Wetland Restoration
Whole Farm Plan

7.1.1 Management practices

Soil health activities have been shown to decrease erosion and increase water storage on the land. Soil health practices include conservation tillage, erosion control, and cover crops/perennial vegetation. Local partners wish to maintain and build on this trend while there is momentum. Goals for improving soil health will include annual workshops, demonstration plots for cover crops. There are technical and financial assistance programs for cover crops. These practices while specifically implemented to control l pollutant loading to surface water, are also expected to address groundwater protection for nitrates. In 2023, the approach will be assessed for effectiveness and revised for improvement.

To accomplish the goals outlined in this plan, equipment is available for rent that allows producers to implement soil health practices (e.g., InterSeeders, no till drills). Some of these efforts are directed toward soil health, but many go beyond to address multiple water quality issues. Additionally, Rice County and Le Sueur SWCDs provides technical assistance and connects landowners with various cost share programs (state cost-share, EQIP, CRP, and AgBMP Loans). Le Sueur SWCD also has a special cost share for landowners in Sand Creek Watershed.

The Scott County WMO has created the Technical Assistance and Cost Share (TACS) Program that supports implementation of "on-the-ground" conservation projects that protect and improve water quality in rivers, lakes, streams and other valuable water resources in Scott County. All practices will follow the current Scott WMO Conservation Practice Eligibility and Payment Docket, found on the TACS Program web page. All NPS pollution BMPs approved by the TACS program, EQIP, CRP, state cost share, and AgBMP loans may be used as implementation practices.

SSTS replacement and upgrades will continue to be targeted through county programs to reduce *E. coli*.

Feedlot and NPDES (point source) permits will be managed and enforced by the MPCA. It is expected that the feedlots will continue to meet the feedlot program standards and not be a significant contributor of pollutants.

Comprehensive land use planning, including managing the transition from agriculture to rural residential, is conducted by the local governments. For the Sand Creek Watershed this involves growth in the urban areas around Jordan and New Prague and will follow Scott WMO standards which largely embrace NPDES requirements in the Construction Stormwater and MS4 General Permits. Unincorporated areas are also held to the same standards when developed. However, unincorporated area, when developed, will be at much lower rural residential development density. These rural residential areas are also prime areas for installing perennial vegetation since many rural residential landowners will no longer be cropping their land.

Citizen outreach is clearly a priority for this watershed and is described thoroughly in Section 1.

7.1.2 Chloride management

Addressing the issue of chloride impacts on the environment in Sand Creek is a long-term endeavor and it may take some time before water quality improvements are seen due to historical loadings, groundwater inputs, variable residence times, and other complicating factors. Therefore, continued monitoring of sand creeks lakes, wetlands, and streams for chloride is critical as well as the need to document changes in winter maintenance activities, wastewater source discharges, and water softener usage. Several stream reaches in the Sand Creek Watershed are listed as impaired for chloride, triggering the prioritization for action identified in the Twin Cities Metropolitan Area Chloride TMDL Report and Management Plan. The density of roads in the Sand Creek also exceed the greater than 18% to trigger prioritization.

Scott County and the city of Jordan have adopted best practices deicing programs (e.g., Smart Salting). The WMO has conducted deicing certification training in 2018 and 2019. It will continue and expand the education and outreach moving forward. The goals include expanding deicing training to the cities of New Prague and Montgomery.

The Scott WMO has started programs to educate the citizens to the benefit of upgrading water softeners and to adopt smart salting practices. Over the next few years local partners also wish to ramp up efforts addressing the chloride impairments. Chloride wastewater effluent permit limits will be issued and enforced by the MPCA. Decreasing salt usage protects both surface and groundwater.

7.1.3 Mercury management

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 1% 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 in section 4 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.

7.1.4. In-lake treatments

Internal loading to the shallow lakes in the watershed will be addressed with individualized treatment options. The treatments include alum treatments, managing carp populations, and controlling aquatic invasive plant species. Alum treatments are very individualized to the specific lake conditions and typically provide quickly observable phosphorus reductions from sediment release in the short term. Because of the unique nature of alum treatments, a feasibility study will need to be conducted for each water body treated and will include specific number of treatments, areas, costs, and expected phosphorus reductions. Alum treatments may be considered for several of the waterbodies at a later time and the plan will be updated accordingly to reflect this new information.

High carp densities have been associated with significant phosphorus release due to high bioturbation of sediment by carp. Phosphorus reduction associated with carp management depend on many factors; however, population density of less than 100 kg/ha have been identified as a threshold for healthy shallow lake ecosystems. In the case of Cedar Lake, carp control as the added benefit of social engagement through the lake association's annual Karp Kabob Festival.

Controlling aquatic invasive plant species, especially curly leaf pondweed, has been demonstrated to improve Secchi disk clarity significantly. Control has been identified as a means of reducing the internal load by preventing the associated loading with the mid-June dieback (James et al. 2007). 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. Curly leaf pondweed control occurs annually.

7.2 MA-specific implementation practices

To focus implementation efforts in the Sand Creek Watershed, priority Management Areas were identified and are the focus of the management strategies and activities that are outlined in this section.

7.2.1 MA1/FA1 Picha Creek implementation plans

Picha Creek (-579 and -580) is a tributary to the lower reach of Sand Creek (-513), which has a biological impairment and the identified stressor is TSS.

In the *Comprehensive Water Resources Management Plan, 2019–2026* (SWMO 2018), the Capital Improvement Plan identifies one capital project that is planned to reduce sediment loading to Picha Creek and Sand Creek—the Lower Picha Creek Ravine Stabilization (Table 44).

Table 44. Planned capital project for Picha Creek

Project	Description	Cost Estimate	Estimated implementation date
Lower Picha Creek Ravine Stabilization	Priority stabilization project identified as part of the Sand Creek Near Channel Sediment Reduction Feasibility Study. Next steps include concept design and landowner outreach. Project will reduce sediment loading to the creek.	$450,000	Feasibility Study Completed by 2023. Implementation schedule dependent on findings of the Feasibility Study and available funding

The Subwatershed Analysis for Picha Creek describes the analyses completed to identify potential locations and BMPs in the Picha Creek Watershed to reduce phosphorus loading to the stream (Scott SWCD 2014). Because phosphorus travels adsorbed to sediment, projects that reduce phosphorus loading typically will also reduce sediment loading. The methods and analyses used in the subwatershed analysis provide a means to rapidly assess subwatersheds for the identification and location of BMPs most appropriate and feasible based on the identified critical areas. The proposed projects are listed in Table 45, and the subcatchments identified are shown in Figure 29. Final cost and pollutant removal estimates need to be developed as projects are selected for implementation.

Table 45. Summary of potential BMP projects with cost benefit, ranking, and estimated phosphorus reductions for Picha Creek (adapted from Scott SWCD 2014)

Rank	Feasibility Code *	BMP	Subcatchment	Quantity	Units	Reduction (lbs./yr.)	Estimated Project Cost	Cost/lb./Yr.
1	C	Grassed Waterway	2	1,680	Ln Ft	117.6	$ 8,400	$ 7
2	C	Grassed Waterway	5-West	1,290	Ln Ft	76.3	$ 6,450	$ 8
3	C	Grassed Waterway	4	1,750	Ln Ft	95	$ 8,750	$ 9
4	C	Rock Tile Inlet	5-West	1	Each	5.5	$ 550	$ 10
5	C	Grassed Waterway	5-East	1,140	Ln Ft	52.4	$ 5,700	$ 11
6	C	Grassed Waterway	1	375	Ln Ft	15.9	$ 1,875	$ 12
7	C	Grassed Waterway	7	1,050	Ln Ft	42.1	$ 5,250	$ 12
8	C	Grassed Waterway	8	1,600	Ln Ft	61	$ 8,000	$ 13
9	C	Filter Strip	4	1	Acres	13.7	$ 2,400	$ 18
10	A,B	Terrace	5-West	1,650	Ln Ft	85.9	$ 16,500	$ 19
11	C	Rock Tile Inlet	8	2	Each	5.1	$ 1,100	$ 21
12	B	Filter Strip	6	5.9	Acres	66	$ 14,200	$ 22
13	A,B	Terrace	2	1,950	Ln Ft	85.6	$ 19,500	$ 23
14	C	WASCOB ***	1	2	Each	44.5	$ 10,600	$ 24
15	A,B	Filter Strip	8	3.7	Acres	33.9	$ 8,900	$ 26
16	B	Filter Strip	10	3.3	Acres	29.1	$ 7,900	$ 27

