

Minnesota River - Mankato

Comprehensive Watershed Management Plan Appendix



Appendix A.

Planning Memorandum of Agreement



MEMORANDUM OF AGREEMENT

This agreement (Agreement) is made and entered into by and between:

The Counties of Nicollet, Le Sueur, and Blue Earth by and through their respective County Board of Commissioners, and

The Nicollet, Le Sueur, and Blue Earth Soil and Water Conservation Districts, by and through their respective Soil and Water Conservation District (SWCD) Board of Supervisors, and

The City of Lake Crystal, City of Mankato, City of North Mankato, City of Saint Peter, and through their Council members; Collectively referred as the "Parties."

WHEREAS, the Counties of this Agreement are political subdivisions of the State of Minnesota, with authority to carry out environmental programs and land use controls, pursuant to Minnesota Statutes Chapter 375 and as otherwise provided by law; and

WHEREAS, the Soil and Water Conservation Districts (SWCDs) of this Agreement are political subdivisions of the State of Minnesota, with statutory authority to carry out erosion control and other soil and water conservation programs, pursuant to Minnesota Statutes Chapter 103C and as otherwise provided by law; and

WHEREAS, the City(s) of this Agreement is a municipal corporation of the State of Minnesota, with statutory authority to control or eliminate stormwater pollution along with soil erosion and sedimentation within the boundary, and to establish standards and specifications for conversation practices and planning activities that minimize stormwater pollution, soil erosion and sedimentation, pursuant to Minnesota Rules Chapter 7001 and 7090; and with authority to carry out land use controls, pursuant to Minnesota Statutes Chapter 462 and as otherwise provided by law; and

WHEREAS, the parties to this Agreement have a common interest and statutory authority to prepare, adopt, and assure implementation of a comprehensive watershed management plan in *Minnesota River- Mankato one Watershed, One Plan* to conserve soil and water resources through the implementation of practices, programs, and regulatory controls that effectively control or prevent erosion, sedimentation, siltation and related pollution in order to preserve natural resources, ensure continued soil productivity, protect water quality, reduce damages caused by floods, preserve wildlife, protect the tax base, and protect public lands and waters; and

WHEREAS, with matters that relate to the coordination of water management authorities pursuant to Minnesota Statutes Chapters 103B, 103C, and 103D with public drainage systems pursuant to Minnesota Statutes Chapter 103E, this Agreement does not change the rights or obligations of the public drainage system authorities.

WHEREAS, the Parties have formed this Agreement for the specific goal of developing a plan pursuant to Minnesota Statutes § 103B.801, Comprehensive Watershed Management Planning, also known as *Minnesota River- Mankato one Watershed, One Plan*.

NOW, THEREFORE, the Parties hereto agree as follows:

1. **Purpose:** The Parties to this Agreement recognize the importance of partnerships to plan and implement protection and restoration efforts for the *Minnesota River- Mankato Watershed (see Attachment A with a map of the planning area)*. The purpose of this Agreement is to collectively develop and adopt, as local government units, a coordinated watershed management plan for implementation per the provisions of

the Plan. Parties signing this agreement will be collectively referred to as *Minnesota River- Mankato Watershed Partnership*.

2. **Term:** This Agreement is effective upon signature of all Parties in consideration of the Board of Water and Soil Resources (BWSR) Operating Procedures for One Watershed, One Plan; and will remain in effect until 1-year after the term of the BWSR One Watershed, One Plan Planning Grant Agreement, unless canceled according to the provisions of this Agreement or earlier terminated by law.
3. **Adding Additional Parties:** A qualifying party within *Minnesota River- Mankato Watershed* desiring to become a member of this Agreement shall indicate its intent by adoption of a board resolution prior to a date that is six months from the BWSR One Watershed, One Plan Planning Grant Agreement execution. The party agrees to abide by the terms and conditions of the Agreement; including but not limited to the bylaws, policies, and procedures adopted by the Policy Committee.
4. **Withdrawal of Parties:** A party desiring to leave the membership of this Agreement shall indicate its intent in writing to the Policy Committee in the form of an official board resolution. Notice must be made at least 30 days in advance of leaving the Agreement. BWSR has identified the following parties as required parties for this agreement: Nicollet County, Nicollet SWCD, Le Sueur County, Le Sueur County SWCD, Blue Earth County, and Blue Earth County SWCD. If one of the required Parties according to the BWSR Operating Procedures for One Watershed One Plan withdraws from this agreement, it does not make this MOA null and void. Should this occur, the remaining Parties will hold discussions with BWSR representatives regarding the reallocation of reassignment of duties, grant funds, and future projection of the project as a whole.
5. **General Provisions:**
 - a. **Compliance with Laws/Standards:** The Parties agree to abide by all federal, state, and local laws; statutes, ordinances, rules, and regulations now in effect or hereafter adopted pertaining to this Agreement or to the facilities, programs, and staff for which the Agreement is responsible.
 - b. **Indemnification:** Each party to this Agreement shall be liable for the acts of its officers, employees, or agents and the results thereof to the extent authorized or limited by law and shall not be responsible for the acts of any other party, its officers, employees, or agents. The provisions of the Municipal Tort Claims Act, Minnesota Statute Chapter 466, and other applicable laws govern the liability of the Parties. To the full extent permitted by law, actions by the Parties, their respective officers, employees, and agents pursuant to this Agreement are intended to be and shall be construed as a “cooperative activity.” It is the intent of the Parties that they shall be deemed a “single governmental unit” for the purpose of liability, as set forth in Minnesota Statutes § 471.59, subd. 1a(a). For purposes of Minnesota Statutes § 471.59, subd. 1a(a) it is the intent of each party that this Agreement does not create any liability or exposure of one party for the acts or omissions of any other party. Under no circumstances shall a Party be required to pay on behalf of itself and other Parties, any amounts in excess of the limits on liability established in Minnesota Statutes, Chapter 466 applicable to any one Party. The limits of liability for some or all of the Parties may not be added together to determine the maximum amount of liability for any

Party. Nothing in this Agreement shall be construed to waive any immunities or limitations to which a Party is entitled under Minnesota Statutes, Chapter 466 or otherwise.

- c. **Records Retention and Data Practices:** The Parties agree that records created pursuant to the terms of this Agreement will be retained in a manner that meets their respective entity's records retention schedules that have been reviewed and approved by the State in accordance with Minnesota Statutes § 138.17. The Parties further agree that records prepared or maintained in furtherance of the agreement shall be subject to the Minnesota Government Data Practices Act. At the time this agreement expires, all records will be turned over to the Fiscal Agent for continued retention.
- d. **Timeliness:** The Parties agree to perform obligations under this Agreement in a timely manner and keep each other informed about any delays that may occur.
- e. **Extension:** The Parties may extend the termination date of this Agreement upon agreement by all Parties.
- f. **Termination:** The parties anticipate that this Agreement will remain in full force and effect until 1 year after the term of the BWSR One Watershed, One Plan Planning Grant Agreement, unless otherwise terminated in accordance with law or other provisions of this Agreement. The parties acknowledge their respective and applicable obligations, if any, under Minn. Stat. Section 471.59, Subd. 5 after the purpose of the Agreement has been completed.
- g. **Amendment:** The Parties may modify this Agreement upon approval by the majority. Any amendment to this Agreement shall be in writing, adopted by each party in the same manner as the original Agreement.
- h. This is a collaborative effort by the Parties and as such, no employees shall be hired as part of this planning project.

6. **Administration:**

- a. **Establishment of Committees for the Development of the Plan.** The Parties agree to designate one representative, who must be an elected or appointed member of the governing board, to a Policy Committee for the development of the watershed-based plan and may appoint one or more technical representatives to an Advisory Committee for the development of the plan in consideration of the BWSR Operating Procedures for One Watershed, One Plan.
 - i. The Policy Committee will meet as needed to decide on the content of the plan, serve as a liaison to their respective boards, and act on behalf of their Board. Each representative shall have one vote.
 - ii. Each governing board may choose one alternate to serve on the Policy Committee as needed in the absence of the designated member.

- iii. The Policy Committee will establish bylaws within 6 months of the date of the BWSR One Watershed, One Plan Planning Grant Agreement to describe the functions and operations of the committee(s).
 - iv. The Advisory Committee will meet monthly or as needed to assist and provide technical support and make recommendations to the Policy Committee on the development and content of the plan. Members of the Advisory Committee may not be current board members of any of the Parties.
 - b. **Submittal of the Plan.** The Policy Committee will recommend the plan to the Parties of this agreement. The Policy Committee will be responsible for initiating a formal review process for the watershed-based plan conforming to Minnesota Statutes Chapters 103B and 103D, including public hearings. Upon completion of local review and comment, the Policy Committee will submit the watershed-based plan jointly to BWSR for review and approval.
 - c. **Adoption of the Plan.** The Parties agree to adopt and begin implementation of the plan within 120 days of receiving notice of state approval, and provide notice of plan adoption pursuant to Minnesota Statutes Chapters 103B and 103D.
7. **Grant Administration and Fiscal Agent:** Nicollet County will act as the grant administer and fiscal agent for the purposes of this Agreement and agrees to:
- a. Accept all responsibilities associated with the implementation of the BWSR grant agreement for developing a watershed-based plan.
 - b. Perform financial transactions as part of the grant agreement and contract implementation.
 - c. Annually provide a full and complete audit report.
 - d. Provide the Policy Committee with the records necessary to describe the financial condition of the BWSR grant agreement.
 - e. Retain fiscal records consistent with the agent's records retention schedule until termination of the agreement (at that time, records will be turned over to the *(Fiscal Agent)*).
 - f. Administration of the grant with BWSR for the purposes of developing a watershed-based plan, including reporting, process oversight, consistent planning and update meetings with BWSR staff, and overall coordination of the process.
8. **Project Coordinator:** Nicollet County will act as the project coordinator for the purposes of this Agreement and agrees to provide the following services:
- a. Accept all day-to-day responsibilities associated with the implementation of the BWSR grant agreement for developing a watershed-based plan, including being the primary BWSR contact for

the *One Watershed, One Plan* Grant Agreement, and being responsible for BWSR reporting requirements associated with the grant agreement.

- b. Coordination and facilitation of Steering Team meetings including establishing date, location, time, space, technology needs, preparing agendas and supporting materials, taking meeting notes and sending out meeting minutes, and any necessary accommodations such as refreshments.
- c. Coordination and facilitation of Policy Committee and Advisory Committee meetings including establishing date, location, time, space, technology needs, preparing agendas and supporting materials, taking meeting notes, sending out meeting minutes, and maintain website for the partnership, and any necessary accommodations such as refreshments.
- d. Identifying potential contracted service providers for process facilitation, plan writing, GIS, mapping, data analysis, monitoring activities, or any other technical services needed throughout the process.
- e. Contracting for Services with the chosen consultant for plan preparation and writing of the watershed-based plan, including:
 - i. Execute the Contract for Services agreement.
 - ii. Ensuring project timelines and deliverables are meeting plan requirements.
 - iii. Oversee expenditures incurred by the consultant;
 - iv. Provide prompt payment for services rendered; and
 - v. Serve as the primary contact person with the consultant.

9. **Project Coordinator Support:** The Steering Team will act as the support project coordinator for the purposes of this Agreement and agrees to provide the following services:

- a. Assist with identifying potential contracted service providers for process facilitation, plan writing, GIS, mapping, data analysis, monitoring activities, or any other technical services needed throughout the process.

10. The following parties agree to provide the following services to the *Minnesota River- Mankato Watershed* Partnership:

- a. Additional work tasks and responsibilities will be identified in the work plan and sub-agreements.

11. **Authorized Representatives:** The following persons will be the primary contacts for all matters concerning this Agreement:

Nicollet County

Kenny Famakinwa or successor
Environmental Specialist
501 South Minnesota Avenue
St. Peter, MN 56082
Telephone: (507) 934-7073

Nicollet Soil and Water Conservation District

Kevin Ostermann or successor
District Manager
501 7th St
Nicollet, MN 56074
Telephone: (507) 232-2550

Le Sueur County

Holly Bushman or successor
Environmental Resources Specialist
88 South Park Ave
Le Center, MN 56057
Telephone: (507) 357-8540

Le Sueur Soil and Water Conservation District

Michael Schultz or successor
District Manager
181 W Minnesota Street
Le Center, MN 56057
Telephone: (952) 807-3423

Blue Earth County

Scott Salsbury or successor
Land Use Planner
410 S 5th St PO Box 3566
Mankato, MN 56001
Telephone: (507) 304-4489

Blue Earth Soil and Water Conservation District

Jerad Bach or successor
District Manager
1160 S Victory Dr Ste 5
Mankato, MN 56001
Telephone: (507) 345-4744

City of Lake Crystal

Angela M. Grafstrom
City Administrator
100 E. Robinson St.
Lake Crystal, MN 56055
Telephone: (507) 726-2538

City of North Mankato

Kevin P. McCann
City Administrator
1001 Belgrade avenue
North Mankato, MN 56002
Telephone: (507) 625-4141

City of Mankato

Jeff Johnson
Director of Public Works
10 Civic Center Plaza
Mankato, MN 56001
Telephone: (507) 995-6389

City of Saint Peter

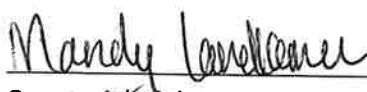
Curtis Thompson
Water Resources Superintendent
405 W St. Julien
St. Peter, MN 56082
Telephone: (507) 934-0774

IN TESTIMONY WHEREOF the Parties have duly executed this agreement by their duly authorized officers.

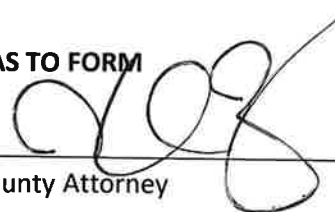
PARTNER: Nicollet County

APPROVED:

BY:  3/26/24
County Board Chair Date

BY:  3/26/2024
County Administrator Date

APPROVED AS TO FORM

BY:  3.26.2024 3.26.2024
County Attorney Date

IN TESTIMONY WHEREOF the Parties have duly executed this agreement by their duly authorized officers.

PARTNER: Nicollet Soil and Water Conservation District

APPROVED:

BY: John H. Kral 03-12-2024
Nicollet SWCD Board Chair Date

BY: [Signature] 3-12-2024
Nicollet SWCD Manager Date

IN TESTIMONY WHEREOF the Parties have duly executed this agreement by their duly authorized officers.

PARTNER: Le Sueur County

APPROVED:

BY:

DocuSigned by:

Steve Rohlfing

3726901C65AE402...

3/6/2024

County Board Chair

Date

BY:

DocuSigned by:

Joe Martin, Le Sueur County Administrator

53367B3B70604D7...

3/6/2024

County Administrator

Date

APPROVED AS TO FORM

BY:

DocuSigned by:

Brent Christian, Le Sueur County Attorney

78B4DB1AA82A4A7...

3/11/2024

County Attorney

Date

IN TESTIMONY WHEREOF the Parties have duly executed this agreement by their duly authorized officers.

PARTNER: Le Sueur Soil and Water Conservation District

APPROVED:

BY:  3-12, 2024
Le Sueur SWCD Board Chair Date

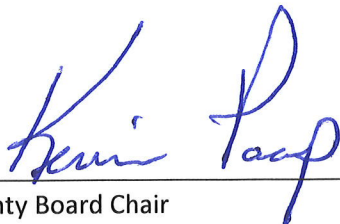
BY:  3/12/2024
Le Sueur SWCD Manager Date

IN TESTIMONY WHEREOF the Parties have duly executed this agreement by their duly authorized officers.

PARTNER: Blue Earth County

APPROVED:

BY:


County Board Chair

03/05/2024
Date

BY:


County Administrator

03/05/2024
Date

APPROVED AS TO FORM

BY:

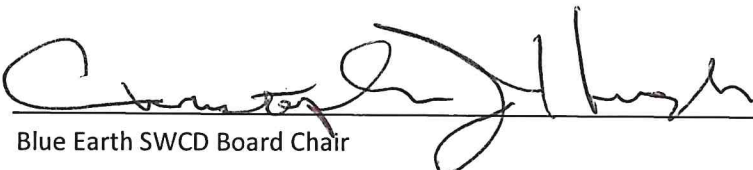
County Attorney

Date

IN TESTIMONY WHEREOF the Parties have duly executed this agreement by their duly authorized officers.

PARTNER: Blue Earth Soil and Water Conservation District

APPROVED:

BY:  3-7-24
Blue Earth SWCD Board Chair Date

BY:  3/7/24
Blue Earth SWCD Manager Date

IN TESTIMONY WHEREOF the Parties have duly executed this agreement by their duly authorized officers.

PARTNER: **City of Saint Peter**

APPROVED:

BY: Shanon A. Nowell 3/19/24
Mayor Date

BY: [Signature] 3/19/24
City Administrator Date

IN TESTIMONY WHEREOF the Parties have duly executed this agreement by their duly authorized officers.

PARTNER: **City of Lake Crystal**

APPROVED:

BY: Naywa Massad 2-28-24
Mayor Date

BY: Renae Kopischke 2-28-24
City Clerk Date

IN TESTIMONY WHEREOF the Parties have duly executed this agreement by their duly authorized officers.

PARTNER: City of North Mankato

APPROVED:

BY: Scott Carlson 3-4-24
Mayor Date

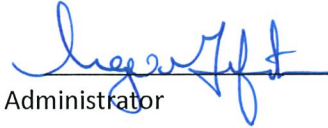
BY: [Signature] 3-4-24
City Clerk Date

IN TESTIMONY WHEREOF the Parties have duly executed this agreement by their duly authorized officers.

PARTNER: City of Lake Crystal

APPROVED:

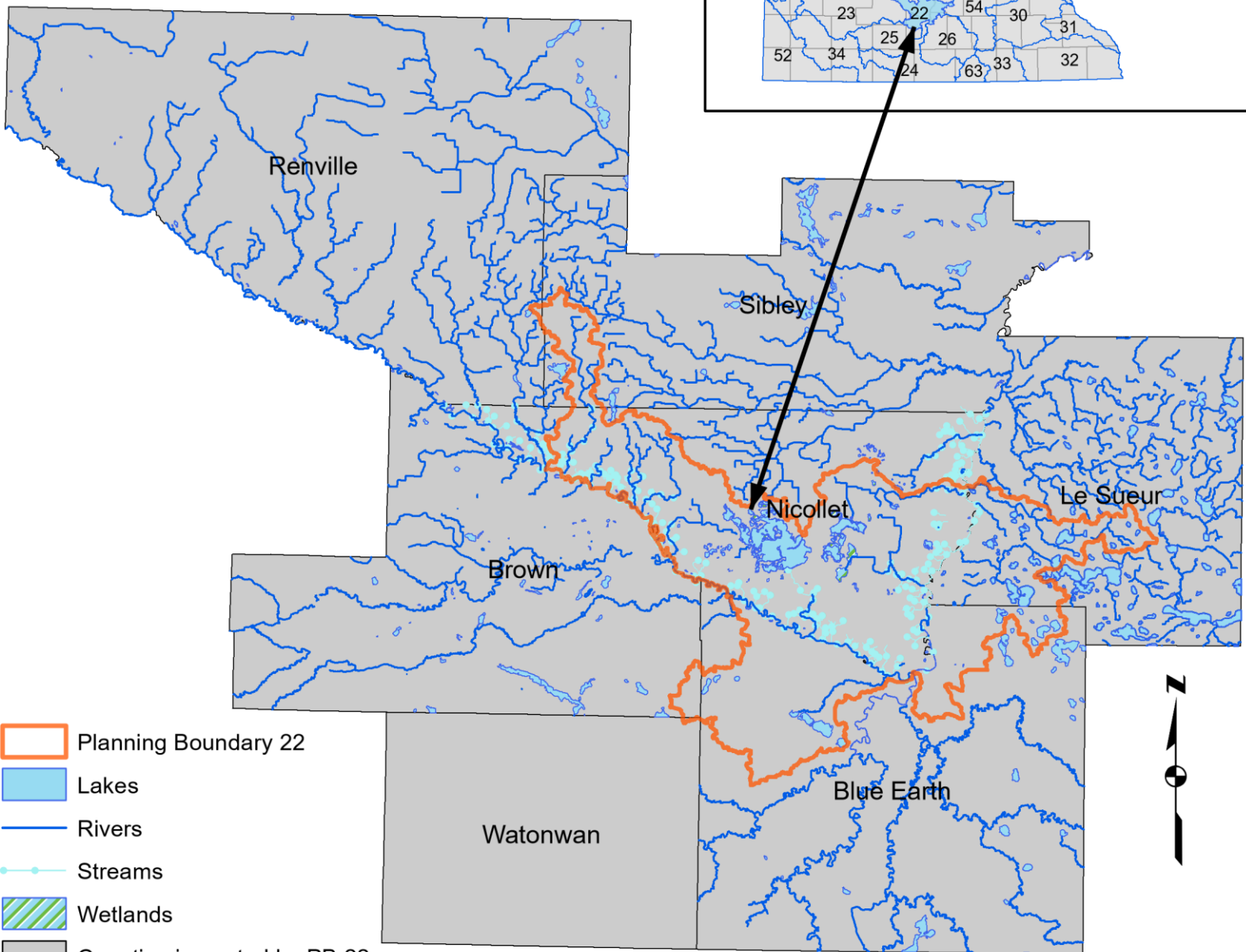
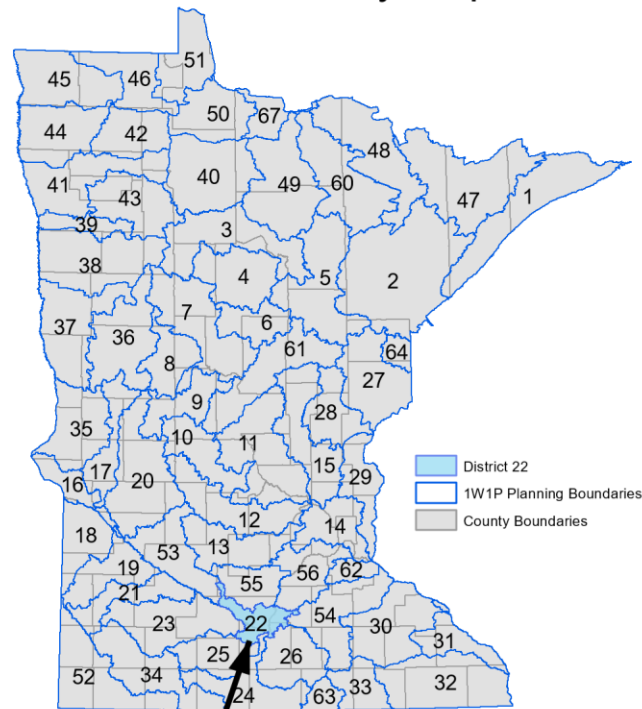
BY:  2/23/24
Mayor Date

BY:  2/28/24
City Administrator Date

One Watershed, One Plan

Minnesota River - Mankato Watershed Planning boundary

One Watershed, One Plan Boundary Map



0 10 20 40 Miles

Appendix B.

Local Regulatory

Comparison





Local Regulatory Comparison

	Blue Earth	Le Sueur	Nicollet
Aquatic Invasive Species (AIS)	County	County	County
Buffers	County ordinance; County jurisdiction and enforcement; SWCD determining compliance	County Ordinance; County jurisdiction and enforcement; SWCD delegated ditch inspector	County Ordinance; County jurisdiction and enforcement; SWCD determines compliance
Feedlots	Delegated County	Delegated County	Delegated County
Floodplain management	County Ordinance	County Ordinance	County Ordinance
Hazard Management	2020 Hazard Mitigation Plan	All Hazard Mitigation Plan (2021)	Hazard Mitigation Plan
Shoreland Management	County Ordinance	County Ordinance	County Ordinance
Public Drainage	160 miles of open ditches and 500 miles of tile systems. County Board is authority.	236 miles of open ditch and 27 miles of tile systems. County Board is authority.	456 miles of open and tiled ditches. County Board is authority.
Noxious Weeds	County ag inspector or local weed inspector	County ag inspector, township supervisors, and city mayors are local weed inspectors	County ag inspector or local weed inspector
Subsurface Sewage Treatment Systems (SSTS)	County Ordinance	County Ordinance	County Ordinance
Solid Waste Management	County Ordinance	County Ordinance	County Ordinance
Wetland Conservation Act (WCA)	County is WCA local government unit	SWCD is WCA local government unit	County is WCA local government unit

Cities also have regulatory programs. Local city ordinances can be found online at <https://mn.gov/law-library/research-links/ordinances.jsp#2>



Appendix C.

60-Day Response Letters





11 Civic Center Plaza, Suite 300
Mankato, MN 56001

April 25, 2024

Middle Minnesota River-Mankato One Watershed, One Plan Partnership
C/O Kenny Famakinwa, Nicollet County
501 S Minnesota Ave
St. Peter, MN 56082

Re: Response to request for priority issues and plan expectations (One Watershed, One Plan)

Dear Kenny,

Thank you for the opportunity to provide priority issues and plan expectations for the development of the - Middle Minnesota-Mankato Comprehensive Watershed Management Plan (plan) under Minnesota Statutes section 103B.801.

The Board of Water and Soil Resources (BWSR) has the following overarching expectations for the plan:

Process

The planning process must follow the requirements outlined in the [One Watershed, One Plan Operating Procedures \(Version 3.0\)](#) adopted by the BWSR Board on August 24, 2023. More specifically, the plan must have:

- Involve a broad range of stakeholders to ensure an integrated approach to watershed management.
- Reassess the agreement established for planning purposes when finalizing the implementation schedule and programs in the plan, in consultation with the Minnesota Counties Intergovernmental Trust and/or legal counsel of the participating organizations, to ensure implementation can occur efficiently and with minimized risk. This step is critical if the plan proposes to share services and/or submit joint grant applications.