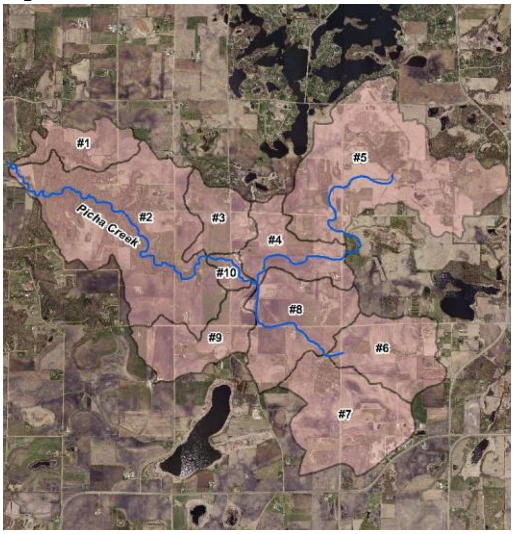
Rank	Feasibility Code *	BMP	Subcatchment	Quantity	Units	Reduction (lbs./yr.)	Estimated Project Cost	Cost/lb./Yr.
17	B	Filter Strip	5-West	5.7	Acres	48.8	$ 13,700	$ 28
18	A	Terrace	9	1,300	Ln Ft	46.9	$ 13,000	$ 28
19	C	Grassed Waterway	6	800	Ln Ft	13.6	$ 4,000	$ 29
20	C	Filter Strip	9	2.5	Acres	19	$ 6,000	$ 32
21	C	Grassed Waterway	9	890	Ln Ft	37	$ 4,450	$ 34
22	B	WASCOB	8	3	Each	39.5	$ 15,900	$ 40
23	C	Filter Strip	5-East	2.8	Acres	13.8	$ 6,700	$ 49
24	A	Terrace	7	2,300	Ln Ft	36.7	$ 23,000	$ 63
25	B	WASCOB	5-West	4	Each	30	$ 21,200	$ 71
26	B	WASCOB	4	1	Each	6.9	$ 5,300	$ 77
27	C	Rock Tile Inlet	4	2	Each	1.3	$ 1,100	$ 85
28	A	Wetland Restoration	3	5.3	Acres	20.6	$ 29,150	$ 94
29	C	WASCOB	5-East	4	Each	22.2	$ 21,200	$ 95
30	C	WASCOB	7	5	Each	20.3	$ 26,500	$ 130
31	A	Wetland Restoration	5-West	8.3	Acres	22.8	$ 45,650	$ 133
32	C	Rock Tile Inlet	9	3	Each	1	$ 1,650	$ 165
33 Alt-1**	A C	Wetland Restoration Rock Tile Inlet	7 7	14.8 1	Acres Each	30.2 6.2	$ 81,400 $ 550	$ 180 $9
34	A	Native Grass	5-West	1.7	Acres	1.5	$ 3,200	$ 213
35 Alt-1**	A C	Wetland Restoration Rock Tile Inlet	6 6	11.6 1	Acres Each	17.8 2.1	$ 63,800 $ 550	$ 239 $ 21
36	B	Filter Strip	7	4.8	Acres	2.2	$ 11,500	$ 524

* Feasibility Codes: A – Low likelihood of landowner acceptance due to inconsistency of the practice with current cultural or operational practices, and or perceived low cost/benefit ratio; B – Low likelihood of landowner acceptance due to loss of agricultural production, land value or other land-use concerns; and C – Good to high likelihood of landowner acceptance, particularly with substantial cost share availability.

** Alt-1: Multiple alternatives are possible

*** WASCOB – Water and sediment control basin

Figure 29. Subcatchments in the Picha Creek Watershed (from Scott SWCD 2014)



The Minnesota River Sediment Reduction Study recommends that 75% of the row cropland use adopt the use of cover crops.

Additionally, SWMO anticipates a regional stormwater assessment of Campbell Lake (SWMO 2018). Campbell Lake is in the Picha Creek headwaters region and the area is anticipated to be annexed by the City of Prior Lake. The study will be completed in 2020 and will assess potential development issues and identify opportunities for regional stormwater management.

Estimated reductions from these planned implementation activities will result in meeting the goals for fish and macroinvertebrate health. Additional BMPS will include those described in Table 43.

Assessments, milestones, and goals for MA1/FA1

The long-term goal for Picha Creek is to develop and maintain a healthy stream community of macroinvertebrate and fish numbers and species and to complete 30% of practices identified. These will be measured by the number of practices completed, the MPCA 10-year cycle of monitoring, including MIBI and FIBI in 2024, and synoptic monitoring of Picha Creek in 2020 and 2025. Milestones for this plan are developed on a biennial basis for eight years to allow for reassessment. Costs for this series of implementation activities, including estimated materials, incentive payments, staff, education, and technical assistance is approximately $11,200,000.

Table 46. MA1/FA1 Picha Creek assessments, milestones, and goals (-579 and -580)

Impairment	Pending	Milestones				Long-Term Goals	Assessment
	(2021)	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)		
MIBI (-579) and FIBI (-579 and -580)	CIP Lower Picha Creek Ravine Stabilization	Complete feasibility study concept design and landowner outreach			Install practices on another 5% (bringing total to 30%)	Complete project	Project fully completed
	Remove migration barrier at Hwy 169						
	Complete assessment of upper (Campbell Lake) watershed	Contact 100% of landowners with identified potential practices per 2014 SWA, and 50% of those from 2020 assessment	Encumber contracts with an additional 5 to 10% of land owners/ practices	Encumber contracts with an additional 5% of land owners/ practices		Complete 30% of practices identified	Number of practices completed
		Encumber applications for 15% of landowners contacted	Complete 100% of landowner contacts from 2020 upper watershed assessment	Install practices on another 5% (bringing total to 25%)			MPCA 10-year cycle of monitoring including MIBI and FIBI in 2024
			Install 20% of practices identified	Reevaluate list of practices from SWA and Campbell Lake assessments			Synoptic monitoring of Picha Creek in 2020 and 2025

7.2.2 MA2 – Middle Sand Creek Management Area Implementation plans

The Sand Creek near channel sediment reduction: feasibility report by Inter-Fluve (2015) identified potential bluff and ravine restoration areas using a desktop geomorphic investigation for the Middle Sand Creek and Picha Creek Watersheds. Conceptual treatments were presented for six sites prioritized for potential pilot projects.

The Scott County WMO identified several CIPs to be conducted in MA2 (Table 47). The Middle Sand Creek is impaired for TSS, nutrients, and chloride. In addition to the CIPs planned, BMPs to reduce sediment loading will be implemented. Additional BMPS will include those described in Table 43. Priorities for Rice County are described in Table 56.

Table 47. Capital improvement projects planned for MA2

Management areas	Project	Planned or Potential	Description	Cost Estimate	Estimated dates
MA2	Helen-Broadway Near Channel Sediment Control	Planned	One of a number of near channel capital projects identified for being completed as part of the current joint Targeted Watershed and USEPA 319 project. Scheduled for construction in 2019. Included here as a contingency in case weather or other factors delay construction. Project will reduce sediment loading.	$600,000 Some grant funding available from EPA Section 319 grant, and potentially from the Sand Creek targeting grant	Feasibility 2018 Design 2018/2019 Construction TBD - waiting for landowner interest
MA2	Middle Sand Creek Near Channel Stabilization	Planned	Series of excessively eroding streambanks along Sand Creek in Helena Twp Sect 3. Landowner is interested and design has started.		Scheduled for construction fall of 2019. Included here in case of delay in construction.

Table 48. MA2 and MA3 Implementation strategies from the Rice County Water Plan

Goal/task	Responsible and Participating Agencies	Timeline	Cost estimate	Status
Promote and market wetland preservation and restoration programs such as CRP, WRP, RIM and BWSR Wetland Banks each year. (High Priority)	SWCD, NRCS, FSA, BWSR, Landowners	2014-2019	$1,500	Annual
Promote and implement agricultural BMPs in the Sand Creek Watershed such as: water and sediment basins, grade	SWCD, NRCS, FSA, BWSR, Landowner	2014-2019	$20,000	Annual

control, grassed waterways, conservation tillage, nutrient management, wetland restoration, alternative tile intakes, terraces, critical area planting, diversions (High Priority)				

This area will require a suite of BMPs to help address nutrient, TSS, and chloride impairments. Chloride efforts are discussed in Section 7.1.3. This area will also be addressed through soil health efforts discussed in Section 7.1.1. These practices are included in Table 48, but will not be limited to those practices. Any BMP that addresses chloride, TSS, or nutrients will be suitable for this area. Prioritization of implementation will be based on the critical loading areas of the Management Area as identified in Section 5. The goal for these waters is to reach water quality standards through the adoption of these practices.

Sediment and flow will also be affected by the practices discussed in the soil health Section 7.1.1 that are to be employed in MA3, MA5, and MA6.

Assessments, milestones, and goals for MA2 Middle Sand Creek stream reaches (-538, -840)

For the Middle Sand Creek reach -538, the goal is to meet water quality standards for TSS, chloride, and to create conditions to support a healthy stream community for fish numbers and species. As the long-term goal and is assessed by whether the waterbody meets water quality standards. Table 49 includes the individual assessments. Costs for this series of implementation activities, including estimated materials, incentive payments, staff, education, and technical assistance is approximately $3,400,000.

Table 49. MA2 Middle Sand Creek assessments, milestones, and goals (-538)

Impairment		Milestones				Long-Term Goals	Assessment
	Pending (2021)	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)		
TSS	Complete Near Channel Stabilization CIP on Sand Creek					Meet TSS Standard	Assess TSS trends using Sand Creek at Jordan data from Met Council every 5 years (next assessment in 2023)
	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs		Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance		Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
	Complete waiting lists BMPS						Annual tracking of metric for cost-efficiency of BMPs approved for cost/ton TSS
	Implement additional BMPs per WMO Sediment Strategy	Focus on upstream reaches and Picha Creek for new BMPs	Focus on upstream reaches and Picha Creek for new BMPs	Focus on upstream reaches and Picha Creek for new BMPs	Focus on upstream reaches and Picha Creek for new BMPs		3-year cyclic assessment of buffer compliance by Scott SWCD
	Continue promoting Soil Health	Continue promoting Soil Health	Continue promoting Soil Health	Continue promoting Soil Health	Continue promoting Soil Health		Annual tracking of equipment rental usage
	Host annual Cover Crop Workshops	Host annual Cover Crop Workshops	Host annual Cover Crop Workshops	Host annual Cover Crop Workshops	Host annual Cover Crop Workshops		

Impairment		Milestones				Long-Term Goals	Assessment
	Pending (2021)	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)		
	Continue support to Soil Health Team	Continue support to Soil Health Team	Continue support to Soil Health Team	Continue support to Soil Health Team	Continue support to Soil Health Team		
	Continue cover crop demonstration plots an strips	Continue cover crop demonstration plots an strips	Continue cover crop demonstration plots an strips	Continue cover crop demonstration plots an strips	Continue cover crop demonstration plots an strips		
	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program		
FIBI	Continue to implement practices addressing identified stressors (TSS, and chloride)	See milestones for TSS and chloride	See milestones for TSS and chloride	See milestones for TSS and chloride	See milestones for TSS and chloride	Meet Standard	See TSS and chloride
	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance		
Chloride	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach by Scott Co, and one other upstream city (New Prague or Montgomery)	Continue best practices approach by Scott Co, and one other upstream city (New Prague or Montgomery)	Meet Standard	On-going monitoring of chlorides by Met Council at Jordan station
	Host applicator trainings in 2019	Continue outreach efforts	Start best practices approach at one other upstream City (New Prague or Montgomery)	Continue outreach efforts	Start best practices approach at last upstream city		Synoptic monitoring by Scott SWCD/WMO in 2022

Impairment		Milestones				Long-Term Goals	Assessment
	Pending (2021)	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)		
	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**		Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
							Data trend analysis in 2025

For the Middle Sand Creek reach -840, the goal is to meet water quality standards for TSS, nutrient/eutrophication, chloride, and to create conditions to support a healthy stream community for fish numbers and species. As the long-term goal and is assessed by whether the waterbody meets water quality standards. Table 50 includes the individual assessments.

Table 50. MA2 Middle Sand Creek assessments, milestones, and goals (-840)

Impairment		**Milestones**				**Long-Term Goals**	**Assessment**
	Pending (2021)	**2-year (2023)**	**4-year (2025)**	**6-year (2027)**	**8-year (2029)**		
Meet WQS for TSS	Compliance with MN Buffer Rule	100% compliance with MN Buffer Rule	100% compliance with MN Buffer Rule	100% compliance with MN Buffer Rule	100% compliance with MN Buffer Rule	Meet Standard	Assess TSS trends using Sand Creek at Jordan data from Met Council every 5 years (next assessment in 2023)

Impairment		Milestones					
	Pending (2021)	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
	Complete waiting lists BMPS				Initiate and complete Subwatershed Assessment (SWA) identifying priority potential practices		Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
	Continue promoting Soil Health	Continue promoting Soil Health	Reassess approach to Soil Health	Implement revised approach to Soil Health	Implement revised approach to Soil Health		Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
	Host annual Cover Crop Workshops	Host annual Cover Crop Workshops					Annual tracking of metric for cost-efficiency of BMPs approved for cost/ton TSS
	Continue support to Soil Health Team	Continue support to Soil Health Team					3-year cyclic assessment of buffer compliance by Scott SWCD
	Continue cover crop demonstration plots an strips	Continue cover crop demonstration plots an strips					Annual tracking of equipment rental usage
	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program		

Impairment		Milestones				Long-Term Goals	Assessment
	Pending (2021)	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)		
	Promote Surface tillage system practices (cover crops, conservation tillage, and alternative tile intakes)	Promote Surface tillage system practices (cover crops, conservation tillage, and alternative tile intakes)	Promote Surface tillage system practices (cover crops, conservation tillage, and alternative tile intakes)	Promote Surface tillage system practices (cover crops, conservation tillage, and alternative tile intakes)	Promote Surface tillage system practices (cover crops, conservation tillage, and alternative tile intakes)		
	Promote runoff reduction practices	Promote runoff reduction practices	Promote runoff reduction practices	Promote runoff reduction practices	Promote runoff reduction practices		
		Focus on upstream reach for other targeted BMPS	Focus on upstream reach for other targeted BMPS				
			Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program		
Meet the WQSs for Nutrient / Eutrophication	Same as TSS above	Same as TSS above	Same as TSS above	Same as TSS above	Same as TSS above	Meet Standard	See metrics for TSS, but apply to TP

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
Chloride	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach by Scott Co, and one other upstream city (New Prague or Montgomery)	Continue best practices approach by Scott Co, and one other upstream city (New Prague or Montgomery)	Meet Standard	On-going monitoring of chlorides by Met Council at Jordan station
	Host applicator trainings in 2019	Continue outreach efforts	Start best practices approach at one other upstream City (New Prague or Montgomery)	Continue outreach efforts	Start best practices approach at last upstream city		Synoptic monitoring by Scott SWCD/WMO in 2022
	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**		Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
							Data trend analysis in 2025
MIBI and FIBI: healthy stream community for macro invertebrate and fish numbers and species	Continue to implement practices addressing identified stressors (TSS, TP and chloride)	See TSS, nutrients and chlorides above	See TSS, nutrients and chlorides above	See TSS, nutrients and chlorides above	See TSS, nutrients and chlorides above	Meet Standards	MPCA 10-year cycle monitoring including MIBI and FIBI in 2024
	Compliance with MN Buffer Rule	100% compliance with MN Buffer Rule	100% compliance with MN Buffer Rule	100% compliance with MN Buffer Rule	100% compliance with MN Buffer Rule		Reassess progress and stressors in 2025

7.2.2.1 FA2 Cedar Lake (70-0091-00)

The phosphorus load reduction goals for Cedar Lake are to reduce non-point phosphorus watershed loading by 81 lb/yr and to reduce internal phosphorus loading by 5,196 lb/yr phosphorus. Given the additional work that has been completed and new information, the Scott WMO plans to update the Cedar Lake TMDL in 2025. This implementation plan will get Cedar Lake to water quality standards; although, it may take longer than ten years.

The SWMO has prioritized the following CIPs for Cedar Lake.

Table 51. Planned capital projects for Cedar Lake

Project	Description	Cost Estimate
Cedar Lake Wetland Restoration/Wet Detention Basin	Larger project identified in the Subwatershed Assessment of the Cedar Lake Watershed. Landowner contact has been made, may be interested in the future. Schedule unknown. Project will reduce phosphorus loading to the lake.	$66,000 to $100,000
Cedar Lake Alum Treatment	Timing of the treatment is based on adaptive management linked to the success of other efforts. Project will reduce internal phosphorus cycling.	$1,100,000 for two treatments (will only be completed with significant grant support)

Other actions to be taken include administration, education, and outreach; technical assistance by the Rice and Scott SWCDs; and water quality monitoring. The 10-year CIP cost for implementation of the Cedar Lake activities was estimated to range between $1,390,000 and $2,430,000.

A SWA for Cedar Lake was completed to identify potential locations and BMPs to reduce phosphorus loading. The proposed projects are listed in Table 52, and the critical loading subcatchments identified in the table are shown in Figure 30. The SWA (Scott SWCD 2013) provides descriptions, BMP recommendations, and BMP cost benefit analyses for each sub catchment. Final cost and pollutant removal estimates for internal loading practices will be developed as projects are selected for implementation.