Bemidji Brainerd Detroit Lakes Duluth Mankato Marshall Rochester St. Cloud St. Paul

St. Paul HQ 520 Lafayette Road North St. Paul, MN 55155 Phone: (651) 296-3767

www.bwsr.state.mn.us TTY: (800) 627-3529 An equal opportunity employer

Plan Content

The plan must meet the requirements outlined in [One Watershed, One Plan – Plan Content Requirements \(Version 3.0\)](#), adopted by the BWSR Board on August 24, 2023

- A thorough analysis of issues, using available science and data, in the selection of priority resource concerns.
- Sufficient measurable goals to indicate an intended pace of progress for addressing the priority issues; a specific requirement for water storage goals, expressed in acre-feet, and standards for water storage, retention, and infiltration.
- A targeted and comprehensive implementation schedule, sufficient for meeting the identified goals.
- A thorough description of the programs and activities required to administer, coordinate, and implement the actions in the schedule; including work planning (i.e. shared services, collaborative grant-making, decision making as a watershed group) and evaluation.
- According to Minnesota Statutes, Section 103B.801, subdivision 4, the plan must address:
 - a. Surface water and groundwater quality protection, restoration, and improvement, including prevention of erosion and soil transport into surface water systems;
 - b. Restoration, protection, and preservation of drinking water sources and natural surface water and groundwater storage and retention systems;
 - c. Promotion of groundwater recharge;
 - d. Minimization of public capital expenditures needed to correct flooding and water quality problems;
 - e. Wetland enhancement, restoration, and establishment;
 - f. Identification of priority areas for riparian zone management and buffers; and
 - g. Protection and enhancement of fish and wildlife habitat and water recreational facilities.

Suggested existing plans, studies, models, and tools:

The plan must be based on the best available data, models, and other science to meet plan content requirements. The partnership is encouraged to make use of these existing resources and incorporate them into the final plan document by reference, where possible. Below are a few examples of such resources that are available to the partnership. The other State plan review agencies (Department of Agriculture, Department of Health, Department of Natural Resources, and Pollution Control Agency) as well as yourselves and others have done extensive work in this watershed, and that work may not be listed below, but warrants consideration for inclusion as well.

BWSR has the following specific priority issues:

- **The Nonpoint Priority Funding Plan (NPFP)** – The [NPFP](#) outlines a criteria-based process to prioritize Clean Water Fund investments. Planning partners intending to pursue Clean Water Fund dollars are

strongly encouraged to consider the high-level state priorities, keys to implementation, and criteria for evaluating proposed activities in the NPFP.

- **Drainage** - The drainage authorities within the planning area should be included as stakeholders in the plan development process. This inclusion should ensure that the Chapter 103E processes and proceedings as well as the extent and the limitations of drainage authority responsibility are adequately included in the final plan. Additionally, the planning partners are strongly encouraged to include projects and activities consistent with multipurpose drainage criteria outlined in Minnesota Statutes §103E.011, Subd. 5 and §103E.015. As the 1W1P plan is formulated, BWSR suggests the following:
 - a. Chapter 103E drainage authorities (who are also water planning authorities) be fully engaged from the early stages of the planning process. Use Section 103E.015 CONSIDERATIONS BEFORE DRAINAGE WORK IS DONE and other provisions of drainage law identified below to capture both the extent and limitations of drainage authority responsibility, authority and opportunity for participating in the planning and implementation of conservation practices involving public drainage systems and their associated drainage areas.
 - b. Prioritization within the watershed include identification of Chapter 103E drainage systems and their drainage areas.
 - c. Multipurpose drainage management be included in the approach for targeting best management practices (BMPs) within the drainage area of Chapter 103E drainage systems, considering the five purposes outlined in Section 103E.015, Subdivision 1. Environmental, land use, and multipurpose water management criteria, clause (2).
 - d. Measurable outcomes for erosion and sediment reduction, nutrient reduction, improved instream biology, and detention storage to assist those outcomes, should include correlation to Chapter 103E drainage systems.
 - e. Lay out a coordinated approach for how implementation of multipurpose drainage management practices identified in the plan can be coordinated with, and/or integrated early into Chapter 103E processes and proceedings. When projecting funding needs for BMP implementation along, or within the drainage area of, public drainage systems, incorporate applicable Sections of Chapter 103E.
- **Wetlands** – Protection and restoration of wetlands provides benefits for water quality, flood damage reduction, and wildlife habitat. The plan should support the continued implementation of the Wetland Conservation Act and look for opportunities to improve coordination across jurisdictional boundaries. The plan should also identify high priority areas for wetland restoration and strategically target restoration projects to those areas. The [Restorable Wetland Prioritization Tool](#) is an example resource that can be used to help identify such areas. The state is embarking on a new wetland prioritization plan that will guide wetland mitigation in the future. Wetland restoration and preservation priorities in this plan may be eligible for inclusion in this plan in the future.
- **Conservation Easements** – The State’s Re-Invest in Minnesota (RIM) Reserve easement program and the Conservation Reserve Enhancement Program (CREP), in partnership with the United States Department of Agriculture (USDA), considers several site specific and landscape scale factors when funding applications. Though it is dependent on specific program terms, the State considers local prioritization of areas for easement enrollment. The plan should take into account areas with a higher risk of

contributing to surface and subsurface water degradation, such as highly erosive lands and wellhead protection areas that would benefit from being placed under permanent vegetative cover.

- **GRAPS** - The [Groundwater Restoration and Protection Strategies \(GRAPS\)](#) for the Middle Minnesota watershed is currently under development and may be available in the near future. This report, if available, will help identify specific groundwater issues in the planning area; therefore, implementation actions to address these issues should be addressed in the plan.
- **WRAPS** - The Watershed Restoration and Protection Strategies (WRAPS) for the Middle Minnesota watershed and pertinent information related to development of the WRAPS available from MPCA staff. The WRAPS outlines reduction goals for excess sediment, phosphorus, nitrogen, and E. coli Bacteria as well as identifies areas for protection within the area and goals address degraded stream habitat. These goals should be reviewed and incorporated into your planning effort.
- **Lakes** – Lakes are very important to the local quality of life and local economies and are sensitive to nutrient enrichment and runoff from both shoreland and watershed sources. Several of the lakes within the watershed are listed as impaired. The watershed plan should consider prioritizing practices that meet the Lake Restoration and Protection Strategies listed in the Watershed Restoration and Protection Strategies (WRAPS) and the 2018 Nonpoint Priority Funding Plan (NPFP).
- **Landscape Resiliency and Climate Adaption** – BWSR strongly encourages your planning partnership to consider the potential for more extreme weather events and their implications for the water and land resources of the watershed in the analysis and prioritization of issues. The weather record for the planning area shows increased frequency and severity of extreme weather events, which has a direct effect on local water management. Adjustments involving conservation and fieldwork planning and implementation should be explored; for instance, the use of an updated precipitation frequency chart such as the [NOAA Atlas 14](#) when designing conservation projects. An additional source of information for use in the planning process is the [BWSR Landscape Resiliency Toolbox](#). Finally, a new white paper from the Minnesota Interagency Climate Adaptation Team titled “[Building Resiliency to Extreme Precipitation in Minnesota](#)” also provides resiliency strategies related to this topic.
- **Local Controls** - BWSR suggests a comparative review of local ordinances and regulations across the watershed, redetermination of ditches, SSTS compliance inspection requirements (property transfer, variance, etc.), level III feedlot inventories, shore land regulations, etc.) with the purpose of identifying commonalities and significant differences, and opportunities for coordination when planning implementation goals.
- **Soil Erosion/Soil Health** – BWSR believes that accelerated soil erosion, leading to turbidity and other water quality issues, is a significant issue in the watershed. This is especially true in the higher slope areas adjacent to the Minnesota River. The majority of the land use in the Middle Minnesota River planning area is agriculture. The concept and the associated practices of soil health have the potential to positively change the interaction of agriculture and the natural system at the soil level. Common soil health practices include the use of reduce or no tillage, the use of cover crops, increased areas of continuous living cover, and extended crop rotations. Improving soil health can help decreased soil erosion, increase water infiltration, provide nutrient scavenging, and increase soil organic matter. In addition, there seems to be increased interest from landowners and operators about soil health. It is recommended that these soil health practices be prioritized for implementation in the plan.

- **Surface and Groundwater Quality** – BWSR believes degraded water quality, both surface and groundwater, are significant issues in the watershed. The plan should examine current efforts to address these issues, and examine listed impairments and their locations, as strategies are developed to improve both surface and groundwater quality. BWSR advocates for efforts that will focus on reducing pollutant sources before they reach water resources as a key component of an overall strategy.
- **Altered Hydrology/Flooding/Water Quantity** – The hydrologic conditions of the watersheds in this planning area have changed over time. In recent decades more precipitation, more runoff, and more runoff per unit of precipitation has been observed as well as more frequent periods of extremely low flow in some watercourses. These hydrologic changes as well as others have contributed to instability of natural and artificial watercourses, degradation of wetland habitats, loss of agricultural productivity, and increased the risk of flood damages. Recognizing altered hydrology as a priority issue in the plan will help ensure that a driving factor behind many related issues is directly addressed.
- **Protecting Pollinator Populations** - Projects should identify opportunities to benefit pollinator populations through creating areas of refuge and providing floral resources that can benefit a wide range of pollinators. Governor Walz recently signed a new Executive Order “Restoring Healthy, Diverse Pollinator Populations that Sustain and Enhance Minnesota's Environment, Economy, and Way of Life” that directs efforts of the Interagency Pollinator Protection Team. This team recently released a Minnesota State Agency Pollinator Report that outlines state agency priorities. BWSR also has a [BWSR Pollinator Toolbox](#) that provides guidance for project planning, implementation and management.
- **Invasive Species and Landscape Management:** A cooperative approach across the watershed is recommended for invasive species management to address invasive species and weed issues across geographic and ownership boundaries. Invasive species should be prioritized based on their risk to ecosystems, agriculture, recreation, and human health. There should also be a focus on emerging weed threats such as Palmer amaranth that pose a significant risk to agricultural production. Adaptive management strategies should be used to address invasive species and also maintain ecological functions and services within landscapes.
- **Urban Stormwater/MS4s** – Urban stormwater runoff frequently contains pollutants such as pesticides, fertilizers, sediment, salt, and other debris, which can contribute to excess algae growth and poor water clarity/quality in our water resources. Poorly managed urban stormwater can also drastically alter the natural flow and infiltration of water, scour stream banks and harm or eliminate aquatic organisms and ecosystems. Municipal Separate Storm Sewer System (MS4) General Permits is owned/operated by the City of St Peter, City of Mankato and the City of North Mankato within the planning area. These MS4 permit holders are participating in the planning effort, please ensure that their Stormwater Pollution Prevention Programs are incorporated into the plan.
- Data collection and monitoring activities necessary to support the targeted implementation schedule and reasonably assess and evaluate plan progress are required and should be coordinated with other data collection and monitoring efforts.

We commend the partners for their participation in the planning effort. We look forward to working with you through the rest of the plan development process. If you have any questions, please feel free to contact us via email at Jeremy.Maul@state.mn.us, or via telephone at (507-344-2824).

Sincerely,

Jeremy Maul, *Board Conservationist*



cc: Ed Lenz and Julie Westerlund, BWSR (via email)
Barbara Weisman, Al Gleisner and Korey Woodley, DNR (via email)
Reid Christianson, MDA (via email)
Carrie Raber and Scott J. Hanson, MDH (via email)
Bryan Spindler and Jeff Risberg, MPCA (via email)

Equal Opportunity Employer



MN Department of Natural Resources
South Region
21371 State Highway 15
New Ulm, MN 56073

April 26, 2024

Kenny Famakinwa
Environmental Specialist
Nicollet County, Property Services
501 South Minnesota Avenue
St. Peter, MN 5608

Jeremy Maul
Board Conservationist
Board of Water and Soil Resources
11 Civic Center Plaza Suite 300
Mankato, MN 56001

Dear Kenny and Jeremy,

Thank you for inviting the Minnesota Department of Natural Resources (DNR) to provide input in developing a Comprehensive Watershed Management Plan for the Minnesota River- Mankato Watershed.

Attached are natural resource priority concerns we encourage you to address in your plan—keys to protecting and improving the health of the watershed. A plan centered on these priorities will help sustain water resources in ways that enhance the quality of life for all who live, work, and enjoy the outdoors in this watershed.

The DNR can supply scientific data and information related to the attached priorities. We also offer tools and services that can help stakeholders get to know the watershed and explore water resource values.

Our lead staff person for this One Watershed One Plan (1W1P) project is Alan Gleisner, Area Hydrologist, 507-753-0344, alan.gleisner@state.mn.us, based at the DNR office in Hutchinson. Please contact Alan if you have questions or want more information about the attached priorities or the types of technical assistance we can provide.

Also feel free to contact me directly if needed. As the DNR's Regional Director, I am committed to ensuring that DNR staff in the region are organized to assist with 1W1P planning efforts and the resulting plans. We greatly value the opportunity to contribute to the process and hope the information we provide is helpful.

Sincerely,

A handwritten signature in blue ink, appearing to read 'S. Roemhildt', enclosed within a thin blue rectangular border.

Scott W. Roemhildt
Regional Director, Region 4
Minnesota Department of Natural Resources

cc: Alan Gleisner, Korey Woodley, Ethan Jenzen, Barbara Weisman, Jeremy Maul, Bryan Spindler, Scott Hanson, Catherine Neuschler, Reid Christianson

Equal Opportunity Employer

DNR Priorities for the Minnesota River - Mankato Watershed

The priorities below were identified in consultation with an interdisciplinary team of DNR natural resource management specialists from multiple DNR divisions whose work areas include this watershed. The priorities they helped identify relate most closely to four of the high-level issues that Comprehensive Watershed Management Plans are expected to consider: Water Quality and Quantity; Wetland Protection, Enhancement, and Restoration; Habitat and Outdoor Recreation; and Land Use Management and Natural Resources.

High-Level Priority Issue	Priority Resource Concerns & Opportunities
Water Quality & Quantity	Altered Hydrology, Drainage, and Flood Damage Reduction Concern: Changes to the watershed’s landscape have led to decreased water storage and increased watershed discharge. Changes to the net increase in water flow and volume across the watershed (altered hydrology) reduce stream channel resiliency and increase sediment and nutrient loading, flooding, and stresses to infrastructure and communities. Significant investments in unmitigated drainage improvements can offset public and private investments in watershed health improvement efforts, and the cumulative impact of multiple drainage projects can be substantial, as they are, in effect, watershed projects. Hydrology trend analysis tabulated from the long-term USGS gage data in Mankato, from 1930-2020, indicates a significant increase in river flows over historic averages. An analysis of the flow record indicates 1983 as the approximate change point in the relationship between precipitation and streamflow. Since 1983, watershed discharge has increased at a faster rate than can be explained by precipitation increases alone. This trend has resulted in extended periods of high flows, fewer low flows, and more frequent flooding. For more information, see the Evaluation of Hydrologic Change (EHC) for the Minnesota River- Mankato Watershed. • Opportunity: Drainage Management – Encourage drainage ditch and drainage tile improvement projects to include practices to offset or mitigate increases in cumulative discharge and peak flows. Incorporating landscape-suitable water storage practices and moderate drainage coefficients can help address peak flow volumes downstream and reduce overall cumulative discharge. • Opportunity: Targeted Water Storage – Water storage projects in the upper reaches of a watershed offer multiple benefits, including flood water storage, groundwater recharge, and nutrient filtration, that reduce discharge and mitigate negative impacts of altered hydrology for downstream receiving waters. Off-channel, dry impoundments and wetland restorations are two of many possible water storage practices to consider. • Opportunity: Early Coordination on Drainage Projects – Early coordination when planning drainage improvement projects often benefits all parties by providing opportunities to explore alternative solutions for high-priority issues. Early coordination includes assessing the current condition (including channel stability) of a drainage system and outlet to better inform landowners, drainage authorities, and watershed groups about any potential impacts a proposed project might have

High-Level Priority Issue	Priority Resource Concerns & Opportunities
	on sensitive natural resources or downstream receiving waters. Early coordination also helps identify potential areas of restoration or storage to benefit landowners as well as watershed natural resources while concurrently achieving project goals. Opportunity: Flood Damage Reduction – Utilize or develop effective floodplain management resources to address increased flood risk due to altered hydrology, thereby reducing public expenditures related to flood damages (MNDNR Floodplain Management). Infrastructure such as bridges and culverts must be appropriately designed and the DNR can provide guidance on floodplain culvert designs that lower maintenance costs, improve water quality, and reduce flood risk. Stream Geomorphology and Connectivity Concern: A large portion of the rivers and streams in this watershed have been altered, contributing to channel incision, widening, instability, and sedimentation issues, which impact water quality. Stream connectivity encourages aquatic organism movement, both upstream and downstream, and includes lateral connectivity, which is a stream’s ability to access its floodplain during periods of high water. In many places in this watershed, stream connectivity has become degraded or fragmented. Opportunity: Natural Channel Restoration – Prioritize the restoration of channelized, straightened, altered, or ditched watercourses to improve stream stability and resiliency, reduce erosion (thereby improving water quality), and improve aquatic and terrestrial habitat. Natural-channel design techniques can mimic a stream’s natural form and restore its hydrologic and ecological functions. Opportunity: Perched Culverts – Longitudinal connectivity refers to pathways along the entire length of a stream and is necessary for the passage of fish and other aquatic life. Perched culverts change the longitudinal gradient abruptly, disrupting channel connectivity for fish passage and sediment transport. Prioritize perched culverts for replacement or stream restoration to allow the migration of aquatic organisms and to address sediment issues. Streams with good longitudinal connectivity are more resilient to erosional change and promote more natural sediment transport with less sediment accumulation and less need for clean-out maintenance or repair. In 2019, MNDOT published the Minnesota Guide for Stream Connectivity and Aquatic Organism Passage through Culverts, which provides guidance on culvert design for stream connectivity. Opportunity: Floodplain Access – Lateral connectivity involves periodic inundation of the floodplain and the resulting exchange of water, sediment, organic matter, nutrients, and organisms. Many streams have been impacted by upstream hydrologic alteration, resulting in channel incision/erosion and difficulty in accessing floodplains. Re-connecting rivers and streams to their floodplains and allowing riparian areas to naturally flood has many benefits, including reducing flow velocities and downstream flood risks, and helping to disperse sediment and nutrients, among others. Improving lateral connectivity should be a priority in this watershed, and the DNR may be able to assist with project selection and design implementation. Opportunity: Culvert Sizing – Culverts should be properly sized and designed to function under various flow conditions while maintaining infrastructure integrity

High-Level Priority Issue	Priority Resource Concerns & Opportunities
	and public safety. Improperly sized culverts negatively impact sediment transport, fish passage, channel stability, and water quality. The DNR can provide additional resources and design information for waterway crossings (see The Geomorphic Approach). • Opportunity: Watershed Characterization – To assist with watershed planning efforts, the DNR published the Minnesota River, Mankato Watershed Characterization Report in 2016, which summarizes watershed and stream conditions, floodplain connectivity, and hydrology. More recently, we completed a supplemental Evaluation of Hydrologic Change (EHC) for the Minnesota River-Mankato Watershed that can aid in the planning process. Another valuable watershed planning resource is the DNR Watershed Health Assessment Framework (WHAF). The WHAF provides an organized approach for understanding natural resource conditions and challenges, and for identifying opportunities to improve the health and resilience of the watershed. Erosion Concern: One of the state’s goals is to ensure that lakes, rivers, and streams are fishable and swimmable. A watershed’s landscape greatly influences the water quality of its streams, rivers, lakes, and ponds. Current water quality conditions in this watershed point to a need for land use changes to reverse pollutant loading trends. • Opportunity: Targeted Agricultural BMP Implementation – While key agricultural land should be protected for agriculture, significant benefits can be realized using targeted conservation best management practices (BMPs), such as cover crops and conservation tillage. Healthy soils protected by cover crops and reduced tillage lessen nutrient loading, increase residue, reduce runoff, and increase water storage within the soil profile. Contact the Minnesota Soil Health Coalition for information on promoting soil health practices farmers can utilize to aid in water retention on the landscape and improve water quality. • Opportunity: Targeted Urban BMP Implementation – A substantial portion of the watershed’s urbanized areas are located on the eastern side and downstream extent of the watershed, with North Mankato, Mankato, and St. Peter accounting for a significant amount of the population. Runoff from these highly developed or densely populated areas carries pollutants and can cause moderate to extreme fluctuations in stream flow and water levels. Design subdivisions and commercial development with urban stormwater management BMPs and incorporate adequately sized water retention basins, catch basins, and storm sewers. Encourage residential property owners to use practices that address stormwater runoff, like rain barrels and rain gardens, to help reduce runoff, promote groundwater infiltration, and establish buffer zones on riparian properties. • Opportunity: Higher Standards for Water Quality in Local Ordinances – Encourage communities to maintain and develop higher-than-minimum water quality standards for shoreline development within riparian areas, especially around high-priority and natural environment lakes. Promote shoreland BMPs to minimize impervious surface impacts, encourage infiltration, and limit nutrient inputs to

High-Level Priority Issue	Priority Resource Concerns & Opportunities
	waters. See the DNR's model ordinance and Innovative Shoreland Standards Showcase for examples. Groundwater Quantity and Protection Concern: A large portion of this watershed relies on groundwater for its drinking water supply. Surface water infiltration plays an important role in increasing aquifer recharge, reducing the amount of surface water runoff, and decreasing flooding. • Opportunity: Groundwater Sustainability and Drinking Water Supply – Ensure groundwater sustainability throughout the watershed and encourage groundwater conservation in water supply plans. Make it a high priority to continue and enhance the protection of Drinking Water Supply Management Areas (DWSMA). • Opportunity: Groundwater Recharge – Give special attention to groundwater recharge areas when drainage tile is being installed or impervious surfaces are being added, especially in low-lying or depressional areas. Consider limiting these activities to help promote groundwater infiltration and aquifer recharge. The DNR can help identify groundwater recharge areas.
Wetland Protection, Enhancement, and Restoration	Concern: A significant portion of the watershed's wetlands have been lost. Priority should be placed on protecting and enhancing existing wetland areas. These existing wetlands provide multiple benefits including water storage, wildlife habitat/corridors, groundwater recharge, and overall ecology of the area. Also promote the restoration of degraded wetland areas throughout the watershed. • Opportunity: Existing Wetlands – Promote and support the protection and enhancement of existing high-value wetland areas, particularly Swan Lake and the surrounding wetland complexes, along with wetlands in the Minnesota River Valley corridor, and utilize various funding sources to restore degraded wetland areas. Target areas that offer higher cost/benefit scenarios, promote wildlife corridors, and maximize water storage. • Opportunity: Permanent Protection – Promote the restoration and permanent protection of wetland areas through the Conservation Reserve Enhancement Program (CREP), Reinvest in Minnesota (RIM), Wetlands Reserve Program (WRP), Wildlife Management Areas (WMA), and other opportunities, along with temporary set-aside programs like the Conservation Reserve Program (CRP).
Habitat and Outdoor Recreation	Concern: This plan should consider the increasing demand for outdoor recreation and address current and developing needs of outdoor recreation for the benefit of watershed residents. Emphasize the maintenance and enhancement of current recreational areas while also promoting new recreational areas to increase quality of life. • Opportunity: Recreation Infrastructure – Prioritize and augment outdoor recreation infrastructure along riparian and upland areas. Continue to support public resources that promote outdoor recreation like biking, hiking, fishing, and boating. • Opportunity: Recreational Fishing - Many valuable recreational fishing resources in this watershed are in poor condition, with low IBI scores (see Watershed Health

High-Level Priority Issue	Priority Resource Concerns & Opportunities
	Assessment Framework: Lakes). Prioritize those lakes, rivers, and streams that are nearly or barely impaired to maintain and enhance high-quality resources while continuing restoration efforts for degraded lakes, rivers, and streams to increase their suitability for recreation. High-priority waters are the Minnesota River, Seven Mile Creek, and Ballantyne, Crystal, Duck, Emily, Loon, Washington, George, Henry, Scotch, and Wita Lakes.
Land Use Management and Natural Resources	Concern: The few native landscapes and natural areas that remain in the watershed support a wide array of threatened and high-value plant and animal species. Land use management tools such as zoning codes and ordinances can help address new challenges that negatively impact these aquatic and terrestrial ecosystems. Education, outreach, and partnerships would also help move the needle for natural resource conservation. • Opportunity: Riparian Habitat – Land adjacent to water bodies and watercourses provides critical habitat corridors for plants and animals. Consider prioritizing fragmented habitats for restoration or protection and preservation. Also consider prioritizing the protection of lake resources from shoreline development and the protection of unaltered stream courses. • Opportunity: Existing Natural Features, Native Species, and Landscapes – Protecting and restoring existing high-value native landscapes, natural features, and native communities is important. Remaining clusters of rare, native, or sensitive natural features help maintain high-quality habitat, while their scarcity elsewhere in the watershed signals the need for restoration or adaptive management. Some of the high-value features within this watershed include Swan Lake WMA and surrounding habitat complexes, the Minnesota River Valley, and several calcareous fens. The Minnesota Wildlife Action Plan and Wildlife Action Network are valuable resources for data and information about species and habitat diversity, habitat quality, habitat connectivity, and opportunities to help protect threatened and endangered species. If requested, the DNR can provide a comprehensive list and map of rare features and native plant communities for this watershed. • Opportunity: Conservation Partnerships – Encourage and continue conservation partnerships with LGUs, state agencies, NGOs, Lake Associations, Conservation Clubs, etc., and seek funding to help with these efforts. • Opportunity: Aggregate Mining – Use the DNR's Aggregate Mapper to encourage responsible and sustainable land use decisions while anticipating future aggregate demand. • Opportunity: Invasive Species – Promote the prevention, containment, and control of both aquatic and terrestrial invasive species. Also, utilize local efforts in collaboration with state programs to improve water quality by stopping the spread of invasives. The Infested Waters List can be downloaded from the DNR's website. The DNR works to help prevent the spread and promote the management of invasive species and may be able to assist. We can provide a map of resources impacted by aquatic invasive species upon request.

High-Level Priority Issue	Priority Resource Concerns & Opportunities
	• Opportunity: Education and Outreach – Increase outreach and education regarding rare and natural species in the watershed and increase awareness of the Species in Greatest Conservation Need (SGCN) identified in Minnesota's Wildlife Action Plan.



Protecting, Maintaining and Improving the Health of All Minnesotans

Date

Kenny Famakinwa, Nicollet County
501 S. Minnesota Ave.
St. Peter, MN 56082
Kenny.famakinwa@co.nicollet.mn.us

Jeremy Maul
BWSR Board Conservationist
11 Civic Center Plaza, Suite 300
Mankato, MN 56001
Jeremy.maul@state.mn.us

Subject: Initial Comment Letter – Minnesota River-Mankato Watershed Planning Project

Thank you for the opportunity to submit comments regarding water management issues for consideration in the One Watershed One Plan (1W1P) planning process for the Minnesota River- Mankato Watershed Planning Area. Our agency looks forward to working closely with the local government units, stakeholders, and other agency partners on this watershed planning initiative.

The Minnesota Department of Health's (MDH) mission is to protect, maintain, and improve the health of all Minnesotans. An important aspect to protecting citizens health is the protection of drinking water sources. MDH is the agency responsible for implementing programs under the federal Safe Drinking Water Act (SDWA).