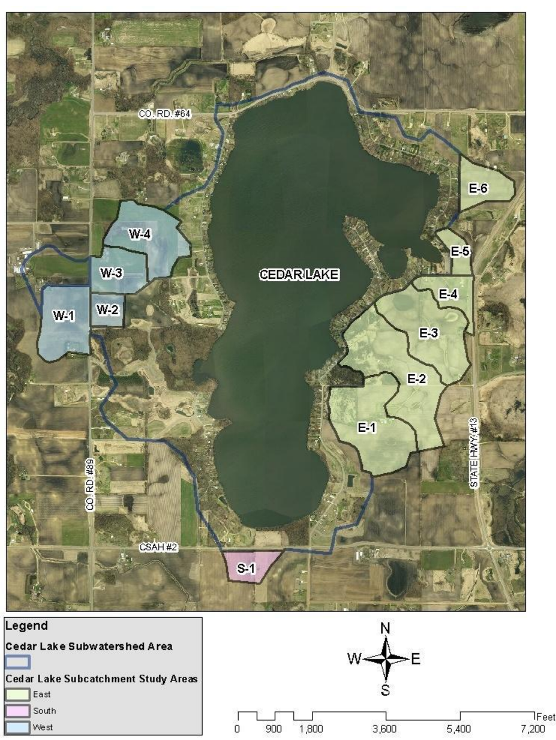
Table 52. Summary of potential BMP projects with cost benefit and ranking for Cedar Lake (adapted from Scott SWCD 2013)

Rank	Feasibility Code *	BMP	Subcatchment	Quantity	Units	Phosphorus Reduction (lbs./yr.)	Estimated Project Cost	Cost/lb./Yr.
1	A	Conservation Tillage	S-1	13.8	Acres	5.4	$ 0	$ 0
2	A	Conservation Tillage	W-4	9.3	Acres	3.9	$ 0	$ 0
3	A	Conservation Tillage	W-1	14.6	Acres	7.7	$ 0	$ 0
4	C	Rock Tile Inlet	W-1	1	Each	16.2	$ 550	$ 3
5	C	Rock Tile Inlet	S-1	1	Each	10.3	$ 550	$ 5
6	C	Rock Tile Inlet	E-1	1	Each	6.2	$ 550	$ 9
7	C	Grassed Waterway	W-1	900	Ln Ft	25.5	$ 4,500	$ 18
8	C	Rock Tile Inlet	W-2, W-3, W-4	3	Each	5.6	$ 1,650	$ 29
9	C	Grassed Waterway	E-2	670	Ln Ft	11.3	$ 3,350	$ 30

Rank	Feasibility Code *	BMP	Subcatchment	Quantity	Units	Phosphorus Reduction (lbs./yr.)	Estimated Project Cost	Cost/lb./Yr.
10	C	Grassed Waterway	E-5	575	Ln Ft	9.4	$ 2,875	$ 31
11	C	Wet Detention Basin	E-2	1	Each	31.6	$ 16,500	$ 35
12	C	Filter Strip	E-4	2.5	Acres	13.6	$ 6,400	$ 47
13	A	Terrace	E-6	1450	Ln Ft	28.7	$ 14,500	$ 50
14	C	Grassed Waterway	E-1	1250	Ln Ft	10.5	$ 6,250	$ 60
15	C	Grassed Waterway	S-1	540	Ln Ft	3.7	$ 2,700	$ 73
16	A,B	Wetland Restoration/ Wet Detention Basin	E-3	9	Acres	37	$ 42,500	$ 77
17	A,B	Native Grass	S-1	15.5	Acres	37.1	$ 28,800	$ 78
18	C	Grassed Waterway	E-4	550	Ln Ft	3.3	$ 2,750	$ 83
19	A	Grassed Waterway	E-3	950	Ln Ft	5.4	$ 4,750	$ 88
20	C	Wet Detention Basin	E-1	1	Each	6.2	$ 10,900	$ 117
21	A,B	Native Grass	E-5	13	Acres	16.7	$ 24,200	$ 145

* Feasibility Codes: A – Low likelihood of landowner acceptance due to inconsistency of the practice with current cultural or operational practices, and or perceived low cost/benefit ratio; B – Low likelihood of landowner acceptance due to loss of agricultural production, land value or other land-use concerns; and C – Good to high likelihood of landowner acceptance, particularly with substantial cost share availability.

Figure 30. Priority subcatchments in the Cedar Lake Watershed (from Scott SWCD 2013)



Planned watershed load reduction activities

The activities outlined in the subwatershed analysis have a potential phosphorus load reduction of 338 lb/yr. Practices will be implemented as opportunities arise to achieve the watershed load reduction goal of 81 lb/yr. SWMO plans on achieving 100% of the watershed load reductions, or 81 lb/yr phosphorus, by 2025, as presented in the SWMO's Comprehensive Water Resources Management Plan (SWMO 2018).

Planned internal load reduction activities

The Capital Improvement Plan identifies an alum treatment in Cedar Lake to reduce internal loading (Table 51).

The results of a carp study on Cedar Lake (Carp Solutions 2017) indicated that the biomass of carp in the lake would likely remain relatively stable at about 80 kg/ha if carp were not further managed. Carp biomass would decrease to 50 and 30 kg/ha in five and ten years, respectively, if 10% of the population was removed annually. Removal of carp could be done in various ways, but the report recommended open water seining as the main strategy. The report did not provide cost estimates or estimates of the expected phosphorus reductions. The carp density found in the 2017 study was much lower than that assumed in the original phosphorus load modeling completed for the TMDL. The planned update for the TMDL is 2025.

The SWMO is not planning major investments to further reduce carp densities in the lake, but will continue to work with the Cedar Lake Improvement District with on-going modest efforts to maintain densities below the desired threshold, such as the annual Carp Kabob Festival. SWMO also commits to updating the Cedar Lake water quality modeling to reflect the recent findings on phosphorus loading from carp (Carp Solutions 2017).

SWMO offers cost share funding to local associations or improvement districts for lakes such as Cedar Lake for which curly-leaf pondweed is identified as a major implementation program element in a TMDL study. Cost share funding can be used for completion and implementation of whole lake aquatic plant management plans or sustainable lake management plans. The CLID has a current lake management plan/permit to apply amounts of herbicide that exceed regulated amounts to address the high curly-leaf pondweed that has been approved by the DNR.

As an interim goal, the SWMO commits to achieving all of the load reductions needed to meet the Cedar Lake TMDL (SWMO 2018), which include reductions in phosphorus loading from non-point watershed sources and from internal sources. The SWMO believes that additional improvements to Cedar Lake water quality beyond those prescribed in the TMDL are reasonable.

Additional BMPS will include those described in Table 43.

Assessments, milestones, and goals for MA2 Middle Sand Creek FA2 Cedar Lake

The overall goal for Cedar Lake is to meet WQS for shallow lake, which specifically needs an 81 lbs/yr reduction in external NPS phosphorus watershed loading. The aquatic recreation impairment requires a 5,196 lbs/yr of internal loading reduction. Costs for this series of implementation activities, including estimated materials, incentive payments, staff, education, and technical assistance is approximately $2,900,000.

Table 53. Middle Sand Creek assessments, milestones, and goals for Cedar Lake

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
External phosphorus		Re-contact landowners with potential practices per the Cedar Lake SWA MA2/FA2	Maintain existing BMPs	Maintain existing BMPs	Maintain existing BMPs	Meet WCBP Standards for Shallow Lake	
		Maintain existing BMPs	Replace BMPs with new BMPs if lost	Replace BMPs with new BMPs if lost	Replace BMPs with new BMPs if lost		Annual CAMP Program monitoring
		Complete 1 to 2 additional BMPs as safety factor in MA2/FA2					
Internal phosphorus	Continue curly-leaf pondweed mgmt	Continue curly-leaf pondweed mgmt	Continue curly-leaf pondweed mgmt	Continue curly-leaf pondweed mgmt	Continue curly-leaf pondweed mgmt	Meet WCBP Standards for Shallow Lake	
						Reduce acreage o curly-leaf needing treatment with time	
	Continue effort to keep carp biomass low	Continue effort to keep carp biomass low	Continue effort to keep carp biomass low	Continue effort to keep carp biomass low	Continue effort to keep carp biomass low	Maintain carp biomass below 100lbs/ac	Annual CAMP Program monitoring
	Carp Kabob Festival	Carp Kabob Festival	Carp Kabob Festival	Carp Kabob Festival	Carp Kabob Festival		Update TMDL in 2025 due to LA being met, curly-leaf pondweed control efforts, and low carp biomass

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
	Opportunistic carp seining	Opportunistic carp seining	Opportunistic carp seining	Opportunistic carp seining	Opportunistic carp seining		
			Update TMDL and Implementation Plan	Implement updated TMDL and Implementation Plan	Implement updated TMDL and Implementation Plan		

7.2.3 MA3 – Upper Sand Creek implementation plans

The Scott County WMO identified several CIPs to be conducted in the Upper Sand Creek in MA3 (Table 54). The Upper Sand Creek Watershed is impaired for TSS, nutrients, and chloride. There is an area-wide promotion of cropland soil and nutrient loss reduction practices (e.g., conservation, tillage, cover crops, nutrient management and alternative tile intakes per the TACS program docket. Table 55 and Table 56 identify Le Sueur and Rice County's identified priorities. Subwatershed assessments will be completed in MA3 in 2019/2020 for Cody/Phelps Lakes and Sanborn Lake to identify specific practices in critical areas to be targeted. After targeting and implementing these, a SWA for Lake Pepin is to be completed in 2029. The adoption of these practices will get the water bodies to water quality standards.

Table 54. SWMO CIP projects planned for MA3

Management areas	Project	Planned or Potential	Description	Cost Estimate	Estimated dates
MA3/MA6	Hwy 19 Sand Creek Near Channel Stabilization	Potential	Severely eroding bank identified on Sand Creek in Le Sueur County just south crossing with Hwy 19. Landowner is interested. Need to identify funding sources for design and construction. Project will help reduce sediment loading to the creek.	Construction cost $400,000	Feasibility Study completed by 2025. Implementation schedule dependent on findings of Feasibility Study and available funding
MA3	Upper Sand (Haycraft) Wetland Restoration	Potential	Potential 12-acre wetland restoration with landowner interest identified in early 2019.	Incentive and construction $75,000	Feasibility Study completed by 2025. Implementation schedule dependent on findings of Feasibility Study and available funding

Table 55. MA3 and MA6 implementation priorities from the Le Sueur County Water Plan

Implementation strategies	Responsible and Participating Agencies	Timeline	Cost estimate	Status
Incorporate TMDL and WRAPS implementation actions into local plans	Environmental Services, lake associations, SWCD, agricultural organizations	2016-2021	$2,000	When the reports are complete / approved
Implement TMDL plans	MPCA, ES, LA, SWCD, Ag Orgs	2016-2021	$600,000	Ongoing
Work with Met Council, Scott, and Rice counties on a Sand Creek Watershed implementation project	ES, SWCD, NRCS, FSA, Friends of MN Valley,	2016-2021	$10,000	Ongoing

Table 56. MA2 and MA3 implementation priorities from the Rice County Water Plan

Goal/task	Responsible and Participating Agencies	Timeline	Cost estimate	Status
Promote and market wetland preservation and restoration programs such as CRP, WRP, RIM and BWSR Wetland Banks each year. (High Priority)	SWCD, NRCS, FSA, BWSR, Landowners	2014-2019	$1,500	Annual
Promote and implement agricultural BMPs in the Sand Creek Watershed such as: water and sediment basins, grade control, grassed waterways, conservation tillage, nutrient management, wetland restoration, alternative tile intakes, terraces, critical area planting, diversions (High Priority)	SWCD, NRCS, FSA, BWSR, Landowner	2014-2019	$20,000	Annual

This area will require a suite of BMPs to help address nutrient, TSS, and chloride impairments. Chloride efforts are discussed in Section 7.1.3. This area will also be addressed through soil health efforts discussed in Section 7.1.1. These practices are included in Table 48, but will not be limited to those practices. Any BMP that addresses chloride, TSS, or nutrients will be suitable for this area. The goal for these waters is to reach water quality standards. Additional BMPS will include those described in Table 43.

Assessments, milestones, and goals for MA 3 stream reach -839

The long-term goals for stream -839 will include meeting WQS for TSS, nutrient/eutrophication, chloride, and to achieve healthy stream community for fish numbers and species for an aquatic life impairment. Table 52 describes these goals, milestones, and assessment measures. Costs for this series of implementation activities, including estimated materials, incentive payments, staff, education, and technical assistance is approximately $2,200,000.

Table 57. Upper Middle Sand Creek assessments, milestones, and goals (-839)

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
TSS	Compliance with MN Buffer Rule	100% compliance with MN Buffer Rule	100% compliance with MN Buffer Rule	100% compliance with MN Buffer Rule	100% compliance with MN Buffer Rule	Meet Standard	Assess TSS trends using Sand Creek at Jordan data from Met Council every 5 years (next assessment in 2023)
	Complete SWA for Cody/Phelps Lk, and Sanborn Lake Watersheds identifying and prioritizing potential practices	Contact 50% of landowners with priority BMPs identified in the SWAs	Contact 100% of landowners with priority BMPs identified in the SWAs	Encumber contracts with landowners for additional 5% of practices identified	Implement additional 10% of practices identified in SWAs		Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
		Encumber contracts with landowners for 10% of practices identified	Encumber contracts with landowners for additional 10% of practices identified	Implement 20% of practices identified	Complete a SWA for an additional subwatershed (Lake Pepin) identifying and prioritizing potential practices		Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
		Implement 5% of practices identified	Implement 15% of practices identified	Reevaluate lists of practices from existing SWAs, and re-contact landowners with priority practices	Implement revised approach to soil health		Annual tracking of metric for cost-efficiency of BMPs approved for cost/ton TSS

Impairment	Pending	Milestones				Long-Term Goals	Assessment
	(2021)	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)		
	Continue promoting Soil Health	Continue promoting Soil Health	Reassess approach to Soil Health	Implement revised approach to Soil Health			3-year cyclic assessment of buffer compliance by Scott SWCD
	Host annual Cover Crop Workshops	Host annual Cover Crop Workshops					Annual tracking of equipment rental usage
	Continue support to Soil Health Teams	Continue support to Soil Health Teams					
	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program		
Nutrients/Eutrophication	Same as TSS above for reach -839	Same as TSS above for reach -840	Same as TSS above for reach -841	Same as TSS above for reach -842	Same as TSS above for reach -843	Meet Standards	Assess TSS trends using Sand Creek at Jordan data from Met Council every 5 years (next assessment in 2023)
							Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
							Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
							Annual tracking of metric for cost-efficiency of BMPs approved for cost/ton TSS
							3-year cyclic assessment of buffer compliance by Scott SWCD

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
							Annual tracking of equipment rental usage
Chloride	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach by Scott Co, and one other upstream city (New Prague or Montgomery)	Continue best practices approach by Scott Co, and one other upstream city (New Prague or Montgomery)	Meet Standard	On-going monitoring of chlorides by Met Council at Jordan station
	Host applicator trainings in 2019	Continue outreach efforts	Start best practices approach at one other upstream City (New Prague or Montgomery)	Continue outreach efforts	Start best practices approach at last upstream city		Synoptic monitoring by Scott SWCD/WMO in 2022
	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**		Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
							Data trend analysis in 2025
FIBI	Continue to implement practices addressing identified stressors (TSS, and chloride)	See milestones for TSS and chloride	See milestones for TSS and chloride	See milestones for TSS and chloride	See milestones for TSS and chloride	Meet Standard	See TSS and chloride
	Compliance with MN Buffer Rule						

7.2.3.1 FA3 Cody and Phelps

Cody Lake and Phelps Lake are impaired lakes located in Rice County in the upper regions of the Sand Creek Watershed. SWMO is conducting subwatershed assessments in the Cody and Phelps Lakes watersheds; the results of the assessments will be available in 2020. The general suites of implementation, including soil health and other agricultural BMPs, will be implemented in these areas. The SWA will identify specific practices in critical areas. Adoption and implementation of these practices will achieve water quality standards.

Assessments, milestones, and goals for FA3 Cody and Phelps Lakes

Detailed and specific milestones for Cody and Phelps Lakes will be developed following the completion of the SWAs. The SWA for this area is expected to cost approximately $75,000.

7.2.3.2 FA4 Sanborn Lake

Sanborn Lake is an impaired lake located in Le Sueur County in the upper regions of the Sand Creek Watershed. The draft TMDL requires 937 lb/yr phosphorus reduction (Tetra Tech 2019, Table 30).

SWMO is conducting a subwatershed assessment in the Sanborn Lake Watershed; the results of the assessment will be available later in 2019. This effort will identify specific potential BMPS, and prioritize them for targeted outreach and implementation, similar to that presented earlier for Picha Creek. The suite of general BMPs, including soil health and other agricultural BMPs, will be evaluated. The SWA will identify specific practices in critical areas. Adoption and implementation of these practices will achieve water quality standards.

Assessments, milestones, and goals for FA4 Sandborn Lake

Detailed and specific milestones for Sandborn Lake will be developed following the completion of the SWA. The SWA for this area is expected to cost approximately $75,000.

7.2.4 MA4 – Lower Sand Creek implementation plans

Broad-based BMPS to address TSS, nutrient/eutrophication, chloride, *E. coli*, and stream habitat will include those described in Table 43. The efforts directed toward *E. coli* impairments, however, will largely focus on maintaining existing programs. Tracking shows that septic system compliance is increasing, replacement loan programs are being successful, and other efforts addressing feedlots and manure spreading are in place. The prioritization of the implementation will be to impaired waters with a priority to critical loading areas. Adoption and implementation of these practices will achieve water quality standards.

Assessments, milestones, and goals for MA 4 Lower Sand Creek stream reaches

The long-term goals for -513 are to meet water quality standards for *E. coli*, TSS, nutrient/eutrophication, chloride, and develop a healthy stream community of macroinvertebrate and fish numbers and species. The city of Jordan also has flooding concerns that can be met through additional NPS pollution BMPs. Table 58 describes the goals, milestones, and assessment methods for Sand Creek -513. Costs for this series of implementation activities, including estimated materials, incentive payments, staff, education, and technical assistance is approximately $1,500,000.