Source Water Protection (SWP) is the framework MDH uses to protect drinking water sources. The broad goal of SWP in Minnesota is to protect and prevent contamination of public and private sources of groundwater and surface water sources of drinking water using best management practices and local planning. Core MDH programs relevant to watershed planning are the State Well Code (MR 4725), Wellhead Protection (MR 4720) and surface water / intake protection planning resulting in a strong focus in groundwater management and protecting drinking water sources.

One of the three high level state priorities in Minnesota's Non-point Priority Funding Plan is to "Restore and protect water resources for public use and public health, including drinking water" which aligns with our agency's mission and recommendations to your planning process.

MDH Priority Concerns:

Prioritize Drinking Water Supply Management Areas (DWSMA) in the Minnesota River-Mankato Watershed 1W1P.

DWSMA boundaries establish a protection area through an extensive evaluation that determines the contribution area of a public water supply well, aquifer vulnerability and provide an opportunity to prioritize specific geographic areas for drinking water protection purposes. DWSMA boundaries that extend beyond city jurisdictional limits or are established in Wellhead Protection (WHP) Action Plans for non-municipal public water supplies, like mobile home parks, can be a special focus for local partners prioritizing drinking water protection activities.

Aquifer vulnerability determines the level of management required to protect a drinking water supply and provides an opportunity to target implementation practices in accordance with the level of risk different land uses pose. The attached Public Water Supply Summary Spreadsheet highlights the primary drinking water protection activities for many Drinking Water Supply Management Areas (DWSMA's) in the watershed.

Support the implementation of Highly Vulnerable Wellhead Plans and Action Plans

Within the watershed, the cities of St. Peter and Kasota were determined to be highly vulnerable to surface contamination. The city of St. Peter has installed a water treatment system for nitrates because of elevated levels within their public water supply wells. The city of Kasota has nitrate levels that indicate their aquifer has been impacted by surface activities. Both of these cities DWSMA's contain a surface water contribution area which could provide an opportunity for targeting of specific land use practices within the 1W1P. The DWSMA for Valley Mobile Home Park, which is adjacent to the city of Kasota, is also considered highly vulnerable. This system is a non-municipal community public water system and has an active action plan in place. Lakes and Links Homeowners Associate located on Lake Emily in Le Sueur County is another highly vulnerable non-municipal community system that has has an action plan developed to help implementation efforts.

Support the implementation of Mankato's Surface Water Intake Protection Plan.

Approximately 70% of the city of Mankato's drinking water is supplied by two shallow Ranney wells that draw water from the Minnesota and Blue Earth Rivers. Source water to these wells is considered to be groundwater under the direct influence of surface water, filtered through the riverbed sediments with a very short time-of-travel. Mankato well 13 sits at the confluence of the Blue Earth and Minnesota Rivers and Well 15 is directly adjacent to the Minnesota River. Nitrate concentrations in Mankato Ranney Wells has previously reached levels of concern. Portions of the Mankato Drinking Water Supply Management Area- Surface Water, Emergency Response Area, and the Spill Management Area are within the Minnesota River-Mankato Watershed planning area.

The Mankato Emergency Response Area is designed to help the cities address potential contaminant sources and contaminant releases that present an immediate health concern to water users. The Spill Management Area is designed to focus source water protection activities on potential contaminant sources within 500 feet of either the centerline of a public stream or the shoreline of a lake contributing flow to the city's source waterbody. The DWSMA-SW area protects water users from long-term health effects related to low levels of contamination that originate from diffuse, widespread sources. These contaminant sources, known as non-point contaminants, can pose a high-level threat when the combined concentration of the contaminant from across the watershed is substantially high. The DWSMA-SW also delineates areas where future land use development may influence the source water quality.

Watershed protection strategies outlined in the Surface Water Intake Protection Plan are important in protecting the surface water supplies. Protection strategies may include watershed management and implementation of nutrient management BMPs with landowners and other sources of nitrogen. Support any efforts that may protect the surface water which contributes to the drinking water sources. The Mankato Source Water Assessment and the Surface Water Intake Protection Plans can be obtained by contacting the city of Mankato or MDH.

Prioritize Sealing Abandoned Wells

Unused, unsealed wells can provide a conduit for contaminants from the land surface to reach the sources of drinking water. This activity is particularly important for abandoned wells that penetrate a confining layer above a source aquifer.

Sealing wells is a central practice in protecting groundwater quality, however when resource dollars are limited it is important to evaluate private well density to identify the populations most at risk from a contaminated aquifer.

Prioritize Protection of Private Wells

Many residents of Minnesota River-Mankato Watershed rely on a private well for the water they drink. However, no public entity is responsible for water testing or management of a private well after drilling is completed. Local governments are best equipped to assist private landowners through land use management and ordinance development, which can have the greatest impact on protecting private wells. Other suggested activities to protect private wells include: hosting well testing or screening clinics, providing water testing kits, working with landowners to better manage nutrient loss, promoting household hazardous waste collection, managing storm water runoff, managing septic systems, and providing best practices information to private well owners.

Approximately 15% of the 261 arsenic samples taken from wells in the Minnesota River-Mankato Watershed have levels of arsenic higher than the Safe Drinking Water Act (SDWA)

standard of 10 micrograms per liter (µg/L). Arsenic occurs naturally in rocks and soil and can dissolve into groundwater. Consuming water with low levels of arsenic over a long time (chronic exposure) is associated with diabetes and increased risk of cancers of the bladder, lungs, liver and other organs. The SDWA standard for arsenic in drinking water is 10 µg/L; however, drinking water with arsenic at levels lower than the SDWA standard over many years can still increase the risk of cancer. The EPA has set a goal of 0 µg/L for arsenic in drinking water because there is no safe level of arsenic in drinking water.

Eight percent (8.0%) of the 1,418 nitrate samples collected from wells within the Minnesota River- Mankato Watershed exceed the maximum contaminate level of 10 mg/l as set by the Safe Drinking Water Act. Sources of nitrate include organic sources such as human and livestock waste as well commercial fertilizers applied to lawns and farm fields. Elevated nitrates within aquifers is directly related to the environmentally sensitive nature of the soils and landscape within a region. Karst geology and sandy soils tend to increase the amount of nitrates that leach into localized aquifers. These environmentally sensitive areas should be targeted for agriculture BMP's within the plan as well as an area of focus for individual sewage treatment systems.

Prioritize Protecting Noncommunity Public Water Supplies

Noncommunity public water supplies provide drinking water to people at their places of work or play (schools, offices, campgrounds, etc.). Land use and management activities (maintaining/upgrading SSTS, well sealing, etc.) should consider effects on these public water systems. Find information regarding noncommunity public water supplies in the watershed in reports titled Source Water Assessments (SWA) at:

<https://www.health.state.mn.us/communities/environment/water/swp/swa.html>

Source Water Assessments provide a concise description of the water source - such as a well, lake, or river - used by a public water system and discuss how susceptible that source may be to contamination. There are 35 non-community public water systems within the Minnesota River- Mankato Watershed.

Targeting Groundwater & Drinking Water Activities in the 1W1P Planning Process

Limitation of Existing Tools –

Watershed models used for prioritizing and targeting implementation scenarios in the 1W1P, whether PTMapp, HSPF-Scenario Application Manager (SAM) or others, leverage GIS information and/or digital terrain analysis to determine where concentrated flow reaches surface water features. While this is an effective approach for targeting surface water contaminants, it does not transfer to groundwater concerns because it only accounts for the movement of water on the land's surface. Unfortunately, targeting tools are not currently available to model the impact on groundwater resources. The Minnesota Department of Health suggests using methodologies applied by the agency to prioritize and target implementation activities in the Source Water Protection program.

Using the Groundwater Restoration and Protection Strategies (GRAPS) Report –

The MDH, along with its state agency partners, are developing a Groundwater Restoration and Protection Strategies (GRAPS) report for the Minnesota River- Mankato *Watershed*. GRAPS will provide information and strategies on groundwater and drinking water supplies to help inform the local decision making process of the 1W1P. Information in a GRAPS Report can be used to identify risks to drinking water from different land uses. Knowing the risks to drinking water in a specific area allows targeting of specific activities.

- Prioritize Actions Identified in the Groundwater Restoration and Protection Strategies (GRAPS) report.

Using Wellhead Protection Plans –

- Identify Drinking Water Supply Management Areas (DWSMA) located in the watershed.
- Examine the vulnerability of the aquifer to contamination risk to determine the level of management required to protect groundwater quality. For example, a highly vulnerable setting requires many different types of land uses to be managed, whereas a low vulnerability setting focuses on a few land uses due to the long recharge time and protective geologic layer.
- Use the Management Strategies Table in a Wellhead Protection Plan to identify and prioritize action items for each DWSMA

Using Guidance Documents to Manage Specific Potential Contaminant Sources –

The MDH has developed several guidance documents to manage impacts to drinking water from specific potential contaminant sources. Topics include mining, stormwater, septic systems, feedlots, nitrates, and chemical and fuel storage tanks. This information is available at

<https://www.health.state.mn.us/communities/environment/water/swp/resources.html>

Attached you will find a listing of MDH data and information to help you in the planning process. Thank you for the opportunity to be involved in your watershed planning process. If you have any questions, please feel free to contact me at (507) 206-2734 or email: scott.j.hanson@state.mn.us

Sincerely,

Planner Name, Principal Planner
Minnesota Department of Health
Source Water Protection Unit

Attachments

CC: Mark Wettlaufer, MDH Source Water Protection Unit
Lauren Larkin, Hydrologist, MDH Source Water Protection Unit
Yarta Clemens-Billaigbakpu, MDH Source Water Protection Unit
Carrie Raber, MDH Source Water Protection Unit
Dereck Richter, MDH Source Water Protection Unit
Danielle Nielsen, MDH Source Water Protection Unit
Amanda Strommer, MDH Source Water Protection Unit Planner
Adam Beilke, BWSR Clean Water Specialist
Erynn Jenzen, Hydrologist, Minnesota Department of Natural Resources
Paul Davis MPCA
Reid Christianson, MDA Clean Water Technical Unit Supervisor
Scott Matteson, Hydrologist Minnesota Department of Agriculture
Bryan Spindler, MPCA
Katie Wigen, DNR
Alan Gleisner, DNR
Mark Hiles, BWSR

MDH Data and information:

- Drinking Water Statistics – Where do people get their drinking water in the Minnesota River Mankato Watershed? Approximately 70 percent of the drinking water for the city of Mankato comes from surface water through the Ranney wells that pull water from the substrata below the Minnesota and Blue Earth Rivers. The rest of the watershed relies on groundwater for drinking water. This information can help you understand where people are obtaining their drinking water and develop implementation strategies to protect the sources of drinking water in the watershed.
- A spreadsheet of the public water supply systems in the watershed, status in wellhead protection planning, and any drinking water protection concerns or issues that have been identified in protection areas. This information can help you understand the drinking water protection issues in the watershed, prioritize areas for implementation activities, and identify potential multiple benefits for implementation activities.
- Shape files of the Drinking Water Supply Management Areas (DWSMA) in the watershed are located at <https://www.health.state.mn.us/communities/environment/water/swp/maps/index.htm>. This information can help you prioritize and target implementation activities that protect drinking water sources for public water supplies.

MDH Figures:

- A figure detailing the “Pollution Sensitivity” in the Minnesota River- Mankato Watershed. This information can help you understand the ease with which recharge and contaminants from the ground surface may be transmitted into the upper most aquifer on a watershed scale. Individual wellhead protection areas provide this same information on a localized scale. This in turn can be used to prioritize areas and implementation activities.
- A figure detailing “Regional Aquifers” in the Minnesota River-Mankato Watershed. This data source displays the general distribution of aquifer use in the watershed, signaling where drinking water is at greatest risk to contaminants from the ground surface. This information allows for targeting of implementation activities to the sources of water people are drinking.
- A figure detailing “Maximum Nitrate Results” in the Minnesota River-Mankato Watershed. This information can help you understand which wells in the watershed contain elevated nitrate levels.

- A figure detailing “Arsenic Results” in the Minnesota River-Mankato Watershed Underlain by Geologic Sensitivity Ratings from Wells. This information can help you understand which wells in the watershed contain elevated arsenic levels.
- A figure detailing “DWSMA Vulnerability” in the Minnesota River-Mankato *Watershed*. This information can help you understand which DWSMA is most vulnerable to contamination from the ground surface. The surface water DWSMA for the city of Mankato is also shown on the map. This figure allows for targeting of implementation activities for public water suppliers.
- A figure detailing “Land Cover” within the Minnesota River- Mankato Watershed. This information can help target implementation efforts based upon our activities occurring throughout the watershed.

Minnesota River-Mankato Public Water Supplies - Drinking Water Protection Concerns for Quality & Quantity

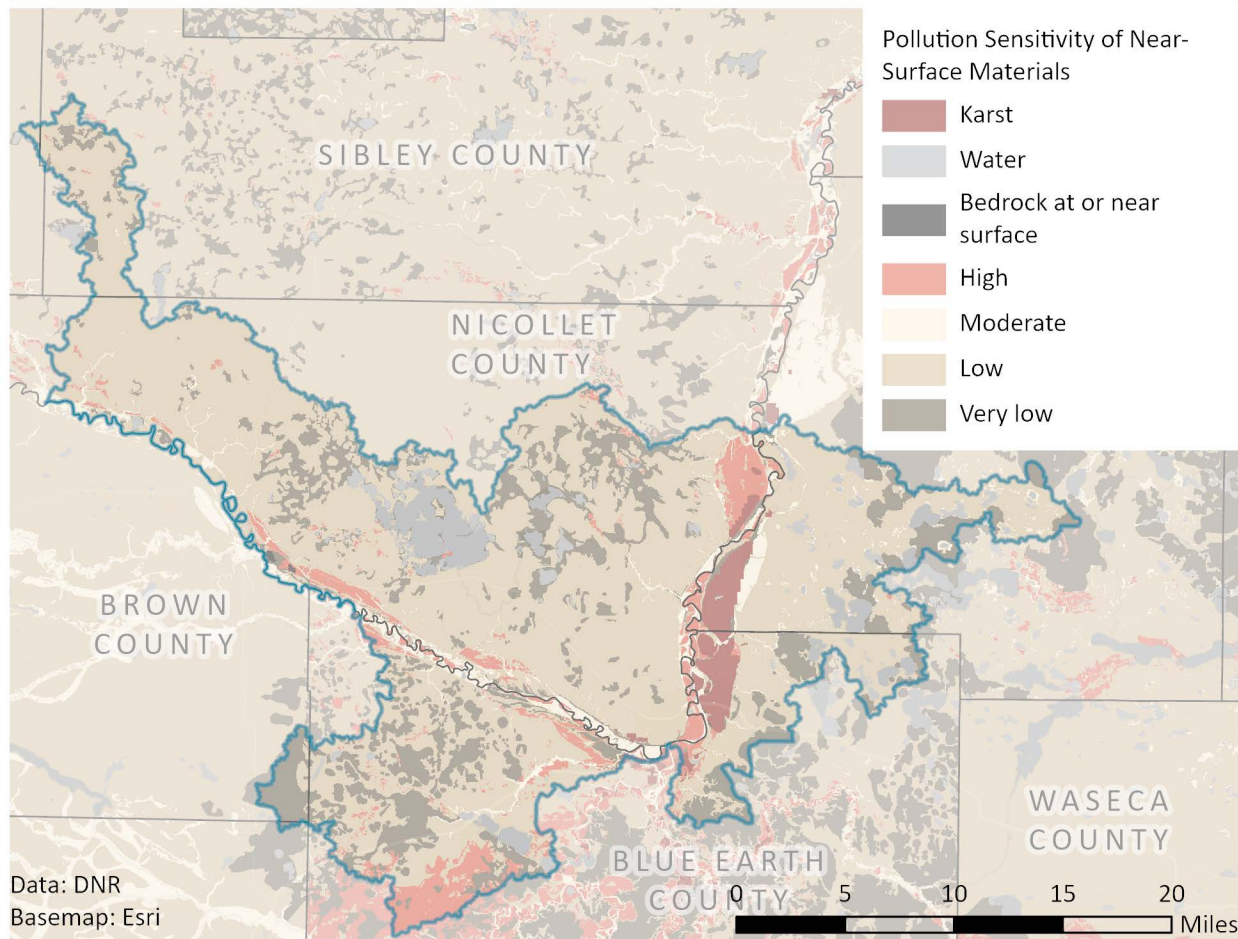
Aquifer Risk	Name	County	Subwatershed	WHP Plan	DWSMA Vulnerability	Drinking Water Protection Concerns
Very high potential contaminant risk due to connection with surface water - Focus on impacts from land use practices and surface water runoff						
High Vulnerable -groundwater	St. Peter	Nicollet	Seven mile creek, Rogers Creek, St. Peter-Minnesota River	Yes	High	Wells #6, #9, and #11 exceed the MCL for nitrates. The city has installed treatment for nitrates utilizing reverse osmosis.
	Mankato	Blue Earth	Judicial Ditch # 48, Minneopa Creek, County Ditch #3, Swan Lake Outlet, Courtland- Minnesota River, New Ulm- Minnesota River, Fritsche Creek, Huelskamp- Minnesota River	SWIPP	High surface water system- Minnesota River	Elevated nitrates
	Kasota	LeSueur	St. Peter-Minnesota River, Shanaska Creek	Yes	High	Nitrate levels show influence of surface activities
	Valley Mobile Home Park	LeSueur	St. Peter-Minnesota River, Shanaska Creek	Action Plan	High	Nitrate levels show influence of surface activities.
	Lakes and Links Homeowner Association	LeSueur	City of St Peter- Minnesota River	Action Plan	High	
Moderate Potential risk and low risk Focus on potential land use contaminant sources that may impact water quality and well sealing						
	Madison Lake	Blue Earth	Madison Lake, Shanaska Creek	Yes	Moderate	
	New Ulm	Brown	Fritsche Creek, Swan Lake, Huelskamp Creek	Yes	Moderate	City has treatment for radionuclides
	LOW RISK					

Nicollet	Nicollet	Middle Lake	Yes	Low	
Lake Crystal	Blue Earth	Judicial Ditch No. 48 , Lake Crystal	Yes	Low	
Cleveland	Le Sueur	Cherry Creek	Yes	Low	
North Mankato	Nicollet	County Ditch # 3 Minnesota River, City of Mankato-Minnesota River	Yes	Low	Treatment for radionuclides
Skyline	Blue Earth	City of Mankato-Minnesota River	Yes	Low	
South Bend Township	Blue Earth	City of Mankato- Minnesota River	Yes	Low	
Mankato #11	Blue Earth	City of Mankato- Minnesota River	Yes	Low	
School Sisters of Notre Dame	Blue Earth	City of Mankato-Minnesota River	Action Plan	Low	Treat for Arsenic
North Mankato SE	Nicollet	City of Mankato-Minnesota River	Yes	Low	Treatment for radionuclides
Mankato West	Blue Earth	County Ditch # 3 Minnesota River, City of Mankato-Minnesota River	Yes	Low	
Klossner Water Association	Nicollet		No		This system has not been brought into the wellhead program. Geology indicates non-vulnerable.
Courtland	Nicollet		No		This system has not been brought into the wellhead program. Geology indicates non-vulnerable.

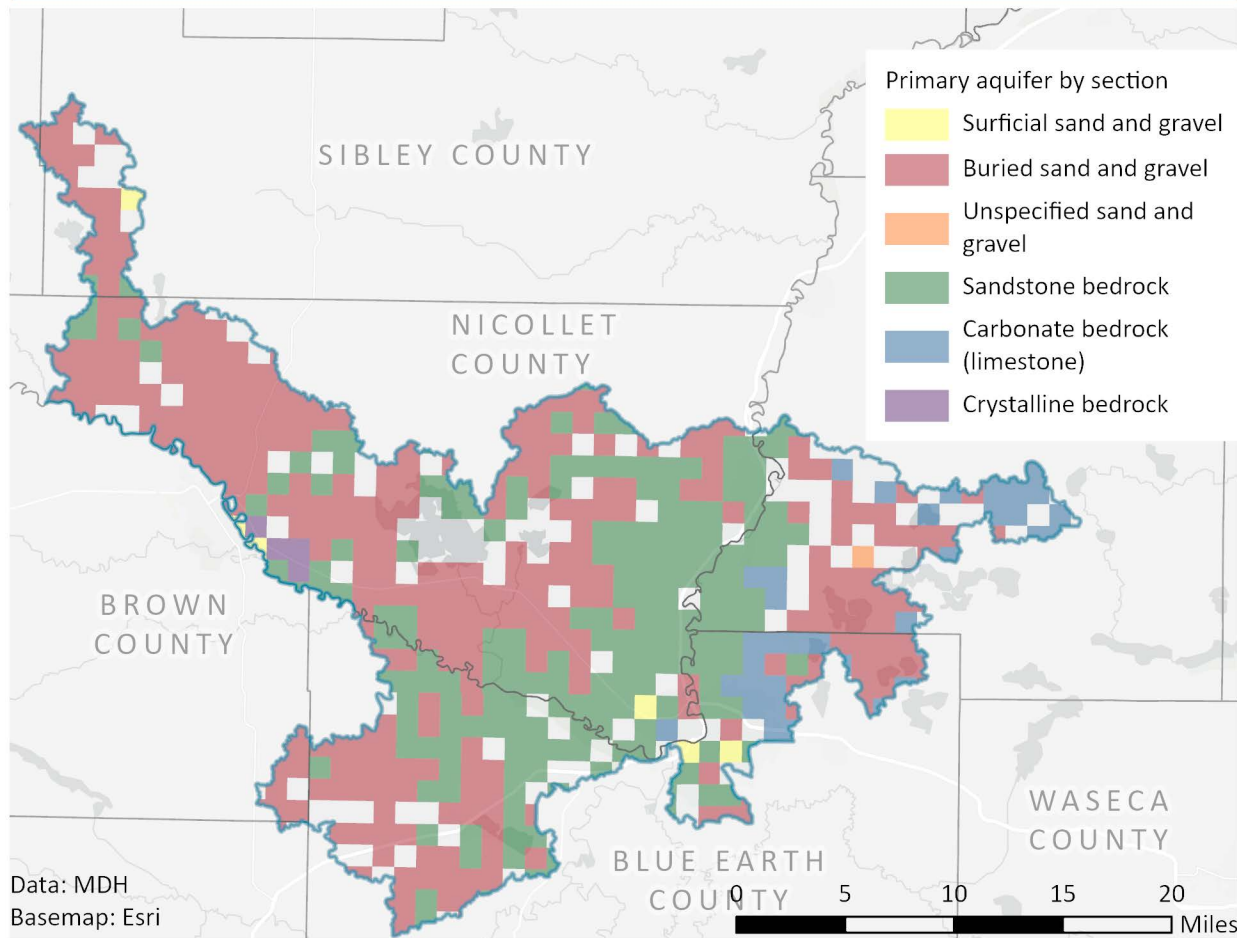
There are 35 non-community public water suppliers within the watershed. Including schools, daycares and businesses.

Acronyms:
SWCA=Surface Water Contribution Area
DWSMA=Drinking Water Supply Management Area
WHP=Wellhead Protection Plan

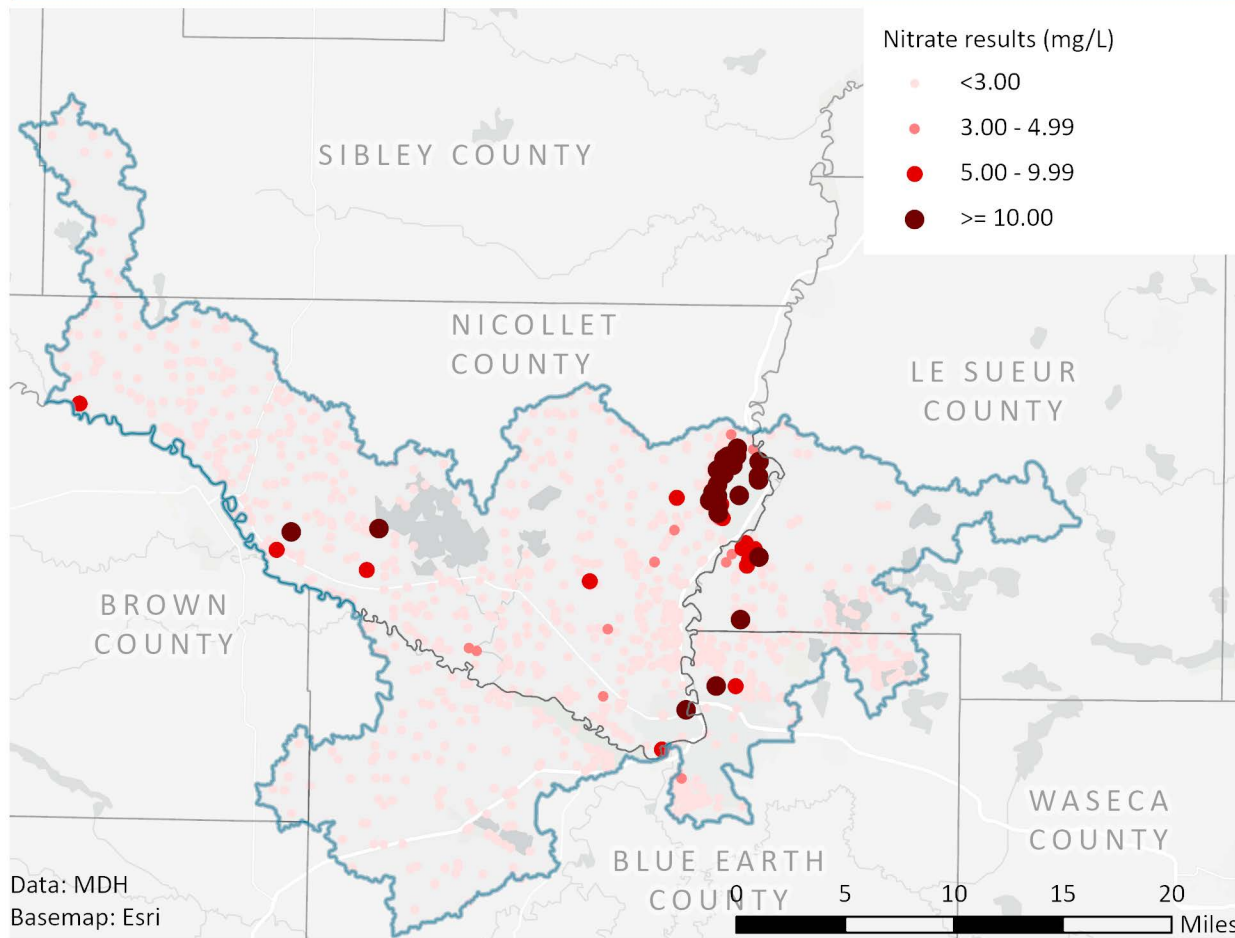
Minnesota River - Mankato: Pollution Sensitivity



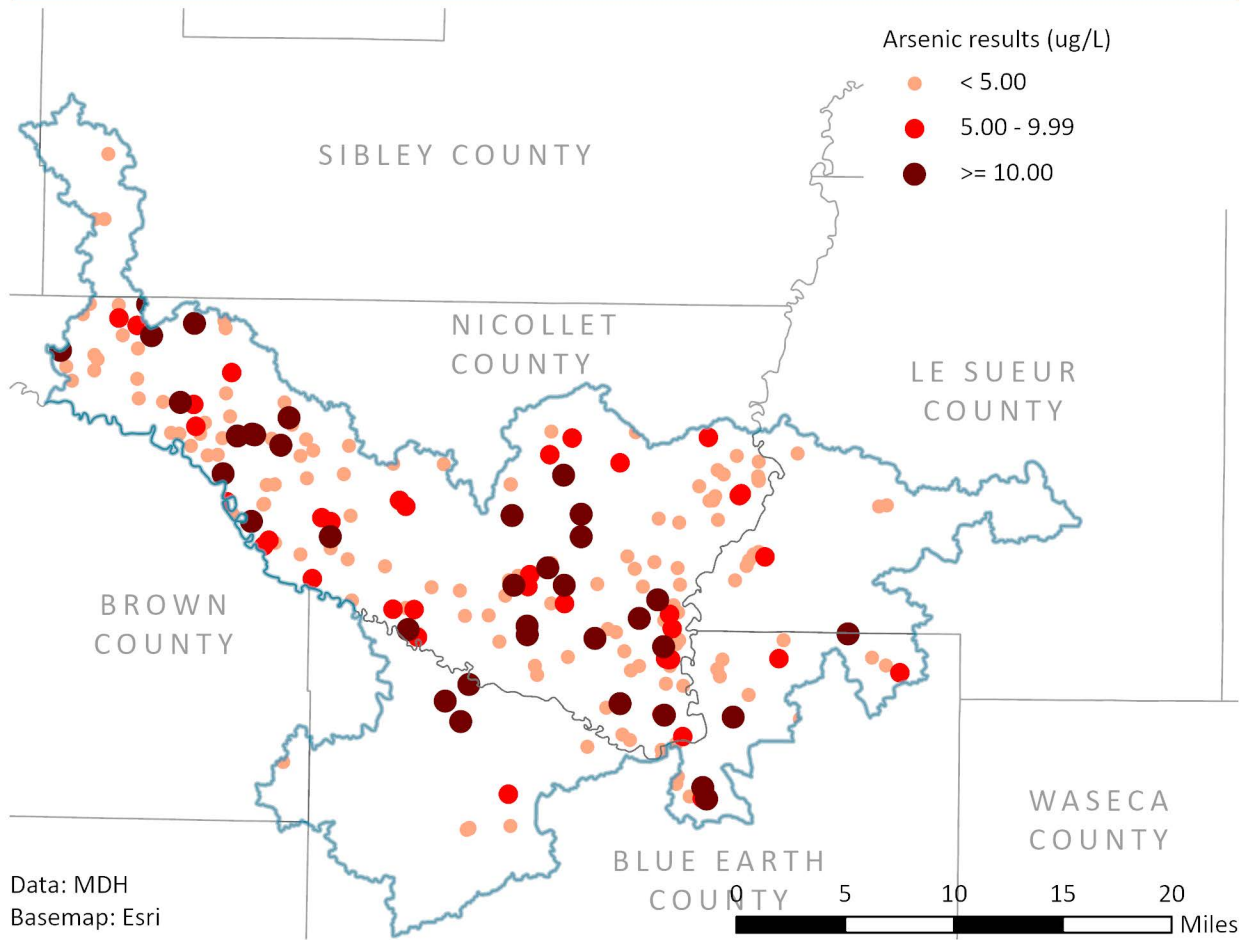
Minnesota River - Mankato: Regional Aquifers



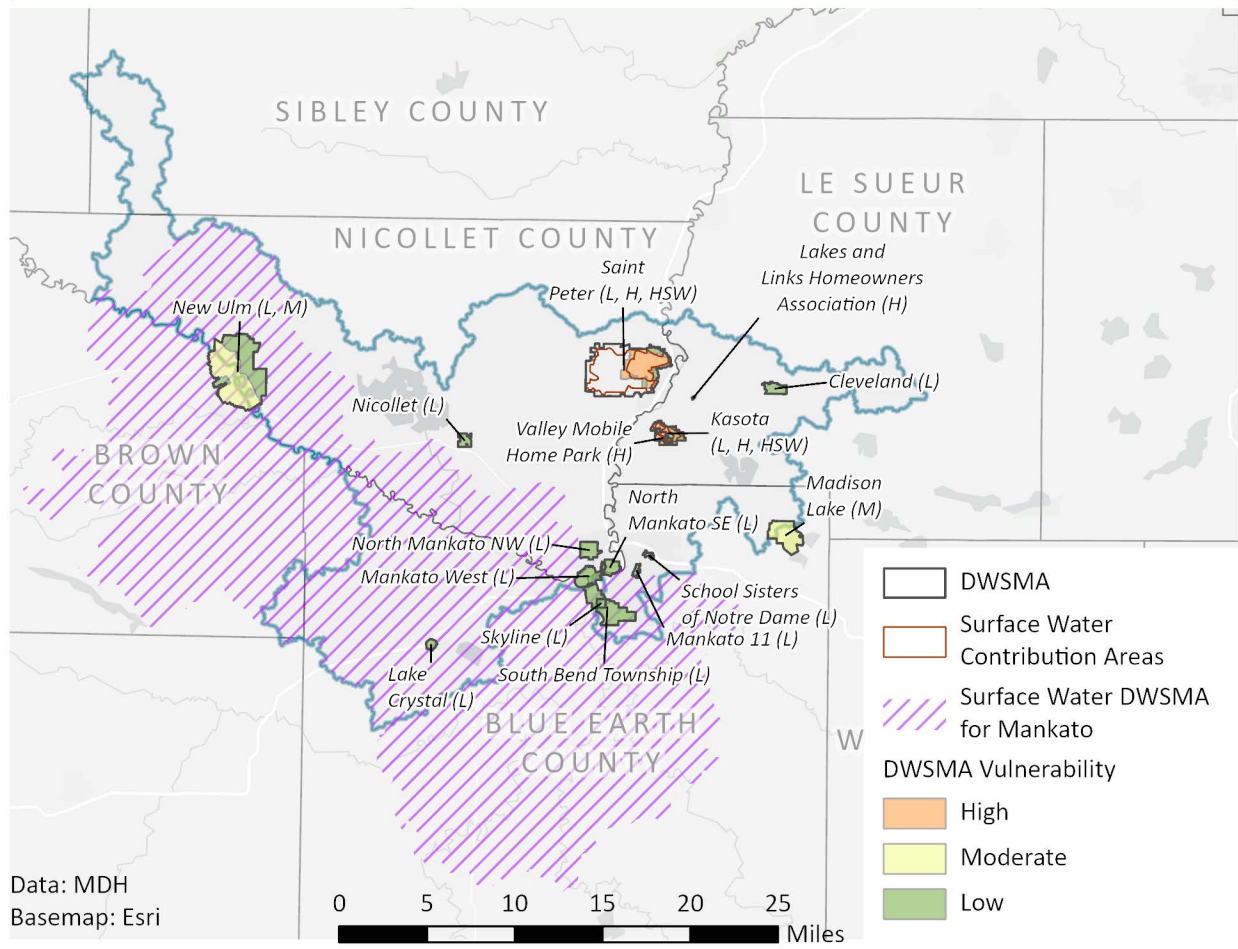
Minnesota River - Mankato: Maximum Nitrate Results



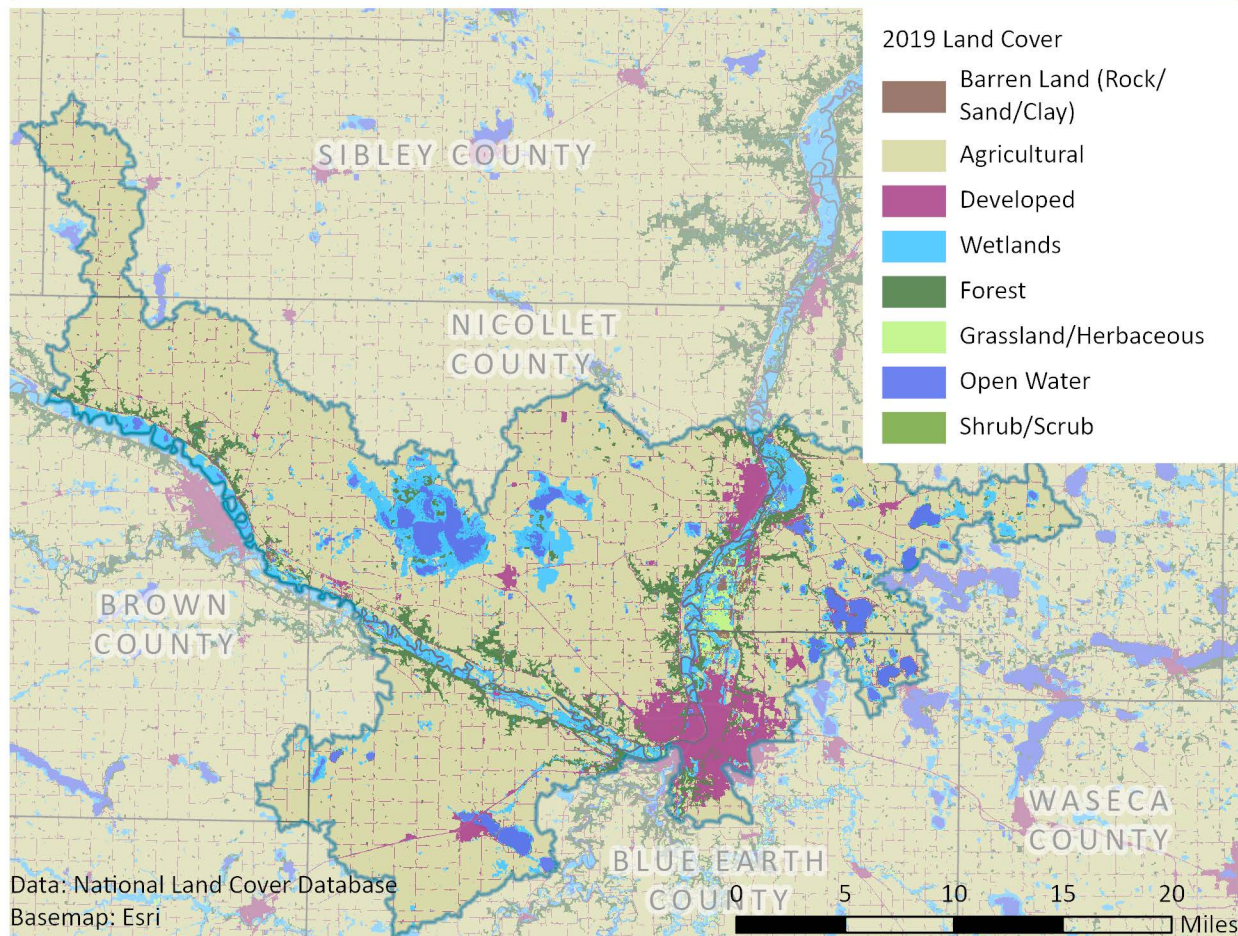
Minnesota River - Mankato: Arsenic Results



Minnesota River - Mankato: DWSMA Vulnerability



Minnesota River - Mankato: Land Cover



April 22, 2024

Kenny Famakinwa
Environmental Specialist
Nicollet County
501 S Minnesota Ave
St. Peter, MN 56082
Kenny.Famakinwa@co.nicollet.mn.us

Jeremy Maul
Board Conservationist
Board of Water and Soil Resources
11 Civic Center Plz, Ste 300
Mankato, MN 56001
jeremy.maul@state.mn.us

RE: Response to Request for Priority Issues and Concerns to be addressed in the Minnesota River-
Mankato River One Watershed, One Plan

Dear Kenny and Jeremy:

The Minnesota Pollution Control Agency (MPCA) appreciates the opportunity to provide priority resource concerns and issues for consideration in the Minnesota River- Mankato One Watershed, One Plan (1W1P). Our priority resource concerns and issues focus primarily on information available through the [Watershed Approach](#) process for the Minnesota River- Mankato Watershed (MRMW) that began in 2013. A list of the available reports, studies, technical information, data, and other relevant supporting documents from this process and prior watershed work is included below.

The MPCA and other state agencies coordinated with local partners to gather, analyze, and summarize information to develop the watershed restoration and protection strategies (WRAPS) report for the entire MRMW Hydrologic Unit Code (HUC)-8. The following pages provide a summary of available information from the watershed process, and where possible only discuss the tributary streams and lakes in the 1W1P planning area (Nicollet, Blue Earth, and Le Sueur counties). The data for the mainstem Minnesota River is excluded. The MPCA requests you consider this information during development of the 1W1P.

Background Information

The State of Minnesota employs a watershed approach to restore and protect Minnesota's rivers, lakes, and wetlands. The watershed approach includes the following processes that can be used to inform water planning:

1. Watershed monitoring and assessment
2. Stressor identification (SID) of biological impairments
3. Total maximum daily loads (TMDLs)
4. WRAPS

The following pages provide a brief description of these processes and internet links for the reports associated with these efforts in the MRMW.

Monitoring and Assessment

In 2013, a comprehensive approach was taken to monitor and assess surface water bodies in the MRMW for aquatic life, recreation, and fish consumption use support. For details on the data collected, refer to the [Minnesota River-Mankato Watershed Monitoring and Assessment Report](#). For more

information about the MRMW and links to reports visit: [Minnesota River- Mankato Watershed Information Page](#).

Monitoring data are used to determine if water quality is supporting a water body's designated use. During the assessment process, data on the waterbody are compared to relevant standards. When pollutants/parameters in a waterbody do not meet the water quality standard, the waterbody is considered impaired. When pollutants/parameters in a waterbody meet the standard (e.g., when the monitored water quality is cleaner than the water quality standard), the waterbody is considered supporting. Data from three water quality monitoring programs inform water quality assessment and create a long-term data set to track progress toward water quality goals. These programs will continue to collect and analyze data in the MRMW as part of Minnesota's Water Quality Monitoring Strategy. Intensive Watershed Monitoring (IWM), the WPLMN, and Volunteer Stream and Lake Monitoring Program (VSMP and CLMP) data provide a periodic but intensive "snapshot" of water quality conditions throughout the watershed.

Within the MRMW 1W1P planning area there are 81 impairment listings. The table below summarizes the listings by impairment type and TMDL status. See the [2024 Minnesota Impaired Waters List](#) for details.

Summary of water quality impairments for the MRMW planning area.

Impairment Type	Number of Listings	Beneficial Use	Completed TMDL
Benthic Macroinvertebrates Bioassessments	21	Aquatic Life	0
<i>Escherichia coli</i> (<i>E. coli</i>)	12	Aquatic Recreation	12
Fecal Coliform	8	Aquatic Recreation	8
Fish Bioassessments	20	Aquatic Life	0
Mercury in Fish Tissue	5	Aquatic Consumption	4
Nitrate	2	Drinking Water	2
Nutrients	9	Aquatic Recreation	9
Turbidity	4	Aquatic Life	4

Stressor Identification

SID is performed on biological impairments to determine what pollutant and nonpollutant stressors are causing impairments to the aquatic biological community. The process is described in more detail and documented in the [Minnesota River Mankato SID Report](#) for the reaches listed for aquatic life impairments (fish, aquatic macro-invertebrate impairments). SID was completed on 25 water bodies for biota (fish and/or macroinvertebrates) impairments in the MRMW planning area. In the study, primary stressors are identified as summarized below. Details of each stream reach are in the SID report.

Stressor identification summary for the aquatic life impaired streams in the MRMW planning area.

Stressor	Number of Reaches
Dissolved Oxygen	10
Eutrophication	6
Nitrate	14
Total Suspended Solids	4
Habitat	14
Connectivity	13
Temperature	1
Altered Hydrology	25

Total Maximum Daily Loads

The Clean Water Act requires that TMDLs be developed for waters that do not support their designated uses. A TMDL essentially provides the allowable pollutant loading, as well as needed reductions, to attain and maintain water quality standards in waters that are not currently meeting standards. TMDL studies have been completed for 39 of the 81 impairments on waterbodies for the MRMW planning area.

TMDL reports containing impaired water bodies in the MRMW, and pollutant reductions are found here:

[Minnesota River - Mankato Watershed TMDL Report](#)

[Crystal Lake TMDL Study Excess Nutrients](#)

WRAPS

In each cycle of the watershed approach, rivers and lakes across the watershed are monitored and assessed, WRAPS and local plans are developed, and conservation practices are implemented. Much of the information presented in the WRAPS report was synthesized from the Monitoring and Assessment, SID, and TMDL reports. However, the WRAPS report presents additional data and analyses including watershed-scale models and tools, detailed analyses and output from these work products, and a set of potential strategies for point and nonpoint source pollution that will cumulatively achieve, or otherwise make significant progress toward, water quality targets. The MRMW WRAPS report can be found here:

[Minnesota River - Mankato WRAPS Report](#).

To ensure the WRAPS strategies and other analyses appropriately represent the MRMW, local county, SWCD staff, and state natural resource and conservation professionals were convened to inform the report and advise technical analyses. Two key products of this WRAPS report are the strategies table and the priorities section. The strategies table outlines high level strategies necessary to restore and protect water bodies in the watershed, including social strategies that are key to achieving the physical strategies. The priorities section presents criteria to identify priority areas for water quality improvement, including examples of water bodies and areas that meet the prioritizing criteria.

The primary audience for the WRAPS report is local planners, decision makers, and conservation practice implementers; watershed residents, neighboring downstream states, agricultural business, governmental agencies, and other stakeholders are the secondary audience.

Goals and 10-year Targets

Among the required elements of WRAPS are timelines for achieving water quality targets and interim milestones within 10 years of strategy adoption. It is the intent of the implementing organizations in this watershed to make steady progress in terms of pollutant reduction. However, needed pollutant load reductions are generally high and will require significant adoption of conservation practices. This is a general guideline and approximation. Factors that may mean slower progress include limits in funding or landowner acceptance, challenging fixes (e.g., unstable bluffs and ravines, invasive species) and unfavorable climatic factors. Conversely, there may be faster progress for some impaired waters, especially where high-impact fixes are slated to occur or where the watershed is subject to focused efforts.

WRAPS Strategies

A set of restoration and protection strategies were developed to achieve water quality targets for water bodies addressed in the WRAPS. The strategies are provided in the WRAPS report. Where possible, the strategies were derived through quantitative methods; however, in other cases, only more qualitative

characterization of actions was feasible. The chief goal of providing this information is to inform local planning. Specifically, by providing an overall set of actions needed to meet the goals (over some period of years or decades), local planners can focus on a subset of actions to take on for their shorter-term (e.g., 10-year) planning cycle. This provides a means to gauge a plan's ability to make progress over time as well as make adjustments through adaptive management.

Watershed Goals

Among the required elements of WRAPS are timelines for achieving water quality targets and interim milestones within 10 years of strategy adoption. It is the intent of the implementing organizations in this watershed to make steady progress in terms of pollutant reduction. However, needed pollutant load reductions are generally high and will require significant adoption of conservation practices. More information on nutrient reduction goals for the State of Minnesota can be found here: [Reducing nutrient in waters](#)

Prioritizing and Targeting

The WRAPS work group identified initial priorities for restoration for the watershed. The planning MRMW planning group should utilize these priorities and develop/modify as needed to fit the goals of the plan. Listed below are the identified priorities, a brief description of the priority and any water bodies that meet the criteria of that priority if applicable. More details are in the priority table of the WRAPS report.

"Tipping Point: Barely Impaired" Water bodies that are impaired but have a relatively smaller reduction or improvement goal: Nicollet Creek downstream of Swan Lake, headwaters of Seven Mile Creek, and Loon Lake.

"Protection of supporting waters" Water bodies that are currently meeting the water quality standard or not stressed by a specific parameter including "Tipping point - nearly impaired" supporting waters near the threshold and/or with a declining trend: Lake Ballantyne, Lake Emily, Hallett Lake.

"Impaired Waters" Water bodies that have a 303d listed impairment: See WRAPS and impaired waters list.

"Dirtiest Waters or Watersheds" Water bodies or watersheds that have observed data or models indicating that the area is substantially "worse" than others using either 1) estimated reductions, 2) observed data, or 3) model output: Little Cottonwood River, Seven Mile Creek, Henry Lake, Scotch Lake, Crystal.

"Local Priority" Water bodies that are of high social importance to restore or protect: Cherry Creek, Minneopa Creek, Indian Creek, Seven Mile Creek, Lake Washington, Lake Ballantyne, Duck Lake, Lake Emily, Lake Crystal, Swan Lake, Lake Hallett, Scotch Lake, Urban/MS4 areas, cold-water streams, St. Peter Trout Ponds.

"Highly hydrologically altered" Subwatersheds identified as highly hydrologically altered: Minneopa Creek, Seven Mile Creek, and Indian Creek.

"Drinking water and Ground water" Areas contributing water or risks to drinking and ground water resources: Mankato and St. Peter drinking water supply, Kasota Township.

"High impact/ mitigating" Areas that have the ability to mitigate pollutants and stressors when ideally managed or a disproportionately high negative impact when poorly managed.

"Measurable waters" Water bodies with ample monitoring data are selected as priorities because improvements can be measured. Past data can be used to establish baseline conditions prior to work being done and future monitoring data can be used to track the magnitude of change.

Little Cottonwood River, Seven Mile Creek and the lakes with ample data to report trends (see Trends Overview section), and stream reaches with aquatic life (IWM) monitoring locations provide a record to compare after implementing projects. In particular, areas that may show a quick response in aquatic life (IBI) scores are those primarily limited by a connectivity barrier: Eight Mile Creek (intentionally perched culvert), Shanaska Creek (dam/grade control), Spring Creek (perched culvert), and Little Rock Creek (lake outlet).

Groundwater Protection Prioritization

Groundwater protection areas pertinent to the MRMW that were mentioned by the Minnesota River-Mankato WRAPS work group include:

- Protect vulnerable and sensitive groundwater areas throughout the watershed, particularly wellhead protection areas (WHPAs) and drinking water supply management areas (DWSMAs) with high vulnerability.
- Additional concerns in the watershed relate to groundwater and drinking water protection. The main supply of drinking water to the residents and businesses in the MRMW is groundwater – either from private or community wells. Two communities in particular, Mankato and St. Peter, have vulnerable drinking water systems influenced by surface water in the watershed. The MDH has developed Source Water Assessments (SWA) for each of the communities designed to protect the public water source from point and nonpoint pollution including nitrates and other contaminants.

Civic Engagement and Public Participation for WRAPS Work

Civic engagement and public participation were a major focus during the Middle Minnesota River Watershed Approach occurring from 2013 through 2017. The MPCA worked with county and SWCD staff in the watershed, consultants, citizens, and other state agency staff to work on eight projects to promote civic engagement collaboratively in the area. Projects were tailored to local partner interest and capacity. The purpose of this project was to identify community/landowner opportunities, obstacles, and opinions on land management and water quality in the rural portion of the watershed. Ultimately, this work would identify land management options for the purposes of surface water quality restoration and protection within the MRMW. This type of work should be continued and expanded in the 1W1P process. Data and findings are summarized in the [Middle Minnesota River Watershed Approach Civic Engagement Project Summary](#).

Environmental Justice

Environmental justice means the right of communities of color, Indigenous communities, and low-income communities, to the enjoyment of a healthy environment and to fair treatment and meaningful involvement with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. As part of the 2024 WRAPS update process, the MPCA is planning on making environmental justice concerns a priority. As part of this 1W1P, please consider integrating environmental justice values and involve community groups when identifying priority areas in the plan.

The MPCA has resources to assist in identifying areas with environmental justice concerns:

[Understanding environmental justice in Minnesota \(arctgis.com\)](https://arctgis.com)

[MPCA and environmental justice | Minnesota Pollution Control Agency \(state.mn.us\)](https://state.mn.us)

Resident and Farmer Interview Opportunities

As part of MPCA's civic engagement efforts during the first iteration of the MRMW watershed approach, consultants were hired to conduct surveys of watershed residents and farmers. The objectives of these interviews were to: 1) connect residents and local staff, 2) learn resident opinions and concerns regarding water quality, and 3) provide maps and resources to spur conversations and identify conservation opportunities. Generalized themes from these interviews included:

- Farming has undergone significant changes over the last several decades. A wide spectrum of understanding and interest exists regarding water quality, conservation practices, and sustainable agriculture. Most farmers feel they are doing a good job with conservation, but economics are the largest factor in making agricultural land management choices.
- While many farmers have made some conservation improvements, many more opportunities still exist. For instance, some who practice no-till consider this a competitive edge, but most farmers have (real or perceived) obstacles to using no-till. Several potential projects and obstacles to adopting conservation practices were identified.

MPCA Water Management Priorities in the MRMW

The MPCA recommends focusing on the following priorities in the planning process. The priorities were identified based on the existence of these issues watershed wide as identified by monitoring and assessment, SID, and the WRAPS.

Biota (Aquatic Life)

Address the stressors to aquatic life in the 1W1P. Aquatic life use impairments within the watershed are complex. Biotic impairments are a result of nonpoint source pollution and localized stress linked to poor habitat condition and altered hydrology. High nitrogen and phosphorus levels are likely impacting fish and macroinvertebrate communities in the southern part of the watershed. Stabilizing hydrology, increasing riparian buffer width, and stabilizing stream banks would greatly help the in-stream habitat.

Altered Hydrology

Seek changes to the landscape that reduce the volume, rates, and timing of runoff and increase the base flows needed to prevent continued and further impairments. A primary stressor of the biotic impairments in the watershed is altered hydrology. Other pollutants (turbidity, nutrients, bacteria, etc.) are delivered because of altered hydrology. Managing the hydrology to provide a consistent base flow is imperative for the survival of the biological communities in the watershed. Increasing rainfall infiltration and water retention, and improving riparian conditions are activities that are needed to stabilize hydrology and reduce impairments.