Table 58. Lower Middle Sand Creek assessments, milestones, and goals (-513)

Impairment	Pending (2021)	Milestones				Long-Term Goals	Assessment
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)		
E. coli	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Meet Standard	
	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *		Annual tracking of metric for: Septic system compliance
	Operate Septic System Compliance & Replacement Programs	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS		Number of ISTS replaced with loans or grants
		Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system		3-year cyclic assessment of buffer compliance by Scott SWCD
							On-going monitoring of *E. coli* by Metropolitan Council at Jordan Station
							Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
							Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO

Impairment	Pending (2021)	Milestones				Long-Term Goals	Assessment
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)		
TSS	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Meet Standard	Assess TSS trends using Sand Creek at Jordan data from Met Council every 5 years (next assessment in 2023)
	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs		Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
	Implement additional BMPs per WMO Sediment Strategy	Focus on upstream reaches and Picha Creek for new BMPs	Focus on upstream reaches and Picha Creek for new BMPs	Focus on upstream reaches and Picha Creek for new BMPs	Focus on upstream reaches and Picha Creek for new BMPs		Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
	Continue promoting Soil Health	Continue promoting Soil Health	Reassess approach to Soil Health	Implement revised Soil Health approach	Implement revised Soil Health approach		Annual tracking of metric for cost-efficiency of BMPs approved for cost/ton TSS
	o Host annual Cover Crop Workshops	o Host annual Cover Crop Workshops					3-year cyclic assessment of buffer compliance by Scott SWCD
	o Continue support to Soil Health Team	o Continue support to Soil Health Team					Annual tracking of equipment rental usage
	o Continue cover crop demonstration plots an strips	o Continue cover crop demonstration plots an strips					

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program		
Nutrients/Eutrophication	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Meet Standard	See metrics for TSS, but apply to TP
	Complete waiting list BMPs	Focus on upstream reaches and Picha Creek for new BMPs	Focus on upstream reaches and Picha Creek for new BMPs	Focus on upstream reaches and Picha Creek for new BMPs	Focus on upstream reaches and Picha Creek for new BMPs		
	Implement additional practices upstream	Continue promoting Soil Health	Reassess approach to Soil Health	Implement revised Soil Health approach	Implement revised Soil Health approach		
	· Continue promoting Soil Health	o Host annual Cover Crop Workshops					
	o Host annual Cover Crop Workshops	o Continue support to Soil Health Team					
	o Continue support to Soil Health Team	o Continue cover crop demonstration plots an strips					
	o Continue cover crop demonstration plots an strips						

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program		
Chloride	Continue best practices approach for deicing by Scott CO. and City of Jordan	Continue best practices approach for deicing by Scott CO. and City of Jordan	Continue best practices approach for deicing by Scott CO. and City of Jordan	Continue best practices approach by Scott Co, City of Jordan and one other upstream city (New Prague or Montgomery)	Continue best practices approach by Scott Co, City of Jordan and one other upstream city (New Prague or Montgomery)	Meet Standard	On-going monitoring of chlorides by Met Council at Jordan station
	Host applicator trainings in 2019		Start best practices approach upstream one other upstream city (New Prague or Montgomery)		Start best practices approach at last city		Synoptic monitoring by Scott SWCD/WMO in 2022
		Continue outreach efforts	Continue outreach efforts	Continue outreach efforts	Continue outreach efforts		Diagnostic monitoring in 2023 and assessment in 2025 by Scott SWCD/WMO
	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**		Data trend analysis in 2025

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
MIBI and FIBI	Continue to implement practices addressing probable stressors (chloride, TSS, TP, habitat and habitat fragmentation)	Continue to implement practices addressing probable stressors (chloride, TSS, TP, habitat and habitat fragmentation)	· Continue to implement practices addressing probable stressors (chloride, TSS, TP, habitat and habitat fragmentation)	Continue to implement practices addressing probable stressors (chloride, TSS, TP, habitat and habitat fragmentation)	Continue to implement practices addressing probable stressors (chloride, TSS, TP, habitat and habitat fragmentation)		MPCA 10-year cycle monitoring including MIBI and FIBI in 2024
			· Reassess and for FIBI consider options for fish passage at falls in Jordan depending on results				Reassess progress and stressors in 2025
City of Jordan flood concerns	Target practices moderating runoff and controlling sediment	Target practices moderating runoff and controlling sediment	Target practices moderating runoff and controlling sediment	Target practices moderating runoff and controlling sediment	Target practices moderating runoff and controlling sediment	Continue to reduce runoff yield	Annual watershed runoff yield metric calculated by the Scott WMO
							See above metrics for TSS

In the Sand Creek reach -732, the long-term goal will be to focus on developing a healthy stream community of macroinvertebrate and fish numbers and species.

Table 59. Lower Sand Creek goals, milestones, and assessments (-732)

Impairment	Pending (2021)	Milestones				Long-Term Goals	Assessment
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)		
MIBI and FIBI	Continue to implement practices addressing probable stressors (low flow, habitat)	Continue to implement practices addressing probable stressors (low flow, habitat)	Continue to implement practices addressing probable stressors (low flow, habitat)	Continue to implement practices addressing probable stressors (low flow, habitat)	Continue to implement practices addressing probable stressors (low flow, habitat)	Meet standard	MPCA 10-year cycle monitoring including MIBI and FIBI in 2024
			Reassess MIBI and FIBI				Reassess progress and stressors in 2025

7.2.5 MA5 – Porter Creek Implementation plans

The Scott County WMO identified several CIPs to be conducted in the Porter Creek in MA5 (Table 60). The Porter Creek Watershed is impaired for FIBI, *E. coli*, TSS, and nutrients.

Table 60. CIP planned for MA5

Management areas	Project	Planned or potential	Description	Cost estimate	Estimated dates
MA5	McMahon (Carl's) Lakes Alum Treatment	Planned	McMahon (Carl's) Lake treatment has been suspended unless the lake again becomes impaired. Project will reduce internal phosphorus cycling.	McMahon (Carl's) Lake: $175,200 for two treatments	McMahon Lake treatment has been suspended unless the lake again becomes impaired.
MA5	NW McMahon (Carl's) Lake Stabilization Project	Planned	Project to stabilize a head-cutting gully and restore a prairie in a cropped area NW of McMahon (Carl's) Lake.	$80,000	Landowner contacted in 2017. Waiting for a decision. Schedule unknown

Efforts directed toward *E. coli* impairments, however, will largely focus on maintaining existing programs. Tracking shows that septic system compliance is increasing, replacement loan programs are being successful, and other efforts addressing feedlots and manure spreading are in place.

Soil health initiatives in the upper watersheds are critical to slowing runoff into streams. Reducing runoff acts to reduce stream flows that cause excess bank and bluff erosion in the downstream watersheds. The adoption of soil health practices throughout the watershed is important in reducing peak stream flows. As improved soil health provides improved agricultural sustainability and profitability, its adoption should expand.

Additional BMPS will include those described in Table 43. The prioritization of the implementation will be to impaired waters with a priority to critical loading areas. Adoption and implementation of these practices will achieve water quality standards.

Assessments, milestones, and goals for MA 5 Porter Creek

The long-term goal for Porter Creek -817 is to meet water quality standards for *E. coli*, TSS, nutrient/eutrophication, and to develop a healthy stream community of macroinvertebrate and fish numbers and species. Costs for this series of implementation activities, including estimated materials, incentive payments, staff, education, and technical assistance is approximately $2,700,000.

Table 61. MA 5 Porter Creek goals, milestones, and assessments (-817)

Impairment	Pending (2021)	Milestones: 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
E. coli	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Meet Standard	Annual tracking of metric for SSTS compliance
	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *		Number of ISTS replaced with loans or grants
	Operate Septic System Compliance & Replacement Programs	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS		3-year cyclic assessment of buffer compliance by Scott SWCD
		Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system		On-going monitoring of *E. coli* by Metropolitan Council at Jordan Station
							Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
							Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
TSS	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Meet Standard	Assess TSS trends using Sand Creek at Jordan data from Met Council every 5 years (next assessment in 2023)

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs		Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
	Complete waiting list practices	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas		Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
	o 24 acre native grass planting						Annual tracking of metric for cost-efficiency of BMPs approved for cost/ton TSS
	o 2,000 LF grassed waterway						3-year cyclic assessment of buffer compliance by Scott SWCD
	Continue promoting Soil Health	Continue promoting Soil Health	Reassess approach to Soil Health	Implement revised Soil Health approach	Implement revised Soil Health approach		Annual tracking of equipment rental usage
	o Host annual Cover Crop Workshops	o Host annual Cover Crop Workshops					
	o Continue support to Soil Health Team	o Continue support to Soil Health Team					

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
	o Continue cover crop demonstration plots an strips	o Continue cover crop demonstration plots an strips					
	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program		
Nutrients/Eutrophication	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Meet Standard	See metrics for TSS, but apply to TP
		Promote fertilizer and manure management as part of survey tillage system practices	Promote fertilizer and manure management as part of survey tillage system practices	Promote fertilizer and manure management as part of survey tillage system practices	Promote fertilizer and manure management as part of survey tillage system practices		
MIBI and FIBI	Continue to implement practices addressing probable stressors (TSS, TP, habitat)	Continue to implement practices addressing probable stressors (TSS, TP, habitat)	Continue to implement practices addressing probable stressors (TSS, TP, habitat)	Continue to implement practices addressing probable stressors (TSS, TP, habitat)	Continue to implement practices addressing probable stressors (TSS, TP, habitat)	Meet standard	MPCA 10-year cycle monitoring including MIBI and FIBI in 2024
			Reassess MIBI and FIBI				Reassess progress and stressors in 2025

* Feedlot compliance will reduce or minimize any nutrient or *E. coli* contributions to the watershed

Porter Creek -815 will have a long-term goal of meeting water quality standards for TSS.

Table 62. Porter Creek -815 assessments, milestones, and goals

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
TSS	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Meet Standard	Assess TSS trends using Sand Creek at Jordan data from Met Council every 5 years (next assessment in 2023)
	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs		Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
	Complete waiting list practices	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas		Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
	Continue promoting Soil Health	Continue promoting Soil Health	Reassess approach to Soil Health	Implement revised Soil Health approach	Implement revised Soil Health approach		Annual tracking of metric for cost-efficiency of BMPs approved for cost/ton TSS
	Host annual Cover Crop Workshops	Host annual Cover Crop Workshops					3-year cyclic assessment of buffer compliance by Scott SWCD
	Continue support to Soil Health Team	Continue support to Soil Health Team					Annual tracking of equipment rental usage

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
	Continue cover crop demonstration plots an strips	Continue cover crop demonstration plots an strips					
	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program		

The long-term goal for Upper Porter Creek (-849) is to develop a healthy stream community of macroinvertebrate and fish numbers and species.

Table 63. Porter Creek -849 assessments, milestones, and goals

Impairment	Pending (2021)	Milestones				Long-Term Goals	Assessment
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)		
FIBI	Continue to implement practices addressing probable stressors (TSS, TP, low flow, habitat)	Continue to implement practices addressing probable stressors (TSS, TP, low flow, habitat)	Continue to implement practices addressing probable stressors (TSS, TP, low flow, habitat)	Contact 50% of landowners with priority practices identified in the SWA	Contact 100% of landowners with identified priority practices	Meet standard	MPCA 10-year cycle monitoring including MIBI and FIBI in 2024
			Reassess FIBI	Encumber contracts with landowners for 10% of priority practices	Encumber contracts with landowners for additional 10% of practices identified in the SWA		Reassess progress and stressors in 2025

Impairment	Pending (2021)	Milestones				Long-Term Goals	Assessment
		2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)		
			Complete SWA identifying and prioritizing BMPs for the watershed including Cynthia and St. Catherine Lake (listed below)		Implement 10% of practices		

The long-term goals for the MA 5 Porter Creek lakes are shown in the following table.

Table 64. Lakes in Porter Creek assessments, milestones, and goals

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
Phosphorus	Compliance with MN Buffer Rule	100 % Compliance	100 % Compliance	100 % Compliance	100 % Compliance	Meet standards	Monitor in 2024 as part of MPCA 10-year cycle
	Complete waiting lists BMPS		Reassess approach to Soil Health	Implement revised approach to Soil Health	Implement revised approach to Soil Health		
	Continue promoting Soil Health	Continue promoting Soil Health	Promote runoff reduction practices	Promote Surface tillage system practices (cover crops, conservation tillage, and alternative tile intakes)	Promote Surface tillage system practices (cover crops, conservation tillage, and alternative tile intakes)		
	Host annual Cover Crop Workshops	Host annual Cover Crop Workshops	Complete SWA identifying and prioritizing BMPs area upstream of Cynthia Lake	Promote runoff reduction practices	Promote runoff reduction practices		
	Continue support to Soil Health Team	Continue support to Soil Health Team	Complete focused outreach effort promoting Septic System Replacement Programs	Contact 50% of landowners with priority practices identified in the SWA	Contact 100% of landowners with identified priority practices		

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
	Continue cover crop demonstration plots an strips	Continue cover crop demonstration plots an strips	Promote Surface tillage system practices (cover crops, conservation tillage, and alternative tile intakes)	Encumber contracts with landowners for 10% of priority practices	Encumber contracts with landowners for additional 10% of practices identified in the SWA		
	Promote Surface tillage system practices (cover crops, conservation tillage, and alternative tile intakes)	Promote Surface tillage system practices (cover crops, conservation tillage, and alternative tile intakes)	Continue Equipment Rental Program	Enable replacement of 2 ISTS systems	Implement 10% of practices		
	Promote runoff reduction practices	Promote runoff reduction practices		Continue Equipment Rental Program	Enable replacement of 2 ISTS systems		
	Continue Equipment Rental Program	Focus on upstream reach for other targeted BMPS			Continue Equipment Rental Program		
		Continue Equipment Rental Program					

7.2.6 MA6 –Raven Stream

The Scott County WMO identified several CIPs to be conducted in the Porter Creek in MA6 (Table 65). Broad-based BMPS to address TSS, nutrient/eutrophication, chloride, *E. coli*, and stream habitat will include those described in Table 43. Table 55 describes Le Sueur County's priorities in this area. The efforts directed toward *E. coli* impairments, however, will largely focus on maintaining existing programs. Tracking shows that septic system compliance is increasing, replacement loan programs are being successful, and other efforts addressing feedlots and manure spreading are in place.

Table 65. SWMO CIPs planned for MA6

Management areas	Project	Planned or Potential	Description	Cost Estimate	Estimated dates
MA6	#9: City Center/Philips Square Stormwater Improvements	Planned	This is a project in the City of New Prague to convert a gravel parking area near East Raven Stream to parkland, paved parking and stormwater facilities. It will reduce phosphorus loading to Raven Stream. Potential to cost share with the city.	Construction Cost $434,000 (2018 estimate)	
MA3/MA6	#7: Hwy 19 Sand Creek Near Channel Stabilization	Potential	Severely eroding bank identified on Sand Creek in Le Sueur County just south crossing with Hwy 19. Landowner is interested. Need to identify funding sources for design and construction. Project will help reduce sediment loading to the creek.		
MA6	#8: Union Hill Wetland Restoration	Potential	Large depressional area just south of Hwy 19 at Union Hill hamlet in Le Sueur County that has a pumped outlet. Some landowners have expressed an interest in restoring the wetland.		Needed funding for feasibility study
MA6	#10: Upper Raven (Suller)	Potential	Potential 14 acre wetland restoration with landowner		

Management areas	Project	Planned or Potential	Description	Cost Estimate	Estimated dates
	Wetland Restoration		interest identified in early 2019.		

Table 66. MA3 and MA6 Implementation priorities from the Le Sueur County Water Plan

Goal/task	Responsible and Participating Agencies	Timeline	Cost estimate	Status
Incorporate TMDL and WRAPS implementation actions into local plans	Environmental Services, lake associations, SWCD, agricultural organizations	2016-2021	$2,000	When the reports are complete/approved
Implement TMDL plans	MPCA, ES, LA, SWCD, Ag Orgs	2016-2021	$600,000	Ongoing
Work with Met Council, Scott, and Rice counties on a Sand Creek Watershed implementation project	ES, SWCD, NRCS, FSA, Friends of MN Valley,	2016-2021	$10,000	Ongoing

Assessments, milestones, and goals for MA 6 Raven Stream

Long-term goals for the Raven Stream management include meeting water quality standards for *E. coli*, nutrient/eutrophication, chloride, and a healthy stream community of macroinvertebrates and fish. The goals also are to increase water storage and retention through BMPs to reduce the stream flows and resulting near channel erosion. The prioritization of the implementation will be to impaired waters with a priority to critical loading areas. Adoption and implementation of these practices will achieve water quality standards. Costs for this series of implementation activities, including estimated materials, incentive payments, staff, education, and technical assistance is approximately $5,200,000.