Turbidity and Total Suspended Solids (Aquatic Life)

Reduce and control sediment entering the water bodies of the watershed. Total suspended solids (TSS), and turbidity (measure of water clarity affected by sediment, algae, and organic matter), are common impairments and stressors to aquatic life in the watershed. Reducing TSS will also likely reduce how other pollutants are conveyed (phosphorus and bacteria).

Nutrients (Aquatic life/Eutrophication)

Reduce nutrient delivery to the watershed. High levels of nutrients (phosphorus) are driving nuisance algae blooms in the watershed's impaired lakes and threatening other lakes that are on the verge of becoming impaired. Algae blooms can deprive lakes of their oxygen as the algae die off and decay, causing fish kills. High levels of algae cause increased levels of turbidity, degrading aquatic recreation and aquatic life. Blue-green algae can also cause serious health issues for humans and pets.

The MPCA anticipates more lakes and stream reaches will be listed as impaired following the intensive monitoring phase of the second watershed cycle (MRMW beginning 2024; Cottonwood River beginning 2027). Past stream monitoring has documented high concentrations of total phosphorus. With the implementation of [River Eutrophication Standards](#), the MPCA suspects that new stream impairments are likely to emerge.

Management plans that appropriately value the nutrient worth of manure and previous crops and focus on the timing and intensity of the fertilizers and manure applications will help reduce the amount of phosphorus and nitrogen reaching the river. These reductions would also aid in the low dissolved oxygen problems present in some parts of the watershed. Resources for nutrient management include:

- [Point Source Phosphorus Mapping Tool](#): Provides summaries of annual phosphorus loads and flow volumes discharged from National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) permitted facilities since 2005.
- [Minnesota Nutrient Reduction Strategy](#)

Bacteria (Aquatic Recreation)

Practices to control pathways delivering human and livestock feces to the planning area waters should be a priority for the 1W1P. High levels of bacteria are widespread throughout the watershed. The abundance of feedlots, feedlot runoff, improper manure management, and over-grazed pastures in the watershed may correlate with this finding. High bacteria levels could also be attributed to noncompliant septic systems.

Climate Change Resiliency and Adaptation

Planning should incorporate implementation of practices that address changing weather patterns to help our communities be prepared for extreme weather events. As part of the WRAPS update process, the MPCA is planning on making Climate Change Resiliency and Adaptation a priority.

Additional MPCA resources:

- [Minnesota Stormwater Manual](#)
- [MPCA funding options](#)

Drainage Watershed Management

Currently, drainage improvement projects have limited input from local staff to aid in the integration of conservation practices that would help to alleviate hydrology concerns and downstream impacts from increases in water volume. The MPCA recommends early coordination with landowners, SWCD staff, agencies, and engineers to develop improvement projects that account for volume increases.

In most engineering designs of drainage improvement projects, the existing conditions are based on the original design and upgrades. Many drainage improvement projects seek an increase in the drainage coefficient from 0.1 to 0.25 inches/day to a more modern 0.5 inches/day for tile and 1 inch/day for open

ditches. Engineering reports often indicate that drainage pipe is in disrepair and the as built coefficient isn't meeting its original design. This suggests that restoring (maintaining) the system to its original capacity would result in an increase in drainage volume.

The MPCA encourages the planning group to discuss watershed drainage management with an emphasis on finding ways to store and/or reduce the increased volume of water based on the increase in drainage coefficient in improvement projects by working with landowners in areas where drainage improvement will eventually be considered.

Restoring healthy channels and riparian areas of streams and ditches throughout the watershed offers critical habitat, improves water quality, and has the potential to buffer impacts of other stressors. Previously channelized streams in prioritized headwater reaches can be re-meandered to restore stable conditions, increase stream length, create floodplain accessibility, improve habitat, and decrease sediment. Reconnecting incised streams to their floodplains improves ecological and hydrological functions, including increased resiliency in the system and reduced downstream flooding impacts. Collaborative assessment, targeting, and planning is necessary on a subwatershed scale to strategically plan before engaging in stream restoration. Streambank stabilization practices should only be used in appropriate locations (for example threatened infrastructure) due to the natural hydrologic regime being so heavily altered in the MRMW resulting in unstable incised channels.

Stream and Ravine Erosion Control

By-and-large, wide-scale stabilization of eroding streambanks and ravines is cost-prohibitive. Instead, first addressing altered hydrology (e.g., excessive, concentrated flows) within the landscape can help decrease wide-scale stream and ravine erosion problems as discussed in the [Minnesota River Valley Ravine Stabilization Charette](#) and the [Minnesota River Basin Sediment Reduction Strategy](#). Improving activities directly adjacent the stream/ravine (e.g., buffers) can also decrease erosion as summarized in [The River Restoration Toolbox](#). In some cases, high value property may need to be protected, or a ravine/streambank may be experiencing such severe erosion that stabilizing the streambank or ravine is deemed necessary.

Several tools exist to help identify potential erosion areas. The MPCA would offer assistance in trying to locate and prioritize sites for implementation activities if local partners are interested.

Watershed wide practice implementation

While targeting of specific practices is important to prioritize funding that provides the greatest reductions/cost, there is a need in the MRMW to provide opportunities for practices throughout the watershed that would benefit water quality at the HUC-8 scale. The MPCA recommends funding that is flexible and available continuously, watershed wide, to provide options for landowners to try soil health and cover crop practices, work with SWCD staff, and communicate with other landowners who are implementing these practices. The MPCA recommends developing a network of local staff and operators who can provide technical, financial, and practical assistance to landowners implementing soil health principles.

Consider priorities and goals from neighboring completed Comprehensive Water Management Plans

The Minnesota River Mankato HUC-8 Watershed has been divided into four separate planning areas. 1W1P work has been completed in the [Hawk - Middle Minnesota](#) Planning area. The [Cottonwood - Middle Minnesota](#) is nearing completion. The [Redwood - Middle Minnesota](#) is still under development. Priorities and goals from these planning efforts may be beneficial in helping develop the Comprehensive Management plan for the MRMW.

Calibrate modeling efforts to HSPF load estimates

The MRMW Hydrologic Simulation Program-Fortran (HSPF) model has recently been extended and recalibrated. We would recommend that any modeling efforts for implementation utilize the loading information based on the HSPF numbers and Watershed Pollutant Monitoring Network (WPLMN) data to calibrate loads so that reduction calculations would be comparable to monitored loading estimates.

Stream and Lake Protection

There is a growing focus on maintaining the high-quality water that we still have. The same practices that protect water quality will also benefit wildlife, groundwater, air quality, soils, and numerous other aspects of our Minnesota environment.

The MPCA collaborated with the Minnesota Department of Natural Resources and the Board of Water and Soil Resources to develop guidance for incorporating protection strategies into WRAPS, local water plans, and/or 1W1P documents. Link to resource: [Protection and prioritization tools](#)

The MPCA recognizes all the hard work and cooperation from the local partners within the MRMW and offers our continued support in local water planning. Thank you for the opportunity to participate and offer MPCA's priorities. If we may be of further assistance, please contact Bryan Spindler at bryan.spindler@state.mn.us, or 507-344-5267, or at the MPCA's Mankato office.

Sincerely,

Bryan Spindler

This document has been electronically signed.

Bryan Spindler
Environmental Specialist
Watershed Division

BS:jdf

cc: Jeremy Maul, BWSR
Ed Lenz, BWSR
Julie Westerlund, BWSR
Reid Christianson, MDA
Scott Matteson, MDA
Margaret Wagner, MDA
Scot Hanson, MDH
Carrie Raber, MDH
Alan Gleisner, DNR
Korey Woodley, DNR
Barbara Weisman, DNR
Catherine Neuschler, EQB
Jeff Risberg, MPCA

Appendix D.

Public Kickoff Summary



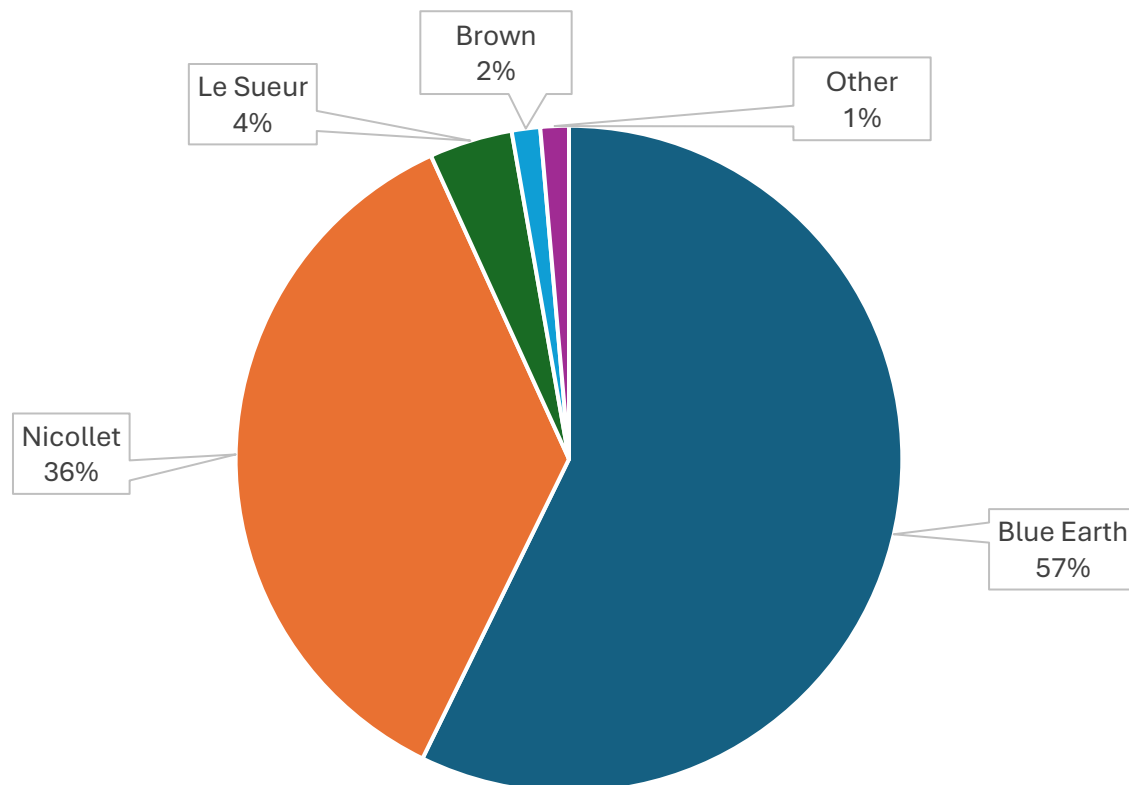
Public Kickoff Summary

Survey

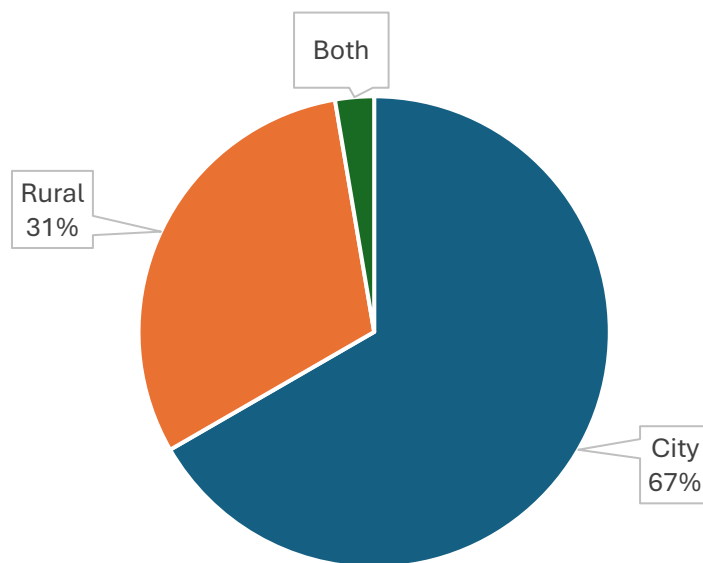
On July 23rd and July 30th, 2024, approximately 40 people attended public kickoff events held in Nicollet and St. Peter respectively. The kickoff events were intended to bring the community into the One Watershed, One Plan (1W1P) planning process, educate community members on the purpose of a watershed plan, and provide opportunities to identify issues and resources most important to them.

At the meetings, community members discussed issues facing their watershed at Resource Stations (see Page 6). There was also a public survey available for people to take in person and online. Between paper surveys available during the kickoff events and online participation, there were 75 responses to the public survey. Results of that survey are summarized here.

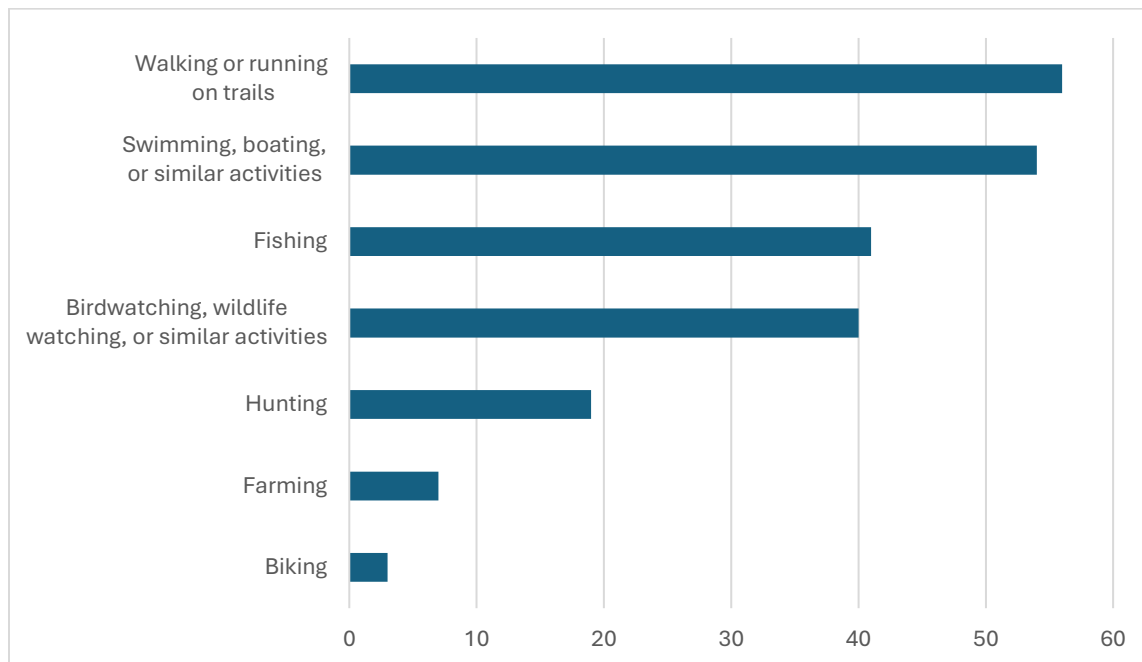
What county do you live in?



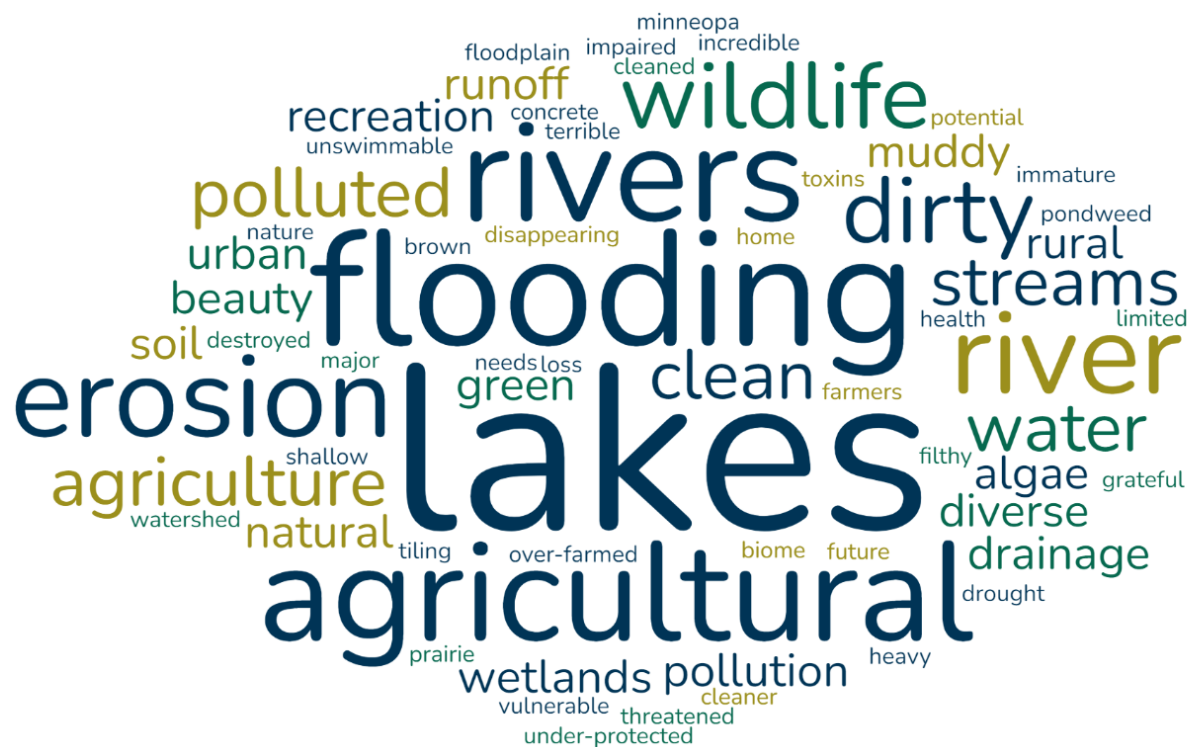
Do you live in a city or rural setting?



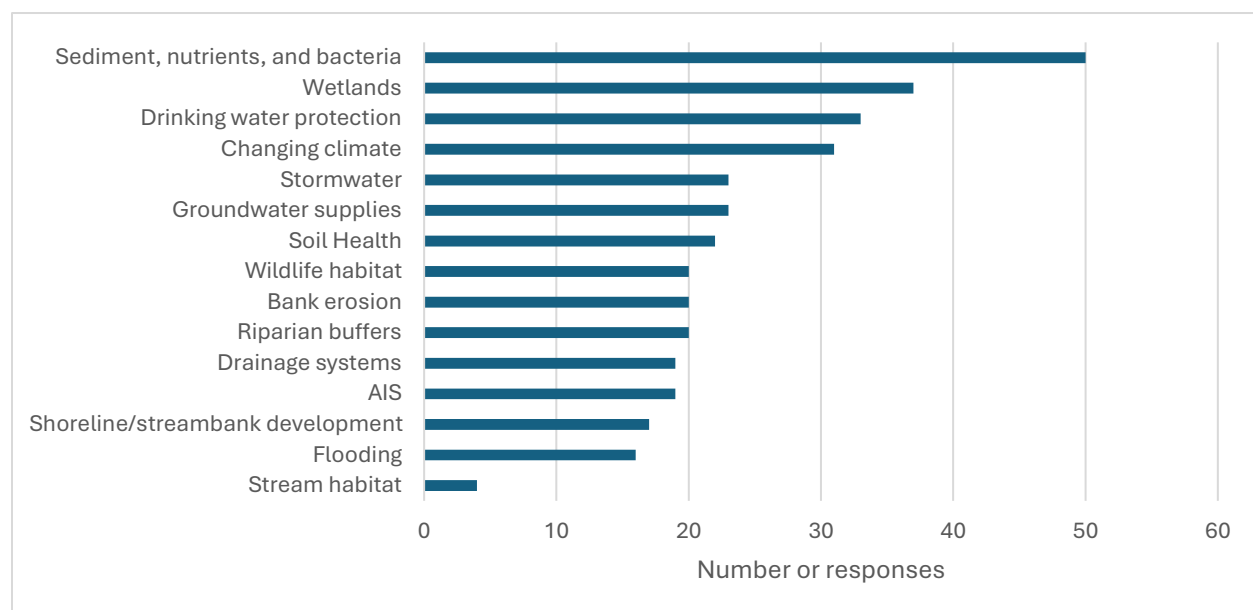
What activities do you enjoy in the watershed?



Using 4-5 words, what comes to mind when thinking of the MRMW?



Choosing up to 5, what are the top issues in the watershed?





Are there any specific waterbodies, stream reaches, or natural areas you are most concerned about?

- Minnesota River, 15 responses
- All, 7 responses
- Duck Lake, 6 responses
- Minneopa Creek, 5 responses
- Lake Washington, 4 responses
- Loon Lake, 4 responses
- 7 Mile Creek, 3 responses
- Crystal Lake, 3 responses
- Le Sueur River, 2 responses
- Swan Lake, 2 responses

One response: Coldwater Streams, Farmland, Hallets Pond, High Quality Habitat, Lake Ballantyne, Lake Crystal, Lake Emily, Lake Hallett, Lake Scotch, Near Unimin, No, Recreation Lakes, Robards Creek, Shanaska Creek, Watonwan River, Wetlands

Are there any topics, resources, problems, or opportunities we didn't cover in this survey you'd like to comment on?

- Citizen shoreline stewardship in particular regarding buffer zones.
- Farm field tiling
- Farm runoff is not very well regulated. Cities are over regulated.
- Flood mitigation planning for municipalities and counties (with Red River project plan as a major resource starting point)
- Have garbage disposals in areas getting off of lakes
- How can people get help fixing bank erosion? Is anyone addressing this?





- I agree that invasive aquatic species are of great concern, but we should also be concerned about invasive trees and plants in our watershed - make sure that our cities and counties are not allowing them to be planted and cause more harm.
- It would be nice to see efforts made to support aquatic natives, not just AIS. The Ag watershed discussion is a mixed bag. When individuals bring up green lakes and surrounding farm runoff, it's like we are not supposed to bring it up because of how important farming is. Farming is important AND it does distress lakes. In turn, individuals discount things they could do because of farming. It's circuitous conversation that's been going on for years and it seems like in the end, nothing gets improved.
- More habitat, easements and public land, wetlands and food prevention
- More natural sloughs to act filters for water entering out lakes
- No enough DNR people to enforce the laws
- No, well done
- Not at this time
- One of your meetings should have been located somewhere South of the river. Get projects on the ground. Don't try to prioritize certain areas so much that you end up not funding good projects in the watershed. People don't like hearing their area is not a priority.
- Polluting farming practices
- Prairie restoration and native plants, grasses, trees, are what we need to support
- Progress? Urban/rural division on issues
- Slalom course to be removed on duck lake.
- Soil erosion on farmland
- The drainage systems and tributaries that feed into the MN River affect the sediment load. Also, selecting only 5 areas of concern does not reflect the magnitude of the impacts to the MN River.
- The impact of climate change and polluting farming practices.
- The lack of protection for Lake Hallett in St. Peter has been and continues to be abysmal. To go from over 20 feet visibility to 2 since the early 2000s is criminal.





- Try to get the green out of the lakes
- Volunteer conservation is great, but if it can't be implementing on a large scale, nothing will improve.
- Water storage
- We drain the wetlands and tile every inch then wonder why our water bodies are unsuitable
- Yes





Resource Stations

At the public kickoff, attendees were directed to resource stations where they discussed issues and geographic areas of concern. A summary of these discussions is included here.

Surface Water Quality Station – St. Peter and Nicollet

- Concerns with ongoing run off into Lake Washington, particularly from nearby agriculture.
- Would there be benefit in making some sort of short appealing “script” or liaison point person to better appeal to landowners to impairment BMPs
- Feel wetlands do not get enough public awareness on their importance. How can public education on the importance of wetlands be done?
- Lake Hallett was supposed to have a fish contamination study done, but it fell through the cracks (fish collected, but lost data). They would like that process to be carried out.
- Lake Hallett is a high value resource waterbody to those in the St. Peter area. This is a high priority from their mayor’s point of view.
- Cyanobacteria is suspected to also make its way to Lake Hallett- a lot of concerns and questions around the trends of HABs (Harmful Algal Blooms).
- 7-Mile Creek, in addition to other cold-water streams would like to ensure habitat is protected and water quality improves.
- Questions and interest from the public and local officials on learning about stream restoration in ditches. Lots of interest in two stage ditches and hoping to see them in more areas in this region. Could they help with downstream stability? Nutrients upspring? Bring back some biology in impaired areas?
- A lot of concerns around nitrates into groundwater – seepage rates?
- Questions and surprise about how bacteria is entering waterways. One member knew a lot about manure application but thought that as it is injected would stay bound to soil and not be able to come out in tile water. Discussion around E. coli fingerprinting study was briefly had and referenced where to find whole report.