Table 67. Raven Streams assessments, milestones, and goals (-628, -716, -842, -819, -822)

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
Raven Stream -628							
	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Meet Standard	
	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *		Annual tracking of metric for: Septic system compliance
	Operate Septic System Compliance & Replacement Programs	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS		Number of ISTS replaced with loans or grants
		Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system		3-year cyclic assessment of buffer compliance by Scott SWCD
E. coli							On-going monitoring of *E. coli* by Metropolitan Council at Jordan Station
							Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
							Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
Nutrient/Eutrophication	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Meet Standard	See metrics for TSS, but apply to TP
		Promote fertilizer and manure management as part of survey tillage system practices	Promote fertilizer and manure management as part of survey tillage system practices	Promote fertilizer and manure management as part of survey tillage system practices	Promote fertilizer and manure management as part of survey tillage system practices		
Raven Stream -716							
E. coli	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Meet Standard	Annual tracking of metric for: Septic system compliance
	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *		Number of ISTS replaced with loans or grants
	Operate Septic System Compliance & Replacement Programs	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS		3-year cyclic assessment of buffer compliance by Scott SWCD
		Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system		On-going monitoring of *E. coli* by Metropolitan Council at Jordan Station

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
							Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
							Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
Chloride	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Meet Standard	On-going monitoring of chlorides by Met Council at Jordan station
	Host applicator trainings in 2019	Continue outreach efforts	Continue outreach efforts	Continue outreach efforts	Start best practices approach for deicing by New Prague		Synoptic monitoring by Scott SWCD/WMO in 2022
	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Continue outreach efforts		Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
					Monitor chlorides in WW effluent**		Data trend analysis in 2025

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
MIBI and FIBI	Continue to implement practices addressing probable stressors (TP, habitat)	Continue to implement practices addressing probable stressors (TP, habitat)	Continue to implement practices addressing probable stressors (TP, habitat)	Continue to implement practices addressing probable stressors (TP, habitat)	Continue to implement practices addressing probable stressors (TP, habitat)	Meet standard	MPCA 10-year cycle monitoring including MIBI and FIBI in 2024
			Reassess MIBI and FIBI				Reassess progress and stressors in 2025
Raven Stream-842							
E. coli	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Meet Standard	
	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *	Compliance with MN Feedlot Requirements *		Annual tracking of metric for: Septic system compliance
	Operate Septic System Compliance & Replacement Programs	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS	Third party inspection compliance at 80% and greater for ISTS		Number of ISTS replaced with loans or grants
		Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system	Enable replacement of 1 ISTS system		3-year cyclic assessment of buffer compliance by Scott SWCD

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
							On-going monitoring of *E. coli* by Metropolitan Council at Jordan Station
							Synoptic monitoring and assessment by Scott SWCD/WMO in 2022
							Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
Nutrient/Eutrophication	Compliance with MN Buffer Rule	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Maintain 100% compliance	Meet Standard	See metrics for TSS, but apply to TP
	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs	Maintain existing CIPs		
	Complete waiting list practices	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas	Promote runoff reduction practices in headwater areas, and surface tillage systems practices (conservation tillage, cover crops and alternative tile intakes) in agricultural areas		

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
	o 24 acre native grass planting						
	o 2,000 LF grassed waterway						
	Continue promoting Soil Health	Continue promoting Soil Health	Reassess approach to Soil Health	Implement revised Soil Health approach	Implement revised Soil Health approach		
	o Host annual Cover Crop Workshops	o Host annual Cover Crop Workshops					
	o Continue support to Soil Health Team	o Continue support to Soil Health Team					
	o Continue cover crop demonstration plots an strips	o Continue cover crop demonstration plots an strips					
	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program	Continue Equipment Rental Program		
	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Same as for meeting WQS for TSS above	Meet Standard	

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
		Promote fertilizer management as part of survey tillage system practices	Promote fertilizer management as part of survey tillage system practices	Promote fertilizer management as part of survey tillage system practices	Promote fertilizer management as part of survey tillage system practices		
MIBI and FIBI	Continue to implement practices addressing probable stressors (TP, habitat)	Continue to implement practices addressing probable stressors (TP, habitat)	Continue to implement practices addressing probable stressors (TP, habitat)	Continue to implement practices addressing probable stressors (TP, habitat)	Continue to implement practices addressing probable stressors (TP, habitat)	Meet standard	MPCA 10-year cycle monitoring including MIBI and FIBI in 2024
			Reassess MIBI and FIBI				Reassess progress and stressors in 2025
Raven Stream -819							
Chloride	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Continue best practices approach for deicing by Scott CO.	Meet Standard	On-going monitoring of chlorides by Met Council at Jordan station
	Host applicator trainings in 2019	Continue outreach efforts	Continue outreach efforts	Continue outreach efforts	Start best practices approach for deicing by New Prague		Synoptic monitoring by Scott SWCD/WMO in 2022

Impairment	Pending (2021)	Milestones 2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	Long-Term Goals	Assessment
	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Monitor chlorides in WW effluent**	Continue outreach efforts		Diagnostic monitoring in 2024 and assessment in 2025 by Scott SWCD/WMO
					Monitor chlorides in WW effluent**		Data trend analysis in 2025
Raven Stream -822							
MIBI and FIBI							
Complete City Center/Philips Square Stormwater Improvement (CIP)		Complete concept design and landowner outreach				Complete project	Project completed

7.3 Information/Education activities

The Multilevel Community Capacity Model for Sustainable Watershed Management (Davenport and Seekamp 2013; Figure 1) (described in Section 1.3.2.) is being used as the basis for developing community capacity for sustainable watershed management. The model focuses on the importance of building individual and community capacity through developing and strengthening relationships, building trust, and providing program and organizational opportunities in building capacity.

Activities that may be used to engage watershed residents and landowners for capacity building and eventual adoption of land management changes may include:

- Citizen advisory committees
- A farmer-led council
- Water quality improvement volunteer opportunities
- Volunteer water quality monitoring
- Outreach events: watershed tours, “thank you” picnics for landowners participating in conservation efforts

Other outreach efforts will include press releases, newsletters, website information, and one-on-one contacts.

8. Monitoring

The purpose of the SWMO water quality monitoring program is to track long-term water quality trends; provide a scientific basis to identify, target and design programs and projects to meet goals; and to evaluate project and program effectiveness and progress towards water quality goals. The SWMO will rely on monitoring currently being completed by the Metropolitan Council on Sand Creek for long-term trends. This will be augmented with additional stream water monitoring completed on a rotating cyclic basis that moves monitoring sites around from year to year focusing on different watersheds called synoptic monitoring to identify “hotspots.” Detailed diagnostic monitoring will also be completed at multiple sites on Sand Creek in 2023 or 2024. Lake monitoring will largely be completed through volunteer efforts under the Metropolitan Council’s CAMP program annually. For groundwater, the SWMO will rely on data from test kits sold by the County, augmented twice during the plan cycle with a designed monitoring effort of 60 to 100 rural wells across the SWMO. This effort will test for nitrates, atrazine (by amino assay), arsenic, and chloride.

The SWMO reviews monitoring data annually. Trend analysis of the data completed by the Metropolitan Council once every five to ten years.

The SWMO will also work closely with the DNR and its partners to complete annual aquatic plant surveys on lakes that are treated for curly-leaf pondweed. Surveys will typically be completed both early and late during the growing season. Results are reviewed annually and reported in the SWMO’s annual report and newsletter.

Monitoring is the data collection tool. It is not the evaluation/assessment piece. This information will help inform and influence measuring the overall effectiveness of this plan and implementation efforts.

Water quality monitoring is conducted by various agencies and organizations at various spatial and temporal scales. The following text describes the primary monitoring efforts.

Metropolitan Council Environmental Services

Sand Creek is part of the Metropolitan Council Environmental Services (MCES) stream monitoring program. The MCES monitoring station is located on Sand Creek in Jordan, Minnesota, approximately 8.2 miles upstream from the creek’s confluence with the Minnesota River. The station provides long-term streamflow and water chemistry data as part of the MCES Stream Monitoring Program. MCES began monitoring the site in 1989 and has continuously operated the site since then with the exception of 2011, when flood flows damaged the station.

The monitoring station includes continuous flow monitoring, event-based composite sample collection, and *in situ* conductivity, temperature, and turbidity probes. Precipitation data for the site are accessed from the Minnesota Climatology Working Group, Jordan Station Number 214176. Metropolitan Council (2014) provides an evaluation of the data collected through 2012.

The Quality Assurance Program Plan can be found at https://metrocouncil.org/Wastewater-Water/Publications-And-Resources/Stream-Monitoring-QAPP_Revised_0111_Web_Reduced-pd.aspx.

MPCA Intensive Watershed Monitoring

The MPCA conducts biology and chemistry monitoring on a ten-year cycle across the state at the HUC-8 watershed scale. Water bodies in the Sand Creek Watershed were sampled as part of the Lower Minnesota River HUC-8 watershed in 2014–2015 and will be sampled again in 2024–2025. MPCA monitoring consists of fish and macroinvertebrate sampling at several stream sites in each watershed. Water chemistry sampling is conducted at a subset of the biological monitoring sites.

Citizen Lake Monitoring

Monitoring of lakes in the watershed is largely completed through volunteer efforts as part of the Metropolitan Council's Citizen Assisted Lake Monitoring Program. Monitored lakes in the watershed include Cedar and McMahon (Carl's) Lakes. Volunteers monitor lake surface water quality on a biweekly basis.

SWMO Monitoring

The SWMO conducts stream monitoring on a rotating basis. The SWMO is planning a detailed diagnostic monitoring effort in 2024 at multiple sites in the watershed.

However, the Scott WMO is also planning a detailed diagnostic type of monitoring effort in 2024 at multiple sites in the watershed. This monitoring in combination with the continuous trend site will allow the local partners to assess whether efforts are working and adapt accordingly. For example, based on results in 2024 partners can assess whether more aggressive efforts will be needed for *E. coli*, or whether it's time to move to focus efforts in different subwatersheds for reducing TSS.

Implementation Monitoring

Implementation activities are reported to the BWSR eLink database.

The monitoring programs will be evaluated for their ability to document the improvement in water quality. Revisions will be considered relative to available funding.

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