- Lake Crystal: Nutrient impairments
- Lake Washington: Nutrient impairments
- Cold water streams
 - People don't know that these are important
 - Maintain them and protect them
 - Temperature evaluation
- Nitrates: big issue within watershed and there were a variety of questions on what we can do to limit the sources
- Outlet from Swan Lake
 - "Clean" water source compared to other resources within the area
- Water Storage and Using Floodplain is key to reducing sediment and erosion
- Education and Outreach Efforts are really important in telling the story of the watershed and showing results
 - Visuals to show improvements within the watershed (ex: field trips to different sites)
- Important to highlight things that are great about the watershed as well, not just all of the impairments

Land Use and Habitat Station - Nicollet

- Focus efforts on the waterbodies that have substantial recreational value
- Protection for high use lakes- Washington, Duck, Ballantyne
- Find cost effective practices to get best bang for the buck
- Expand water storage opportunities of the existing shallow lakes in the watershed
- Find opportunities to increase the size of existing natural land areas and waterbodies
- Efforts should focus on the Minnesota River Flood Plain and Tributaries



- 
- Wildlife and biodiversity have increased with restored natural areas in the watershed
 - Encourage advertising for recreation in peoples' own local areas (many folks in past traveled long distances far from home to recreate and haven't realized the value of local recreation gems in the area)
 - Establish more cover crops
 - Focus on Emerald Ash Borer and invasives in North Mankato/ St Peter Areas
 - Balance the needs of cropland agriculture with conservation practices (need the cropping economy to continue in the area)
 - Provide more resources for education and enforcement of lake shore ordinances (seems like a lot of variances have been approved to get around ordinances)
 - Focus efforts on building protection areas and easements around cold-water streams
 - Focus efforts for better drainage improvements and water storage opportunities that include habitat improvement considerations

Land Use and Habitat Station – St. Peter

- Important lakes to focus work efforts: Lake Washington, Lake Crystal, Swan Lake, Emily, Duck, Ballanytne
 - Consider doing work that will eventually impact Gulf of Mexico and Lake Pepin.
 - Focus habitat work on Hallett Pond and Seven Mile Creek
 - Loon Lake and Lake Crystal need to be emphasized
 - Need to consider how much bigger the natural areas and complexes need to be before we start seeing improvements
 - Seems like there hasn't been good planning in the past. Need focused efforts
 - Need to focus on the Minnesota River Corridor
 - Focus work and improvements to mitigate issues caused by Unimin Mines around the Ottawa area
- 



- Address Pesticide Issues where it is needed
- Deal with the rural stormwater and drainage on the SW side of St Peter
- Minnesota River is not a reliable recreational river
- Could use more prairie restoration projects
- More emphasis on education and outreach
- Sandy soils in the Lake Crystal area and drainage projects need to be scrutinized
- Look for opportunities for more CREP and farmer incentives
- Make enrollment easier for CREP and focus on upland areas for work.
- Include aquatic habitat in consideration with habitat projects
- Need good “sales people” that are good at communicating with farmers to get projects to take off
- Need to get more word out about wetland credit programs
- Focus on relationship building with farmers
- Focus on Hallett stormwater issues
- Rain gardens and prairie planting projects are wanted in the urban
- Focus on work on SW side of St. Peter rural area
- Wetland Protection
- More habitat
- Concerns of suburban development and impacts
- “Buy in by Producers”
- Expand wetland complexes, for water quality and wildlife
- Expand Prairies
- Concerns over bank erosion on main rivers and ditch systems
- More Conservation Easements (used the term CREP, but I believe they wanted RIM by their statements)



- 
- Tap into USDA Farm programs for incentives (partnership with future projects with the plan?)
 - Soil Health Benefits
 - Specifically in the Lake Crystal area
 - Rain Gardens in urban areas
 - Concerns over altered hydrology
 - Pattern tiling
 - Increased surface water

Drinking Water and Groundwater Station – Nicollet

- Nitrates were the main concern raised by the public for both public and private wells.
- Residents of St. Peter mentioned the cost associated with nitrate removal and the impacts to their utility bill.
- Regenerative agriculture was mentioned as a focus of the plan to help reduce nitrates.
- Financial assistance for farmers to implement practices to reduce nitrate pollution was important to success.
- In discussing natural occurring contaminants such as arsenic, residents agreed that sampling and education should be in plan.
- Outreach and education for shared wells that don't qualify as a public water supply well.
- Citizens asked what contaminants and how frequently should private wells be sampled.

Drinking Water and Groundwater Station – St. Peter

- St. Peter
 - Blending drinking water from three different aquifers.
 - Vulnerable groundwater supply due to the Jordan Sandstone aquifer and
- 



- rapid groundwater recharge/sandy soils.
- Reverse osmosis treatment for iron/manganese removal and nitrate removal.
- Comments were made about the about how good St. Peter's water is. It was a recent winner of best tasting water in Minnesota. The good taste was attributed to the mixing of water from multiple aquifers and the reverse osmosis treatment system.
- Mankato
 - Two sources of water:
 - Ranney wells – Shallow groundwater wells directly influenced by surface water.
 - Mt. Simon Aquifer
 - Water from Ranney wells is mixed with water from deep wells from the Mt. Simon aquifer. Approximately 70 percent of Mankato's drinking water is from the Ranney Wells.
 - Concerns were raised about groundwater use for the increased development in Mankato.
- Lake Crystal
 - Water is from a deep well with low vulnerability.
- Nitrates
 - Comments/concerns were raised about elevated nitrates and the cost of treatment.
 - With Mankato and St. Peter blending water from deeper aquifers, there was concern expressed about water use from less sustainable deeper aquifers.
 - The value of projects that reduce nitrate runoff on the landscape prior to reaching the vulnerable wells was discussed to help reduce treatment costs and reduce the amount of water that is mixed from deeper wells.
- Recharge
 - Mt. Simon aquifer recharge rate and water appropriations regarding the shallower aquifers.
- Groundwater – Surface Water Interactions
 - Contaminated stormwater runoff affecting surface waterbodies (water quality and quantity) and their interaction with shallow groundwater
- Private Wells
 - The recommendation for regular testing for bacteria and nitrates was discussed.
 - The naturally occurring arsenic in the groundwater in the watershed was discussed and testing was encouraged as wells testing over the safe drinking water standard are not uncommon. It was noted that new wells have only been required to be tested for arsenic since 2008 and there are likely a lot of wells that have never been tested for arsenic.



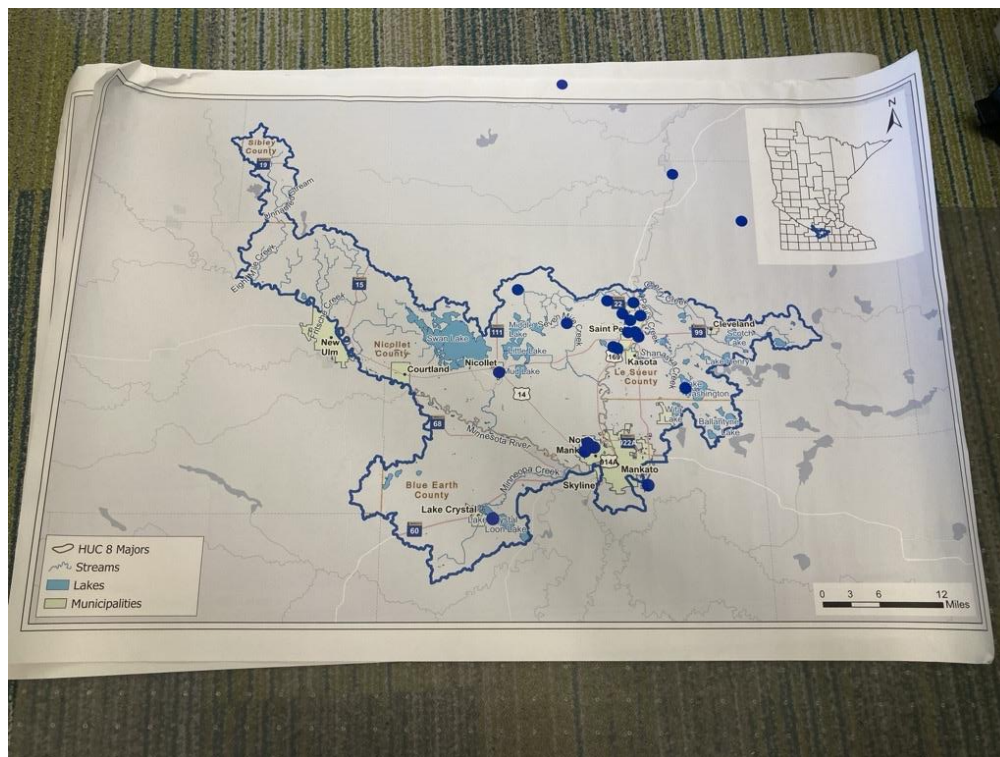
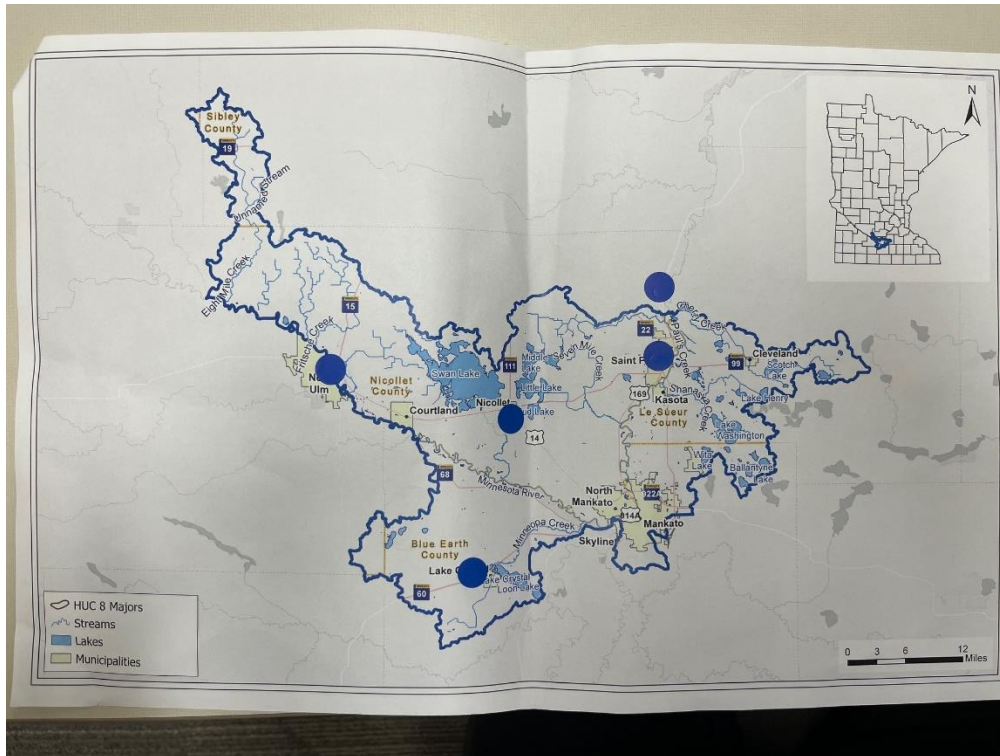


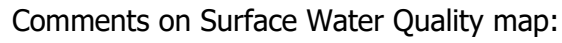
Flood Damage Reduction and Hydrology Station

- There should be more consistency between counties in the evaluation of drainage projects and in the review of the goals for a drainage project.
 - There seems to be barriers for obtaining grants for water storage and conservation practices with drainage ditch improvement projects.
 - There are a number of cold water/trout streams in the watershed and there should be consistency with how drainage projects are reviewed in those watersheds.
 - To help reduce the cost of conservation projects associated with drainage projects, the contractor who is installing the drainage improvement project should also be the contractor doing storage or conservation projects. The set-up costs for the contractor could be leveraged, and the overall cost could be reduced.
 - Regarding tile drainage, it should be acknowledged that that water flows faster through plastic pipes than soil.
 - Wetland restoration, water storage practices, and soil health are all important practices to help reduce peak flows in streams and the Minnesota River.
 - Implementing water storage practices should be the focus of this plan.
 - The water storage aspects of soil health should also be a priority and should be promoted as healthy soil can store significant volume of water.
 - The public could be better engaged in importance of water storage and with successes in the Minnesota River Basin.
 - Conservation practices like CREP and other water storage practices in the upper reaches of the Minnesota River Basin likely played a role in reducing the flood peaks on the Minnesota River in 2024. It would be interesting to model that potential impact to how that flood event may have been worse had those practices not been in place.
 - Storage of water through a variety of structural and non-structural means in the upper reaches of the watershed is important to reduce peak flows.
 - Agricultural drainage and outlets to public waters should be treated like municipal storm sewers as they are a point source for pollution and increased water flow.
- 

Map Feedback from Public Kickoff

Where do you live? Responses from Nicollet (top) and St. Peter (bottom).





Appendix E.

Geospatial Subwatershed

Prioritization





Geospatial Subwatershed Prioritization

Goal	Priority Issues	Geospatial Ranking Layers
Nutrients and Bacteria	- Nutrient Loading (High Priority) - Bacteria (Medium Priority)	- HSPF Total Phosphorous loading - HSPF Total Nitrogen loading - Very High, High and Medium DWSMAs - Priority Resources
Sediment and Erosion	Sediment and Erosion (High Priority)	HSPF Sediment Yields (upland and bed/bank)
Groundwater Quality / Surface Water Interaction	- Surface Water / Groundwater Interaction (High Priority) - Groundwater Quality (Medium Priority)	- Very High, High and Medium DWSMAs - Pollution Sensitivity of Near Surface Materials - Private well nitrate test results
Water Storage, Altered Hydrology, and Flood Damage Reduction	- Loss of Water Storage (High Priority) - Altered Hydrology (High Priority) - Flooding (Medium Priority)	- Streams Stressed by Altered Hydrology - Restorable Wetlands - FEMA 100-Year Floodplains
Stormwater	Stormwater (Medium Priority)	Cities and MS4s
Soil Health	Soil Health (High Priority)	- HSPF sediment loading - Priority Resources - Very High, High, Medium and Low DWSMAs





Goal	Priority Issues	Geospatial Ranking Layers
Invasive Species	Invasive Species (Medium Priority)	- Terrestrial invasive species observations points - Aquatic invasive species observation points - Listed infested waters



Appendix F.

Altered Hydrology

Analysis



Technical Memorandum

To: Minnesota River-Mankato Watershed Planning Partnership
From: Timothy Erickson PE
Houston Engineering, Inc.
Subject: Minnesota River at Mankato, MN Altered Hydrology Analysis
Date: June 3, 2025

1.0 INTRODUCTION

One of the stressors commonly referenced as a reason for aquatic life impairments is “altered hydrology.” Altered hydrology is commonly thought to be characterized by increases in peak discharge and runoff volume for a range of precipitation events, as compared to some historic or benchmark condition. Numerous studies have suggested that this hydrologic alteration is a result of some combination of climatic variation, land use/land cover changes, or other landscape scale changes. Aquatic habitat loss, increased streambank erosion and bank failure, and increased sediment levels are some of the suggested consequences of altered hydrology. Individually and collectively, these are believed to lead to the impairment of aquatic life, exhibited by lower ecological diversity.

This technical memorandum (TM) describes a framework used define and quantify altered hydrology using records for the USGS’s long-term, continuous flow gaging network. In addition, this TMS describes methods to estimate storage goals based on changes of altered hydrology metrics that can be used to develop management plans to help mitigate the impacts of alteration.

1.1 A NEED TO ASSESS ALTERED HYDROLOGY

Although a general sense of the characteristics of altered hydrology exists, a substantive challenge remains. A challenge associated with addressing altered hydrology is the lack of a common definition, including agreement on a set of science-based metrics to establish the desired (i.e., benchmark) condition, and assess whether altered hydrology has indeed occurred.

Figure 1 provides an example of hydrologic data which could be used to illustrate altered hydrology. **Figure 1** shows a flow duration curve for a streamflow gage in the Sand Hill River Watershed, within northwestern Minnesota. Two 30-year time periods are shown on the graph; i.e., 1980 – 2010 (solid line) and 1945 – 1975 (dashed line). The graph represents the likelihood of exceeding a specific daily mean discharge. The graph indicates an increase in the daily mean discharge through most of the flow range, because for the same likelihood of exceedance the daily mean discharge is greater for the more recent time periods. This

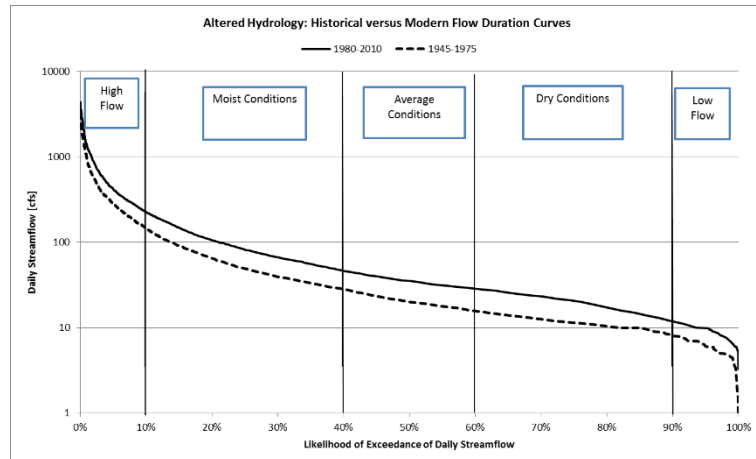


Figure 1. Flow duration curve for the Sand Hill River at Climax, Minnesota. The solid black line shows an increase in daily mean discharge for the 1980 – 2010 period, compared to the early 1945 – 1975 period.

suggests “altered hydrology” meaning that flow conditions in the watershed differ between the two time periods. The example illustrates one possible visual metric which could be used to describe altered hydrology.

Agreement on a set of science-based metrics to assess the extent of hydrologic alteration and the desired (i.e., benchmark) condition is needed in order to quantitatively assess changes in the hydrology of a watershed. A definition is needed to rigorously assess whether hydrology has indeed changed through time, establish goals for altered hydrology, and assess and evaluate various means, methods and projects to mitigate the adverse effects of altered hydrology.

Considerable research and technical information relative to describing altered hydrology has been completed. The recently release report titled “Technical Report: Protection Aquatic Life from Hydrologic Alternatives” (Novak et al., 2015) is one example. The report presents metrics which can be used to describe altered hydrology. However, causal information about how the change in hydrology results in the alteration or loss of ecological function is lacking within the report.

For the hydrology of a watershed to be altered there must be some deviation from a preferred or desired hydrologic condition; i.e., a “benchmark” condition. The benchmark for altered hydrology could be the “natural hydrologic regime” or some other condition. The natural hydrologic regime (Poff et al 1997; Arthington et al 2006; Bunn and Arthington 2002 ; Sparks 1995) is the characteristic pattern of water quantity, timing and variability in a natural water body. A river’s hydrologic or flow regime consists of environmental flow components (Mathews and Richter, 2007; The Nature Conservancy, 2009), each of which can be described in terms of the magnitude, frequency, duration, timing and rate of change in discharge. The integrity of an aquatic system presumably depends on the natural dynamic character of these flow components to thereby driving ecological processes.

Defining altered hydrology and the benchmark condition, identifying the metrics to describe altered hydrology and translating the information into goals to mitigate the adverse consequences is technically challenging. The approach used to evaluate whether a watershed exhibits altered hydrology is presented within this document. A definition of altered hydrology is presented. Specific quantitative metrics to assess the extent of hydrologic change and the desired (i.e., benchmark) condition are also presented. No effort is made to describe the causal relationship between hydrology and the ecological, geomorphological or water quality effects. Rather, the assumption is made that the desired condition is achieved by obtaining the benchmark condition. These results are intended to be a beginning point in addressing the topic of altered hydrology in a more rigorous manner, which no doubt will evolve through time.

2.0 A METHODOLOGY TO DEFINE ALTERED HYDROLOGY

2.1 A BRIEF HISTORY OF CHANGING HYDROLOGY

Streamflow in Minnesota (Novotny & Stefan, 2007) and across the contentious United States (Lins and Slack 1999, McCabe and Wolock, 2002) have been changing during the past century, with flows in the period starting from the 1970s to the beginning of the 21st Century tending to be higher than during the early to mid-1900s (Ryberg et al. 2014). Numerous studies have been conducted to quantify magnitude of impact and pinpoint relative importance of potential causes of these changes, but scientific consensus has currently not been achieved. The science is not at a point where specific causes can be attributed to altered hydrology with any significant certainty and public discussion about specific causes usually leads to barriers to implementation. In general, the leading candidate causes of altered hydrology can be categorized into two primary groups: climatic changes and landscape changes. Examples of climatic changes include changes in annual precipitation volumes, in surface air temperature, timing of the spring snowmelt, annual distribution of precipitation, and rainfall characteristics (timing, duration, and intensity). Examples of landscape changes include changes in land use/land cover, increased imperviousness (urbanization), tile drainage and drainage ditching, wetland removal/restoration, groundwater pumpage, flow retention and regulation, and increased storage (both in-channel and upland storage). Although it is important to water resource management to understand the mechanics behind the changes in hydrology, the focus of this analysis is developing a definition for altered hydrology, a method for assessing whether it has occurred within a watershed, and establishing a goal for addressing altered hydrology. No assumption of causation is made or needed to use this framework.

2.2 ALTERED HYDROLOGY DEFINED

Altered hydrology is defined as a *discernable* change in specific metrics derived from stream discharge, occurring through an entire annual hydrologic cycle, which exceed the measurement error, compared to a benchmark condition. For this framework, *discernable* has been used as a proxy for statistical comparisons. The metrics are typically some type of hydrologic statistic derived from the annual discharge record across a long period of time, usually a minimum of 20-years (Gan et al. 1991). The amount of baseflow, the hydrograph shape, peak discharge, and runoff volume for a range of precipitation event magnitudes, intensities, and durations are specific components of or derived from the annual hydrograph.

2.3 ESTABLISHING BENCHMARK CONDITION

A reference or “benchmark” condition is needed to complete an assessment of whether hydrology is altered. A minimum of a 20-year time-periods reasonably ensures stable estimates of streamflow predictably (Gan et al. 1991; Olden & Poff 2003), sufficient duration to capture climate variability and the interdecadal oscillation typically found in climate (McCabe et al. 2004, Novotny and Stefan 2007), and is the standard timespan used for establishing “normal” climate statistics in the United States. Where the extent data allows it, the analysis is performed for two 35-year time periods; i.e., a benchmark period called “historic” and an “altered” state or called “modern”). The benchmark period used to establish benchmark conditions represents the period before shifts in hydrology are commonly thought to have begun within Minnesota as a result of land use/land cover changes, or increases in the depth, intensity, and duration of precipitation.

To illustrate an example of a change in streamflow and the validity in the breakpoint period, cumulative streamflow (using annual depth values) is plotted across time (**Figure 2**) for the USGS gage at Crow River at Rockford, MN (USGS ID: 05280000). Cumulative streamflow was used instead of straight annual streamflow because (1) it linearizes streamflow relationship where the slope of a trendline would be the average annual streamflow, (2) no assumptions about multi-year dependencies (e.g. changes in storage) or autocorrelation is necessary, and (3) changes in slope can be visualized, showing an altered state of hydrology.

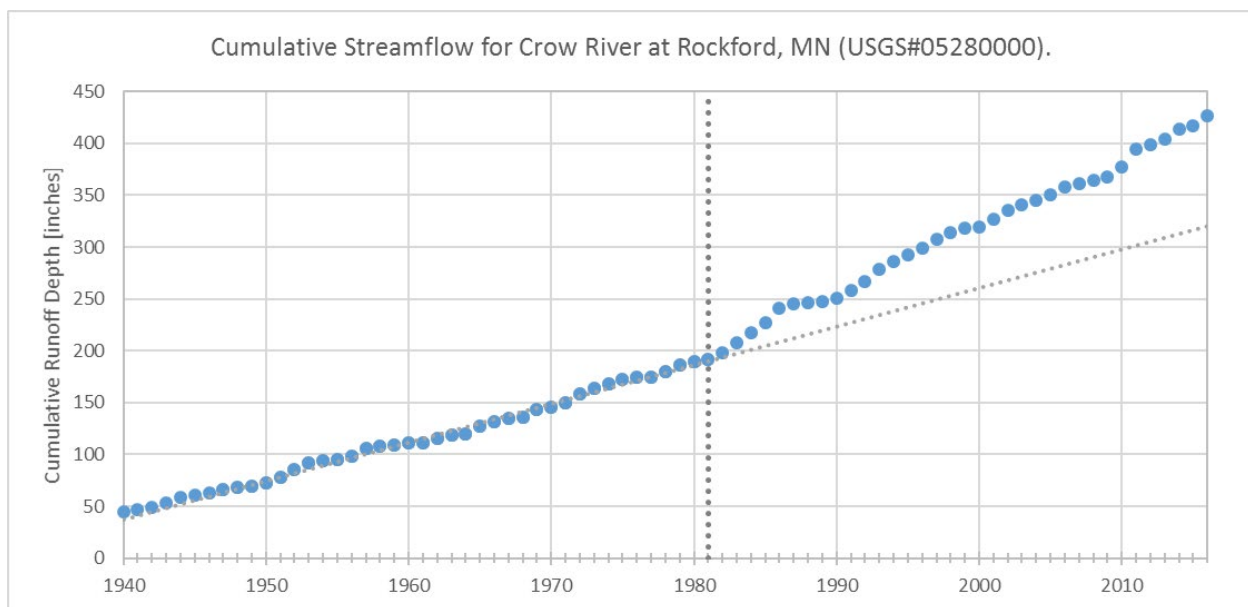


Figure 2. Cumulative streamflow for the Crow River at Rockford, MN (USGS Station 05280000).

Results from analysis shown in the example (**Figure 2**) determine the break point and define the benchmark and modern conditions.

2.4 METRICS USED TO ASSESS ALTERED HYDROLOGY

Many potential metrics can be used to describe a measurable change in the annual hydrograph. For example, the indicators of hydrologic alteration software developed by the Nature Conservancy

(<https://www.conservationgateway.org/ConservationPractices/Freshwater/EnvironmentalFlows/MethodsandTools/IndicatorsofHydrologicAlteration/Pages/indicators-hydrologic-alt.aspx>) uses 67 different statistics derived from mean daily discharge to describe altered hydrology. Ideally, each indicator or metric could be causally linked to an ecological or geomorphological consequence, although this is technically challenging. Use of such a large number of indicators can be problematic as many of the metrics can be correlated and are therefore interdependent or lack ecological or geomorphological meaning.

The structure and therefore function of ecological systems are often “driven” by “non-normal” events; e.g., low flows associated with drought, higher flows which inundate the floodplain. Metrics used to complete this analysis were preferentially selected to reflect the variability in specific characteristics of the annual hydrograph, and include peak discharges, runoff volumes and hydrograph shape. Each metric was specifically selected to represent a flow condition believed to be of ecological or geomorphological importance, in the absence of causal information. **Table 1** shows the specific metrics used to complete the analysis. The use of these metrics is intended to identify: 1) whether the hydrology within a watershed is indeed altered; and 2) which resources may be at risk because of the alteration.

Table 1. Metrics used to define and assess whether hydrology is “altered” for a specific watershed.

Relevance	Hydrograph Feature	Frequency of Occurrence	Duration	Metric	Ecological or Geomorphic Endpoint
Condition of Aquatic Habitat	Baseflow	10-year	30 day	The minimum change between time periods is the accuracy of measuring streamflow discharge and estimating daily mean discharge. A discharge measurement accurate within 10% of the true value is considered excellent by the United States Geological Survey (USGS). Some additional error is induced through the conversion of these data to discharge. Therefore, a minimum change of 15% is needed between “historic” and “modern” period for this metric to classified as “altered.”	Discharge needed to maintain winter flow for fish and aquatic life.
		Annual	30-day median (November)		
Aquatic Organism Life Cycle	Shape	Mean	Monthly average of daily means	Use the “historic” period of record to define “normal variability.” Develop a histograms of daily mean discharges for each month within the period of record for the “historic” and “modern” time periods. Compare the histograms of the monthly average of daily means using an appropriate statistical test. Assume the histograms are from the same statistical population and text for significance at an appropriate significance level.	Shape of the annual hydrograph and timing of discharges associated with ecological cues.
	Timing	Julian day of minimum	1-day		
		Julian day of maximum			
Riparian Floodplain (Lateral) Connectivity	Peak discharge	10-year	24-hour and 10-day	The minimum change between time periods is the accuracy of measuring streamflow discharge and estimating daily mean discharge. A discharge measurement accurate within 10% of the true value is considered excellent by the United States Geological Survey (USGS). Some additional error is induced through the conversion of these data to discharge. Therefore, a minimum change of 15% is needed between “historic” period and “modern” period for this metric to classified as “altered.”	Represents the frequency and duration of flooding of the riparian area and the lateral connectivity between the stream and the riparian area. Functions include energy flow, deposition of sediment, channel formation and surface water – groundwater interactions
		50-year			
		100-year			
	Volume	10-year	Total runoff volume for those days with a daily mean discharge exceeding the 24-hour discharge		
		50-year			
		100-year			
Geomorphic Stability and Capacity to Transport Sediment	Peak Discharge	1.5 year	24 - hour	The minimum change between time periods is the accuracy of measuring streamflow discharge and estimating daily mean discharge. A discharge measurement accurate within 10% of the true value is considered excellent by the United States Geological Survey (USGS). Some additional error is induced through the conversion of these data to discharge. Therefore, a minimum change of 15% is needed between “historic” period and “modern” period for this metric to classified as “altered.”	Channel forming discharge. An increase is interpreted as an increased risk of stream channel susceptibility to erosion.
	Volume	1.5 year	Cumulative daily volume exceeding channel forming discharge		
		Average daily	30-year flow duration curve		

2.5 DETERMINATION OF ALTERED HYDROLOGY

A simple weight of evidence approach is used to decide whether the hydrology of a watershed is “altered” between two time periods. A “+” is assigned to each metric if it has a discernable increase from the benchmark as defined by the metric, between the historic and modern time periods. A “-” is assigned to each metric if it has a discernable decrease from the benchmark as defined by the metric, between the historic and modern time periods. An “o” is assigned to each metric if it lacks a discernable increase or decrease from the benchmark as defined by the metric, between the historic and modern time periods. If the number of “+” values exceeds the number of “-” values, an increase in the watershed response to precipitation is implied and the hydrology is considered altered between the two time periods. If the number of “-” values exceeds the number of “+” values, the a decrease in the watershed response to precipitation is implied and the hydrology is considered altered between the two time periods. The hydrologic response of the watershed is considered “altered” if the percentage of + and – signs exceeds 50% in any group of metrics.

2.6 ESTABLISHING ALTERED HYDROLOGY GOALS

There are two types of goals; i.e., a qualitative and a quantitative goal. The qualitative goal is to return the hydrology to the benchmark condition. The qualitative goal is evaluated using a weight of evidence approach. The goal is simply to achieve the conditions for the historic period as defined by the metrics with **Table 1**. It is presumed the historic period is “better” from an ecological and geomorphological perspective.

The second type of goal is a quantitative storage goal. Several of the metrics within **Table 1** can be used to establish storage goals, which may be accomplished by a variety of types of projects. These project types include not only traditional storage but increasing the organic matter content of soils. These goals are the change in volume between the historic and modern time periods. The volume needs to be described by the effective volume, which is the amount of storage required on the landscape.

2.7 METHODS FOR EVALUATING ALTERED HYDROLOGY MITIGATION STRATEGIES

Several methods can be used to develop strategies to mitigate the effects of altered hydrology. These methods include the use of continuous simulation hydrology models (like the Hydrologic Simulation Program Fortran) and the event-based hydrology approaches (like those within the Prioritize, Target and Measure Application).

3.0 ALTERED HYDOLOGY IN THE MINNESOTA RIVER

The following are summaries of results from the altered hydrology analysis conducted on long-term gaging stations. Beyond the Minnesota River at Mankato, MN stream gage, analysis was conducted on the Blue Earth River near Rapidan, MN and the Le Sueur River near Rapidan, MN as major upstream tributaries to see if the altered hydrology is influenced by those tributaries.

3.1 MINNESOTA RIVER

3.1.1 Minnesota River at Mankato, MN (USGS# 05325000)

The USGS long-term, continuous flow gaging station in the Minnesota River at Mankato, MN (USGS# 05325000) and drains approximately 14,900 square miles. The data record starts in 1906 and runs continuous through present day (2025). The flow record was downloaded on May 13, 2025. The site includes both daily average streamflow records and peak flow measurements. **Figure 3** shows the cumulative streamflow (in inches per year) for the gaging site. Cumulative streamflow is used to determine a breakpoint between the benchmark condition and the altered condition (see **Section 2.3**).

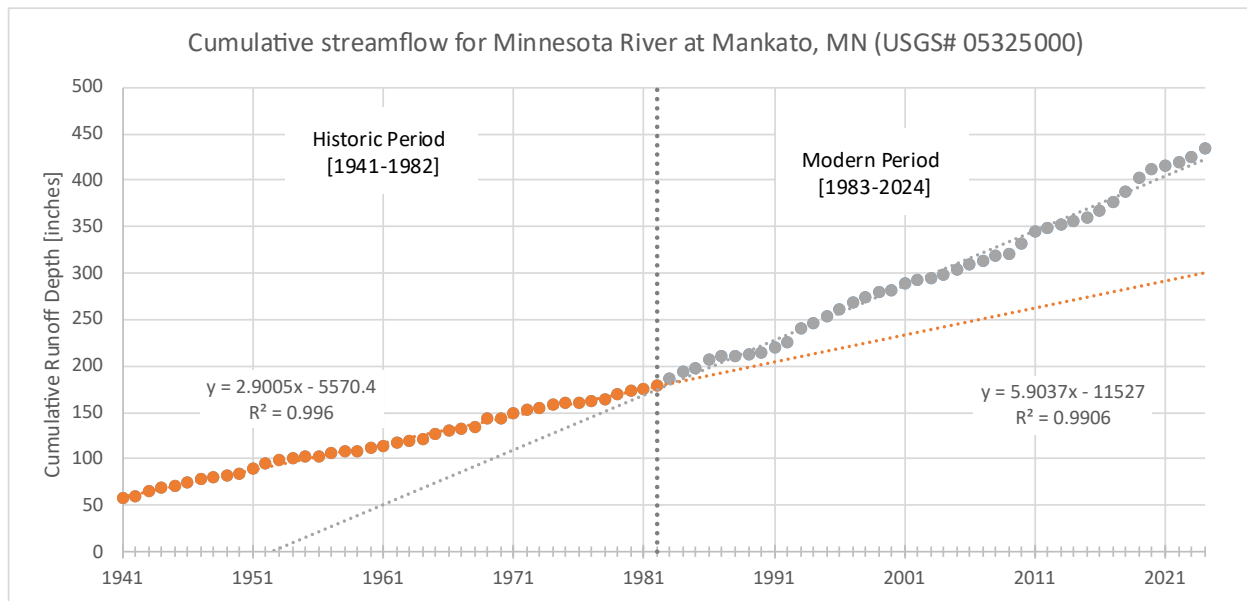


Figure 3. Cumulative streamflow for Minnesota River at Mankato, MN (USGS# 05325000).

According to the cumulative streamflow analysis, a breakpoint exists around 1982. Therefore, the benchmark (“historic”) conditions will include data from 1941-1982 and the altered (“modern”) will include data from 1983-2024.

A summary of the results from the altered hydrology analysis is provided in **Table 2**. A more detailed description of the results is provided in **Appendix A**. A summary of the storage goals based on the altered hydrology analysis are provided in **Section 4**.

Table 2: Altered Hydrology Summary for Minnesota River at Mankato, MN (USGS# 05325000).

Group	Metric	% Difference	Altered Hydrology Metric	Evidence of Altered Hydrology for Group
Aquatic Habitat	10-year, Annual Minimum 30-day Mean Daily Discharge	78.9%	+	Yes, Increasing
	10-year, Annual Minimum 7-day Mean Daily Discharge	74.9%	+	
	Median November (Winter Base) Flow	273.5%	+	
Aquatic Organism Life Cycle	Magnitude of Monthly Runoff Volumes	49.6%-to-236.9%	+	Yes, Increasing
	Distribution of Monthly Runoff Volumes	-28.2%-to-61.8%	o	
	Timing of Annual Peak Discharge	9.90%	o	
	Timing of Annual Minimum Discharge	42.1%	+	
Riparian Floodplain (Lateral) Connectivity	10-year Peak Discharge Rate	52.5%	+	Yes, Increasing
	50-year Peak Discharge Rate	25.6%	+	
	100-year Peak Discharge Rate	15.1%	+	
	Average Cumulative Volume above the Historic 10-year Peak Discharge	10.3%	+	
	Average Cumulative Volume above the Historic 50-year Peak Discharge	-51.3%	-	
	Average Cumulative Volume above the Historic 100-year Peak Discharge	NA	NA	
Geomorphic Stability and Capacity to Transport Sediment	1.5-year Peak Discharge Rate	80.5%	+	Yes, Increasing
	2-year Peak Discharge Rate	78.8%	+	
	Average Cumulative Volume above the Historic 1.5-year Peak Discharge	226%	+	
	Average Cumulative Volume above the Historic 2-year Peak Discharge	172%	+	
	Duration above the Historic 1.5-year Peak Discharge	169%	+	
	Duration above the Historic 2-year Peak Discharge	170%	+	
	Flow Duration Curve	7.9%-to-173%	+	

3.2 BLUE EARTH RIVER

Analysis of the Blue Earth River near Rapidan was included as a major tributary upstream of the Minnesota River at Mankato, MN.

3.2.1 Blue Earth River near Rapidan, MN (USGS# 05320000)

The USGS long-term, continuous flow gaging station in the Blue Earth River near Rapidan, MN (USGS# 05320000) and drains approximately 2,410 square miles. The data record starts in 1909 and runs to the 2025 (present day) with missing data from 1912 to 1940 and 1946 to 1948. The flow record was downloaded on May 9, 2025. The site includes both daily average streamflow records and peak flow measurements. **Figure 4** shows the cumulative streamflow (in inches per year) for the gaging site. Cumulative streamflow is used to determine a breakpoint between the benchmark condition and the altered condition (see **Section 2.3**).

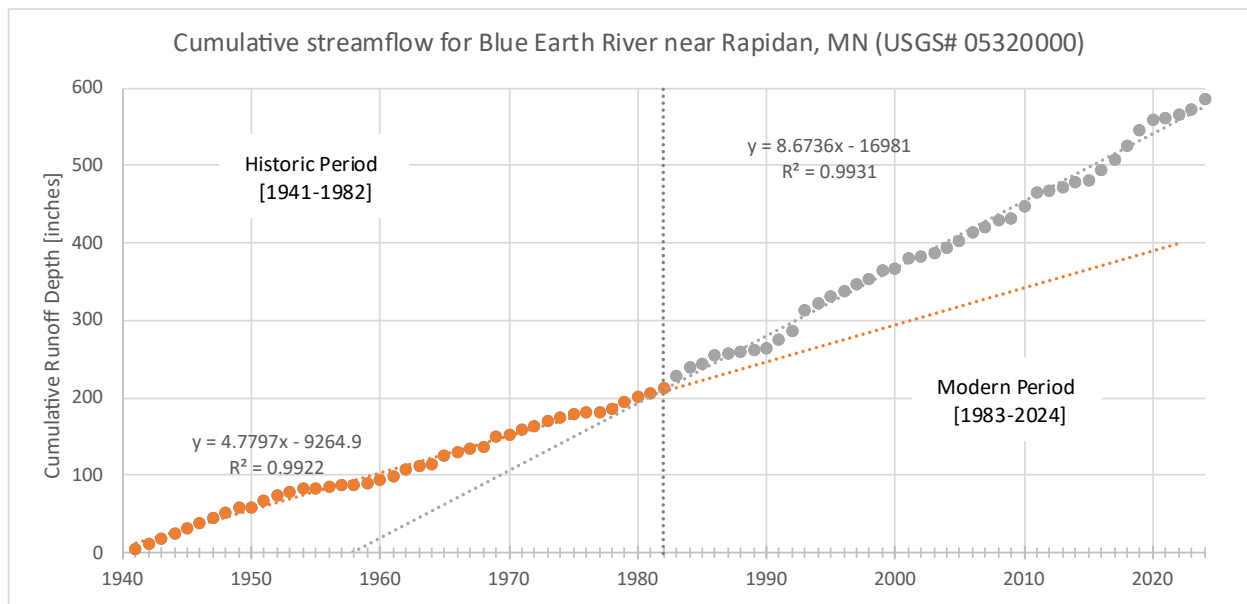


Figure 4. Cumulative streamflow for Blue Earth River near Rapidan, MN (USGS# 05320000).

According to the cumulative streamflow analysis, a breakpoint exists around 1982. Therefore, the benchmark (“historic”) conditions will include data from 1941-1982 and the altered (“modern”) will include data form 1983-2024.

A summary of the results from the altered hydrology analysis is provided in **Table 3**. A more detailed description of the results is provided in **Appendix B**. A summary of the storage goals based on the altered hydrology analysis are provided in **Section 4**.

Table 3: Altered Hydrology Summary for Blue Earth River near Rapidan, MN (USGS# 05320000).

Group	Metric	% Difference	Altered Hydrology Metric	Evidence of Altered Hydrology for Group
Aquatic Habitat	10-year, Annual Minimum 30-day Mean Daily Discharge	63.7%	+	Yes, Increasing
	10-year, Annual Minimum 7-day Mean Daily Discharge	85.0%	+	
	Median November (Winter Base) Flow	106%	+	
Aquatic Organism Life Cycle	Magnitude of Monthly Runoff Volumes	20.5%-to-198%	+	Yes, Increasing
	Distribution of Monthly Runoff Volumes	-34.0%-to-63.4%	o	
	Timing of Annual Peak Discharge	11.1%	+	
	Timing of Annual Minimum Discharge	55.1%	+	
Riparian Floodplain (Lateral) Connectivity	10-year Peak Discharge Rate	15.3%	+	No
	50-year Peak Discharge Rate	3.24%	o	
	100-year Peak Discharge Rate	-0.63%	o	
	Average Cumulative Volume above the Historic 10-year Peak Discharge	-28.3%	-	
	Average Cumulative Volume above the Historic 50-year Peak Discharge	-91.8%	-	
	Average Cumulative Volume above the Historic 100-year Peak Discharge	NA	NA	
Geomorphic Stability and Capacity to Transport Sediment	1.5-year Peak Discharge Rate	48.5%	+	Yes, Increasing
	2-year Peak Discharge Rate	39.2%	+	
	Average Cumulative Volume above the Historic 1.5-year Peak Discharge	152.4%	+	
	Average Cumulative Volume above the Historic 2-year Peak Discharge	114%	+	
	Duration above the Historic 1.5-year Peak Discharge	170%	+	
	Duration above the Historic 2-year Peak Discharge	177%	+	
	Flow Duration Curve	18.9%-to-108%	+	

3.3 LE SUEUR RIVER

Analysis of the Le Sueur River near Rapidan was included as a major tributary upstream of the Minnesota River at Mankato, MN.

3.2.1 Le Sueur River near Rapidan, MN (USGS# 05320500)

The USGS long-term, continuous flow gaging station in the Le Sueur River near Rapidan, MN (USGS# 05320500) and drains approximately 1,110 square miles. The data record starts in 1939 and runs to the 2025 (present day) with missing data from 1945 to 1948. The flow record was downloaded on May 13, 2025. The site includes both daily average streamflow records and peak flow measurements. **Figure 5** shows the cumulative streamflow (in inches per year) for the gaging site. Cumulative streamflow is used to determine a breakpoint between the benchmark condition and the altered condition (see **Section 2.3**).

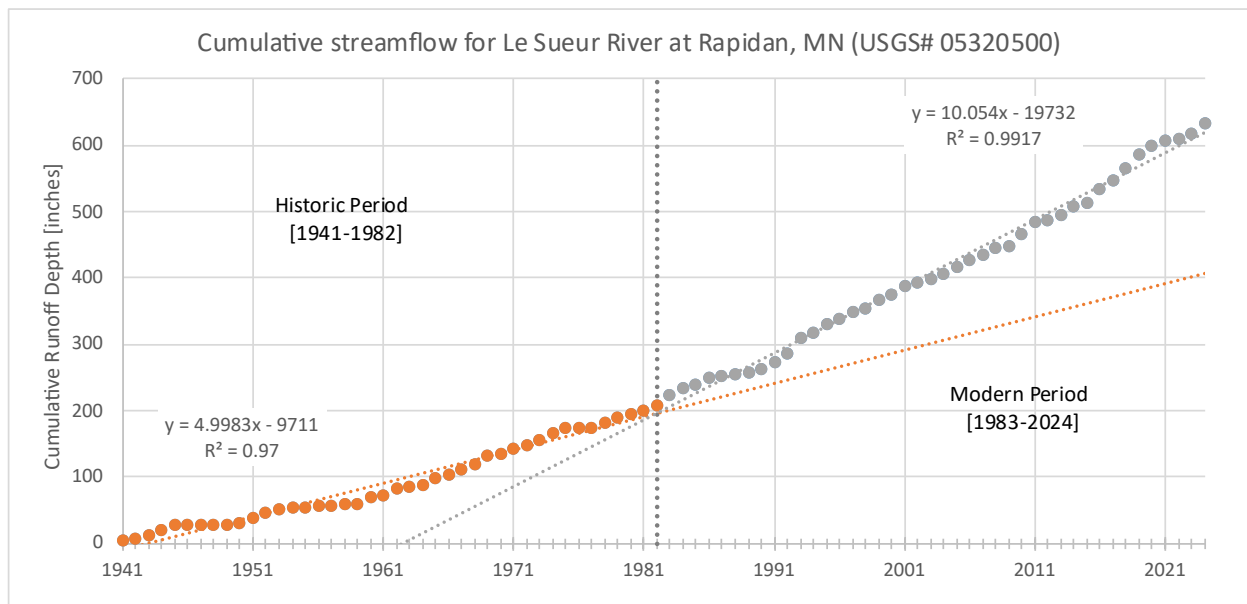


Figure 5. Cumulative streamflow for Le Sueur River near Rapidan, MN (USGS# 05320500).

According to the cumulative streamflow analysis, a breakpoint exists around 1982. Therefore, the benchmark (“historic”) conditions will include data from 1941-1982 and the altered (“modern”) will include data form 1983-2024.

A summary of the results from the altered hydrology analysis is provided in **Table 4**. A more detailed description of the results is provided in **Appendix C**. A summary of the storage goals based on the altered hydrology analysis are provided in **Section 4**.

Table 4: Altered Hydrology Summary for Le Sueur River near Rapidan, MN (USGS# 05320500).

Group	Metric	% Difference	Altered Hydrology Metric	Evidence of Altered Hydrology for Group
Aquatic Habitat	10-year, Annual Minimum 30-day Mean Daily Discharge	103%	+	Yes, Increasing
	10-year, Annual Minimum 7-day Mean Daily Discharge	103%	+	
	Median November (Winter Base) Flow	198%	+	
Aquatic Organism Life Cycle	Magnitude of Monthly Runoff Volumes	24.5%-to-330%	+	Yes, Increasing
	Distribution of Monthly Runoff Volumes	-33.6%-to-129%	o	
	Timing of Annual Peak Discharge	15.1%	+	
	Timing of Annual Minimum Discharge	27.1%	+	
Riparian Floodplain (Lateral) Connectivity	10-year Peak Discharge Rate	35.7%	+	Yes, Increasing
	50-year Peak Discharge Rate	23.6%	+	
	100-year Peak Discharge Rate	20.5%	+	
	Average Cumulative Volume above the Historic 10-year Peak Discharge	9.53%	o	
	Average Cumulative Volume above the Historic 50-year Peak Discharge	840%	+	
	Average Cumulative Volume above the Historic 100-year Peak Discharge	NA	NA	
Geomorphic Stability and Capacity to Transport Sediment	1.5-year Peak Discharge Rate	86.3%	+	Yes, Increasing
	2-year Peak Discharge Rate	69.7%	+	
	Average Cumulative Volume above the Historic 1.5-year Peak Discharge	115%	+	
	Average Cumulative Volume above the Historic 2-year Peak Discharge	80.1%	+	
	Duration above the Historic 1.5-year Peak Discharge	96.6%	+	
	Duration above the Historic 2-year Peak Discharge	105%	+	
	Flow Duration Curve	50.4%-to-275%	+	

4.0 STORAGE GOALS

Goals for addressing the change in hydrology were estimated using four methods. Each method is based on different assumptions and altered the metrics for a specific “altered hydrology” group. The first method is focused on the aquatic habitat and geomorphic and ability to transport sediment metric group and uses the change in the cumulative volume for mean daily discharges, exceeding the 1.5-year return period event. The cumulative total volume when the daily average discharge exceeds the 1.5-year peak discharge includes all flows above the 1.5-year peak, i.e. can include storms with much larger return periods. This method is based on the changes in the observed data and since it includes all flows above the 1.5-year flow relies on the two periods to have a similar distribution of flows. The second method is based on the changes in hydrology across the entire annual hydrograph and integrates the differences in return period discharges between the modern and historic period and finding a probability-weighted representative change in flow rate. A volume is found by assuming a flow period equal to the change in flow period for the 1.5-year flow (i.e. the change in the number of days above the 1.5-year flow). This method assumes a constant flow over a representative duration to estimate the storage goal. Since a hydrograph typically changes over time, this method may over-estimate the storage goal. The third method is also based on addressing the effects through the entire flow range and is a revision to Method 2. Method 3 considers incorporates the observed change in the timing of the peak discharge for each return period event. This method uses the probability-weighted representative change in flow rate and multiplies the flow rates by the change in the number of days exceeding the return period flow for each return period. Method 4 estimates a storage goal based on changes in the flow duration curve (FDC) (see **Figure A.6**). Method 4 integrates the changes in the FDC between two periods and applies the probability of each flow to occur.

This analysis presents a preliminary framework for defining altered hydrology, applying a method to determine whether altered hydrology has occurred, and establishing a goal for relating to proposed projects. The storage goals are provided in **Table 5** for each of the four methods. For planning purposes, we recommend a preliminary goal equal to a representative goal, taken as the average of the 4 methods, across the watershed using the Minnesota River at Mankato, MN, realizing that the altered hydrology goals should ideally be established at the 12-digit HUC scale. The average, representative storage goal is **1.27 inches** across the drainage area. The major tributaries (Blue Earth and Le Sueur Rivers) both show similar goals and in line with results in the Minnesota River at Mankato, MN, so adjustments were made to the goals for the Minnesota River. The actual amount of mitigation needed may exceeds the estimated range, as the methods used to achieve the goal are not expected to be 100% effective in removing volume from peak of the hydrograph. The means to achieve the estimated mitigation goal may include the use of structural practices and management practices and should be specifically evaluated through completion of a hydrologic study or the use of appropriate tools and models.

Table 3: Storage goals for rivers in the Minnesota River.

Stream	USGS ID	Storage Targets			
		Method 1	Method 2	Method 3	Method 4
Minnesota River at Mankato, MN	05325000	1.12 in.	0.70 in.	2.00 in.	1.26 in.
Blue Earth River near Rapidan, MN	05320000	1.23 in.	0.77 in.	1.49 in.	0.96 in.
Le Sueur River near Rapidan, MN	05320500	1.20 in.	0.90 in.	2.24 in.	1.29 in.

Details on calculations of the storage goals can be found in the Appendices.

APPENDIX A: METRICS OF ALTERED HYDROLOGY FOR THE MINNESOTA RIVER AT MANKATO, MN (USGS#05325000).

The following is the summary statistics used to determine the altered hydrology metrics in detail and develop the storage goals. A summary of these statistic is shown in **Table 2** in **Section 3.1**.

A.1 CONDITION OF AQUATIC HABITAT

The condition of aquatic habitat includes a group of metrics that primarily reflect the flow characteristics of the annual hydrograph, needed to maintain adequate habitat for fish and aquatic life. The 7-day low flow, the 30-day low flow, and the median November mean daily discharge are metrics used to represent changes in the availability of flow for aquatic habitat.

A.1.1 Annual minimum 30-day mean daily discharge

The annual minimum 30-day mean daily discharge is the minimum of the 30-day moving mean daily discharge within a year (an annual minimum series). **Figure A.1** shows the annual minimum 30-day mean daily discharge for select return periods (1.01-year, 1.5-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year). **Table A.1** summarizes the data shown in **Figure A.1**.

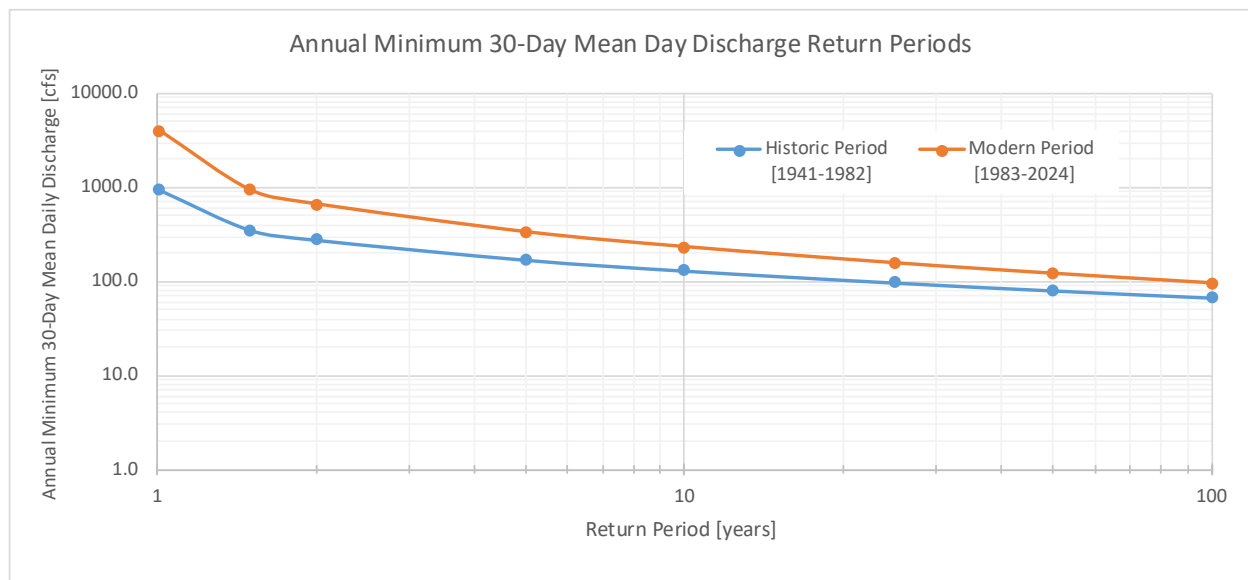


Figure A.1. Historical versus modern annual minimum 30-day mean daily discharge versus return period for Minnesota River at Mankato, MN (USGS#05325000).

Table A.1: Summary of annual minimum 30-day mean daily discharge by return periods for the Minnesota River at Mankato, MN (USGS#05325000).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
1.01	940.8	3997.2	324.9%	+
1.5	351.9	935.6	165.9%	+
2	276.5	663.8	140.0%	+
5	169.4	334.6	97.5%	+
10	129.8	232.1	78.9%	+
25	96.9	156.3	61.2%	+
50	79.9	120.6	50.9%	+
100	67.0	95.4	42.4%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.1.2 Annual Minimum 7-Day Mean Daily Discharge

Like the annual minimum 30-day mean daily discharge, the annual minimum 7-day mean daily discharge is the minimum of the 7-day moving average flow in the year. **Figure A.2** shows the annual minimum 7-day mean daily discharges for select return periods (1.01-year, 1.5-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year). **Table A.2** summarizes the data shown in **Figure A.2**.

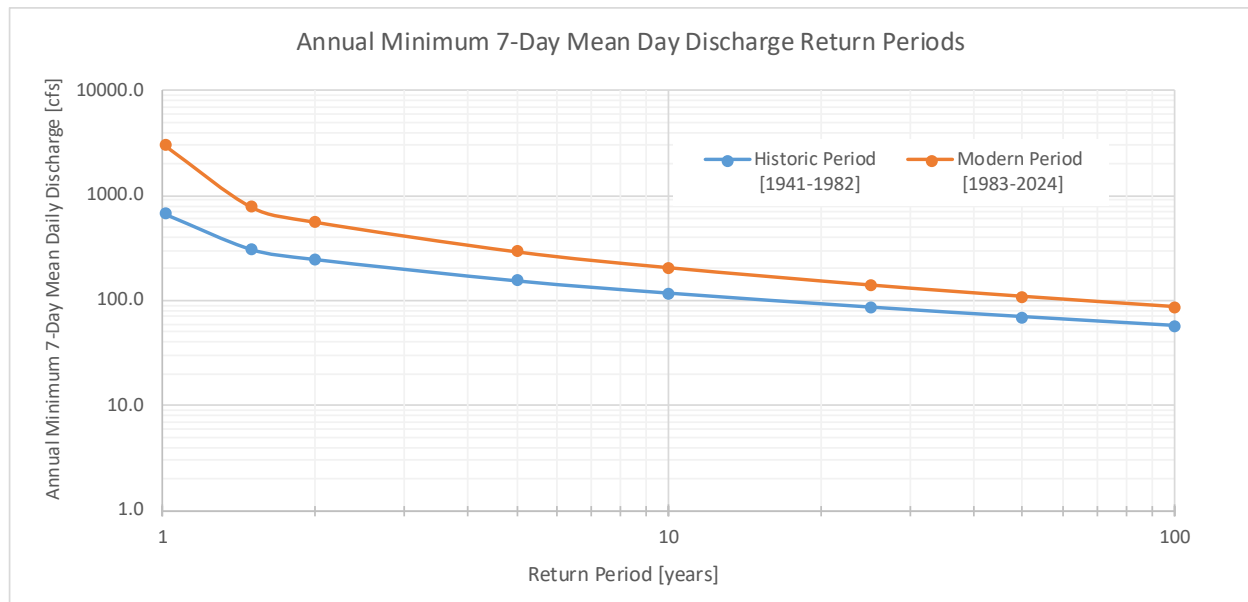


Figure A.2. Historical versus modern annual minimum 7-day mean daily discharge return periods for Minnesota River at Mankato, MN (USGS#05325000).

Table A.2: Summary of annual minimum 7-day mean daily discharge return periods for the Minnesota River at Mankato, MN (USGS#05325000).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
1.0101	672.7	3011.9	347.8%	+
1.5	306.7	773.0	152.0%	+
2	246.6	558.7	126.5%	+
5	153.9	291.3	89.2%	+
10	117.4	205.3	74.9%	+
25	86.2	140.5	62.9%	+
50	69.9	109.5	56.6%	+
100	57.5	87.3	51.9%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.1.3 November Median Daily Discharge

The median daily mean discharge for November is another indicator of baseflow. This metric is intended to represent baseflow condition during the winter months. **Table A.3** provides the median November flow for each period.

Table A.3: Historical and modern median November flow for the Minnesota River at Mankato, MN (USGS#05325000).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
Period median November flow [cfs]	721.5	2,695	273.5%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.2 AQUATIC ORGANISM LIFE CYCLE

The shape of the annual hydrograph and timing of discharges are associated with ecological cues. Metrics related to the aquatic organism life cycle include the shape of the annual hydrographs, timing of the annual minimum flow, and timing of the annual peak flow.

A.2.1 Annual Distribution of Discharges

The annual distribution of runoff is shown two ways: as average monthly runoff volume in acre-feet per month (**Figure A.3**) and as a percentage of average annual runoff volume (**Figure A.4**). **Table A.4** summarized the data used to generate **Figures A.3** and **A.4**.

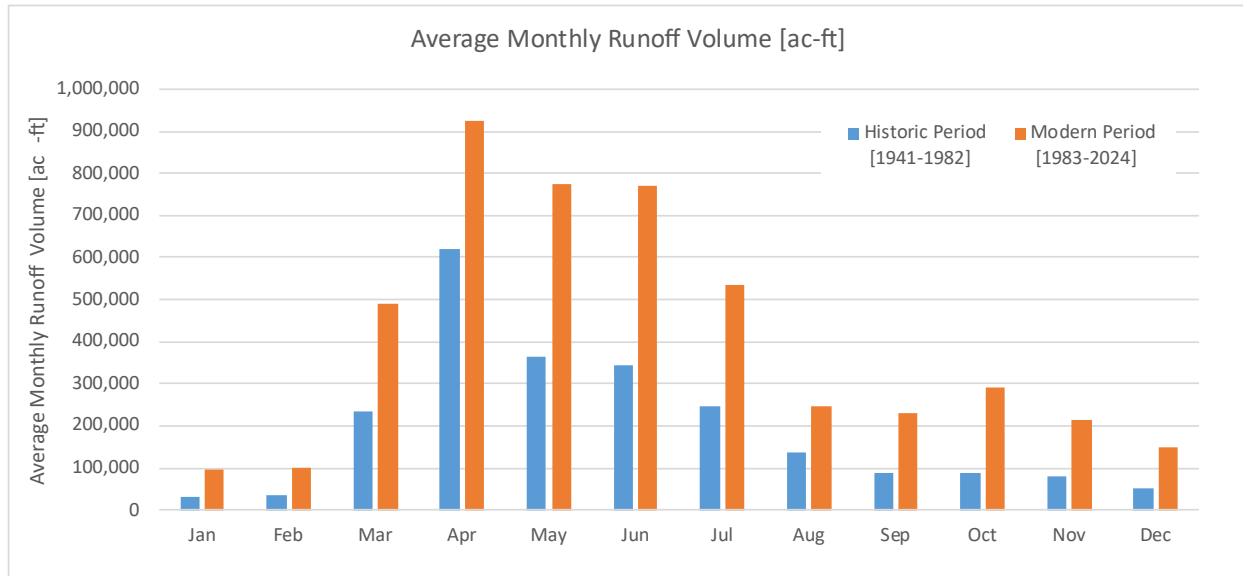


Figure A.3. Average monthly runoff volume [ac-ft] in the Minnesota River at Mankato, MN (USGS#05325000).

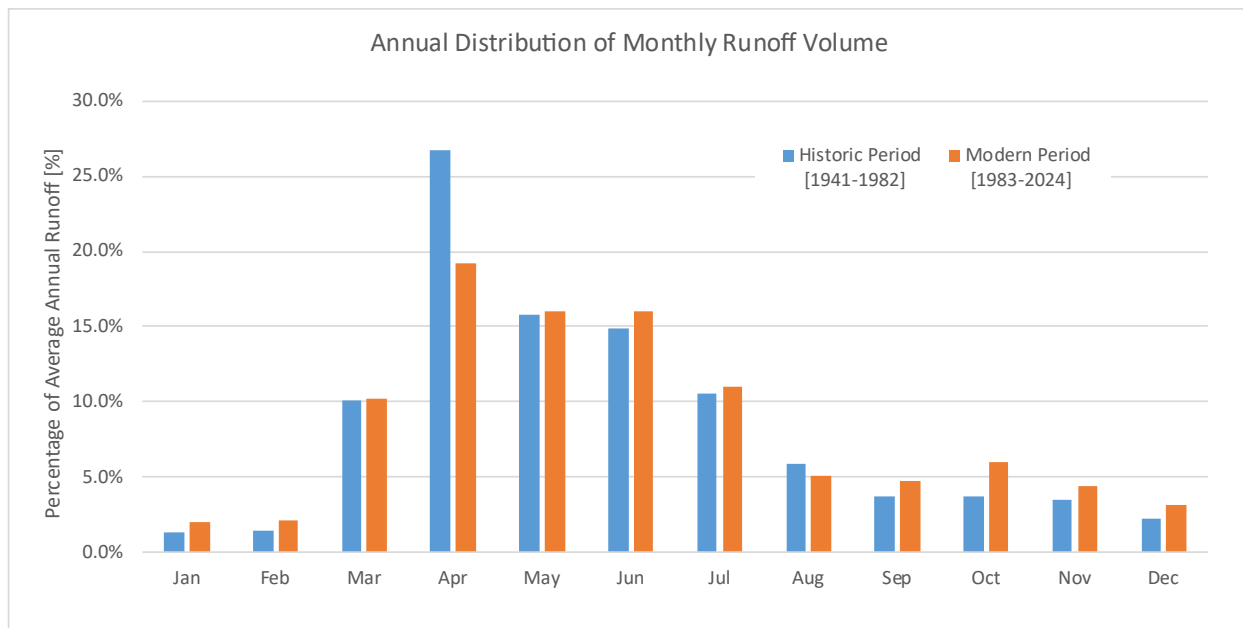


Figure A.4. Annual distribution of average monthly runoff volume as a percentage of annual total volume in the Minnesota River at Mankato, MN (USGS#05325000).

Table A.4. Average monthly runoff volume and annual distribution of monthly runoff volumes in Minnesota River at Mankato, MN (USGS#05325000).

Month	Average Monthly Volumes [ac-ft]				Distribution of Annual Volume			
	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Jan	32,155	97,623	203.6%	+	1.4%	2.0%	45.8%	+
Feb	34,320	101,002	194.3%	+	1.5%	2.1%	41.3%	+
Mar	233,559	490,545	110.0%	+	10.1%	10.2%	0.9%	o
Apr	618,694	925,331	49.6%	+	26.7%	19.2%	-28.2%	-
May	365,657	774,095	111.7%	+	15.8%	16.1%	1.7%	o
Jun	343,759	770,162	124.0%	+	14.9%	16.0%	7.6%	o
Jul	245,298	533,078	117.3%	+	10.6%	11.1%	4.4%	o
Aug	136,688	247,606	81.1%	+	5.9%	5.1%	-13.0%	-
Sep	86,102	228,344	165.2%	+	3.7%	4.7%	27.3%	+
Oct	86,156	290,254	236.9%	+	3.7%	6.0%	61.8%	+
Nov	80,353	211,849	163.6%	+	3.5%	4.4%	26.6%	+
Dec	51,927	150,320	189.5%	+	2.2%	3.1%	39.0%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

AH means altered hydrology criterion

A.2.2 Timing of Annual Maximum and Minimum Flows

The timing of the annual maximum daily discharge and annual minimum daily discharge are important metrics of the annual distribution of flows. The timing of the annual maximum typically occurs during the spring flood and the timing of the annual minimum usually occurs during the winter months. **Table A.5** provides statistics on the Julian day of the annual maximum flow and **Table A.6** provides the Julian day for the annual minimum flow. The statistics include the average, the median, and the standard deviation of the Julian days when the maximum or minimum flow occur.

Table A.5. Julian Day of annual maximum in the Minnesota River at Mankato, MN (USGS#05325000).

Statistic	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Average	7-May	19-May	9.90%	o
Median	22-Apr	15-May	20.00%	+
Standard Deviation	41 days	52 days	27.93%	+

¹Based on 365-day year.

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

AH means altered hydrology criterion

Table A.6. Julian Day of annual minimum flow in the Minnesota River at Mankato, MN (USGS#05325000).

Statistic	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Average	23-May	22-Jul	42.13%	+
Median	21-Feb	24-Sep	413.46%	+
Standard Deviation	132 days	116 days	-12.20%	-

¹Based on 365-day year.

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

AH means altered hydrology criterion

A.3 RIPARIAN FLOODPLAIN (LATERAL) CONNECTIVITY (PEAK FLOWS)

The riparian floodplain connectivity metrics represent the frequency and duration of flooding of the riparian area and the lateral connectivity between the stream and the riparian area. Functions include energy flow, deposition of sediment, channel formation and surface water – groundwater interactions. The riparian floodplain connectivity metrics include the discharge rates for the 10-year, the 25-year, the 50-year, and the 100-year peak discharges. The annual peak discharge rates for select return periods (1.01-year, 1.5-year, 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, and 200-year) are shown in **Figure A.5**.

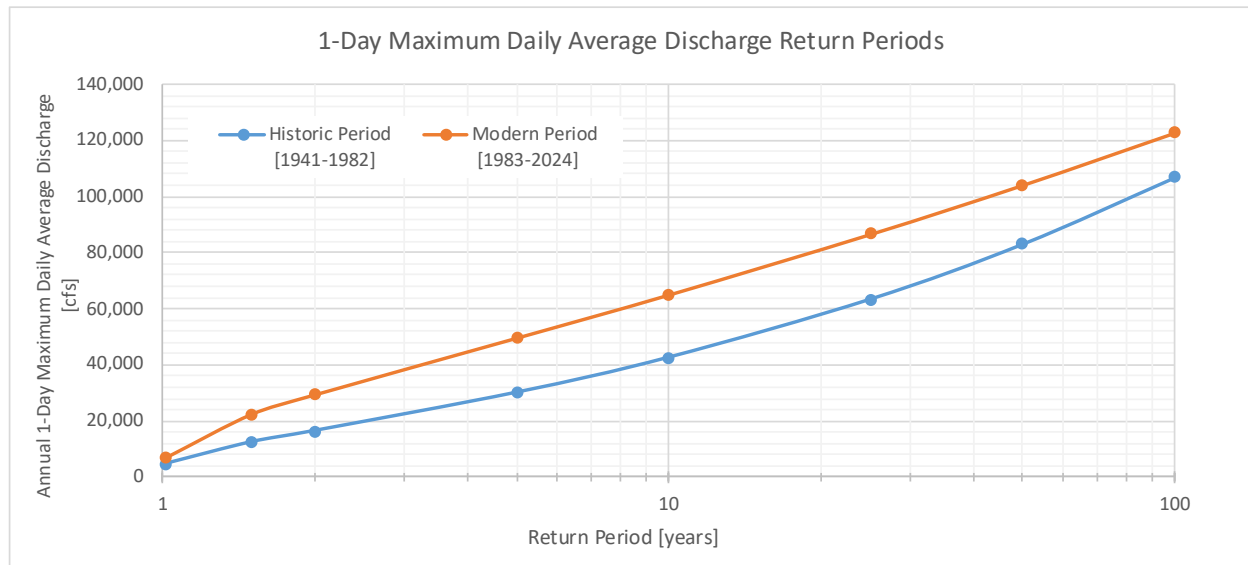


Figure A.5. Historical (1940-1975) versus modern (1980-2015) peak discharge return periods for Minnesota River at Mankato, MN (USGS#05325000).

In addition, the number of years with discharges exceeding the historic peak discharge within a period, the average number of days above the historic peak discharge rates, and the average cumulative volume of discharge above the historic peak discharges are provide (**Table A.7**).

Table A.7. Riparian floodplain connectivity metrics for the Minnesota River at Mankato, MN (USGS#05325000).

Flow Metric	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff. ¹	Altered Hydrology
5-Year Peak Discharge, Q(5) [cfs]	30,096	49,596	64.8%	+
Number of years with Discharge (Q) > Q _H (5)	7	18	157.1%	+
Average number of days per year Q > Q _H (5)	12	23	85.9%	+
Average annual cumulative volume > Q _H (5) [ac-ft]	468,358	638,269	36.3%	+
10-Year Peak Discharge, Q(10) [cfs]	42,629	65,030	52.5%	+
Number of years with Discharge (Q) > Q _H (10)	4	10	150.0%	+
Average number of days per year Q > Q _H (10)	11	18	62.7%	+
Average annual cumulative volume > Q _H (10) [ac-ft]	432,446	477,067	10.3%	+
25-Year Peak Discharge, Q(25) [cfs]	63,352	86,652	36.8%	+
Number of years with Discharge (Q) > Q _H (25)	3	8	166.7%	+
Average number of days per year Q > Q _H (25)	6	6	-4.2%	o
Average annual cumulative volume > Q _H (25) [ac-ft]	167,177	85,931	-48.6%	-
50-Year Peak Discharge, Q(50) [cfs]	82,980	104,201	25.6%	+
Number of years with Discharge (Q) > Q _H (50)	1	2	100.0%	+
Average number of days per year Q > Q _H (50)	5	2	-60.0%	-
Average annual cumulative volume > Q _H (50) [ac-ft]	68,235	33,205	-51.3%	-
100-Year Peak Discharge, Q(100) [cfs]	106,788	122,918	15.1%	+
Number of years with Discharge (Q) > Q _H (100)	0	0	NA	o
Average number of days per year Q > Q _H (100)	0	0	NA	o
Average annual cumulative volume > Q _H (100) [ac-ft]	0	0	NA	o

¹No events occurred above return period discharge.

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.4 GEOMORPHIC STABILITY AND CAPACITY TO TRANSPORT SEDIMENT

The geomorphic stability and capacity to transport sediment metrics are related to the channel forming discharge. An increase in these metrics would be interpreted as an increase in the risk of the stream channel susceptibility to erosion. These metrics include changes to the flow duration curves, the 1.5-year peak flow, the 2-year peak flow. The 1.5-year to 2-year peak flows are generally consider the range of channel forming flow. In addition, the number of years within a period exceeding the historic peak flows, the average number of days above the historic peak flow rates, and the average volume of flow above the historic peak flows are provide (**Table A.8**). **Figure A.6** is the flow duration curves for the historic and modern periods and **Table A.8** provides a summary of flows for select percent exceedances. Both show

that discharges across the flow spectrum have increased substantially, with the exception of the very high flows.

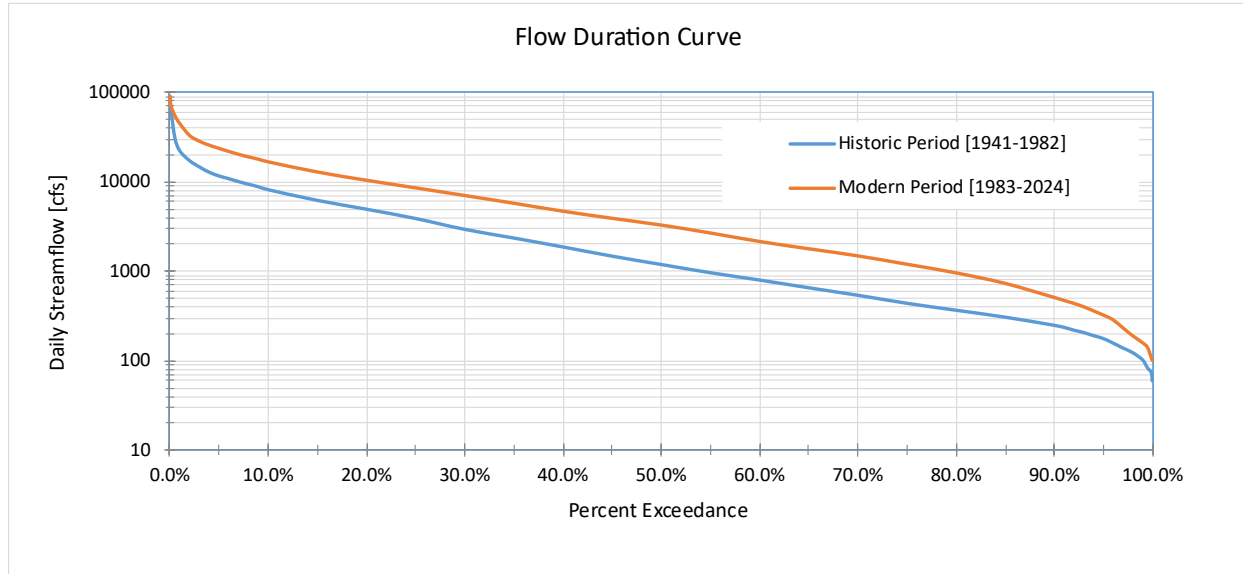


Figure A.6. Historical (1940-1975) versus modern (1980-2015) flow duration for Minnesota River at Mankato, MN (USGS#05325000).

Table A.8. Select summary of the flow duration curves for the Minnesota River at Mankato, MN (USGS#05325000).

Percent Exceedance	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology
0.10%	66,727	71,996	7.9%	o
1.0%	22,600	45,500	101.3%	+
10.0%	8,291	16,900	103.8%	+
25.0%	3,950	8,630	118.5%	+
50.0%	1,210	3,300	172.7%	+
75.0%	548	1,490	171.7%	+
90.0%	253	509	101.2%	+
99.0%	104	158	51.9%	+
99.9%	75	107	42.7%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

Table A.9 provides the 1.5-year and 2-year annual peak flows and flow statistics, including peak discharge, number of years with flow rates above the historic return period flow, average number of days per year above the historic return period flow, and average volume above the historic return period flow.

Table A.9. Geomorphic stability and capacity to transport sediment metrics for the Minnesota River at Mankato, MN (USGS#05325000).

Flow Metric	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology
1.5-Year Peak Discharge, Q(1.5) [cfs]	12,432	22,438	80.5%	+
Number of years with Discharge (Q) > Q _H (1.5)	30	40	33.3%	+
Average number of days per year Q > Q _H (1.5)	23	61	169.2%	+
Average annual cumulative volume > Q _H (1.5) [ac-ft]	392,789	1,281,262	226.2%	+
2-Year Peak Discharge, Q(2) [cfs]	16,439	29,396	78.8%	+
Number of years with Discharge (Q) > Q _H (2)	21	35	66.7%	+
Average number of days per year Q > Q _H (2)	17	46	169.9%	+
Average annual cumulative volume > Q _H (2) [ac-ft]	370,730	1,008,938	172.1%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.5 SETTING GOALS

A summary of the storage goals is provided in **Table 4** in **Section 4**. The following are the methods used to develop those goals. Goals for addressing the change in hydrology were estimated using three methods. Each method is based on different assumptions and altered the metrics for a specific “altered hydrology” group (see Table 11). The first method is focused on the aquatic habitat and geomorphic and ability to transport sediment metric group and uses the change in the cumulative volume for mean daily discharges, exceeding the 1.5-year return period event. The cumulative total volume when the daily average discharge exceeds the 1.5-year peak discharge includes all flows above the 1.5-year peak, i.e. can include storms with much larger return periods. The change in average annual cumulative volume above the 1.5-year peak flow (see **Table A.9**) This method is based on the changes in the observed data and since it includes all flows above the 1.5-year flow relies on the two periods to have a similar distribution of flows. The storage goal based on observed flows is **888,473 AF or 1.12 inches** across the drainage area.

The second method is based on the changes in hydrology across the entire annual hydrograph and integrates the differences in return period discharges between the modern and historic period (see **Table A.10**) and finding a probability-weighted representative change in flow rate. A volume is then found by assuming a flow period equal to the change in flow period for the 1.5-year flow (i.e. the change in the number of days above the 1.5-year flow; see **Table A.9**).

Table A.10. Estimated goal for the drainage area of the Minnesota River at Mankato, MN (USGS#05325000) using method 2.

Return Period	Historic Period Discharges (cfs)	Modern Period Discharges (cfs)	Difference (cfs)	Probability of Occurrence	Difference*Probability (cfs)
1.5	12,432	22,438	10006	0.67	6,670.7
2	16,439	29,396	12957	0.50	6,478.6
5	30,096	49,596	19500	0.20	3,899.9
10	42,629	65,030	22401	0.10	2,240.1
25	63,352	86,652	23300	0.04	932.0
50	82,980	104,201	21221	0.02	424.4
100	106,788	122,918	16131	0.01	161.3
				Sum (cfs):	20,807
				Sum (ac-ft/day):	41,281
Number of days:			39	Total Volume Goal:	1,592,418 AF (2.00 in.)

The third method is also based on addressing the effects through the entire flow range and is a revision to Method 2. Method 3 considers incorporates the observed change in the timing of the peak discharge for each return period event. This method uses the probability-weighted representative change in flow rate and multiplies the flow rates by the change in the number of days exceeding the return period flow for each return period (see **Table A.11**).

Table A.11. Estimated goal for the drainage area of the Minnesota River at Mankato, MN (USGS#05325000) using method 3.

Return Period	Change in Flow ($Q_m - Q_h$) [cfs]	Probability of Occurrence	Probability Weighted Flow [AF/day]	Change in number of days above flow (days)	Storage Volume
1.5	10,006	0.67	13,234.7	39	510,528
2	12,957	0.50	12,853.4	29	375,443
5	19,500	0.20	7,737.4	11	81,612
10	22,401	0.10	4,444.3	7	31,333
25	23,300	0.04	1,849.1	0	0
50	21,221	0.02	842.1	0	0
100	16,131	0.01	320.0	0	0
				Total Volume Goal:	998,915 AF (1.26 in.)

The fourth method integrates the changes in the FDC (see Figure A.6) and the probability of occurrence of each flow. The fourth method estimated a storage goal of **557,601 AF, or 0.70 inches**, across the drainage area.

APPENDIX B: METRICS OF ALTERED HYDROLOGY FOR THE BLUE EARTH RIVER NEAR RAPIDAN, MN (USGS# 05320000).

The following is the summary statistics used to determine the altered hydrology metrics in detail and develop the storage goals. A summary of these statistic is shown in **Table 3** in **Section 3.2**.

A.1 CONDITION OF AQUATIC HABITAT

The condition of aquatic habitat includes a group of metrics that primarily reflect the flow characteristics of the annual hydrograph, needed to maintain adequate habitat for fish and aquatic life. The 7-day low flow, the 30-day low flow, and the median November mean daily discharge are metrics used to represent changes in the availability of flow for aquatic habitat.

A.1.1 Annual minimum 30-day mean daily discharge

The annual minimum 30-day mean daily discharge is the minimum of the 30-day moving mean daily discharge within a year (an annual minimum series). **Figure A.1** shows the annual minimum 30-day mean daily discharge for select return periods (1.01-year, 1.5-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year). **Table A.1** summarizes the data shown in **Figure A.1**.

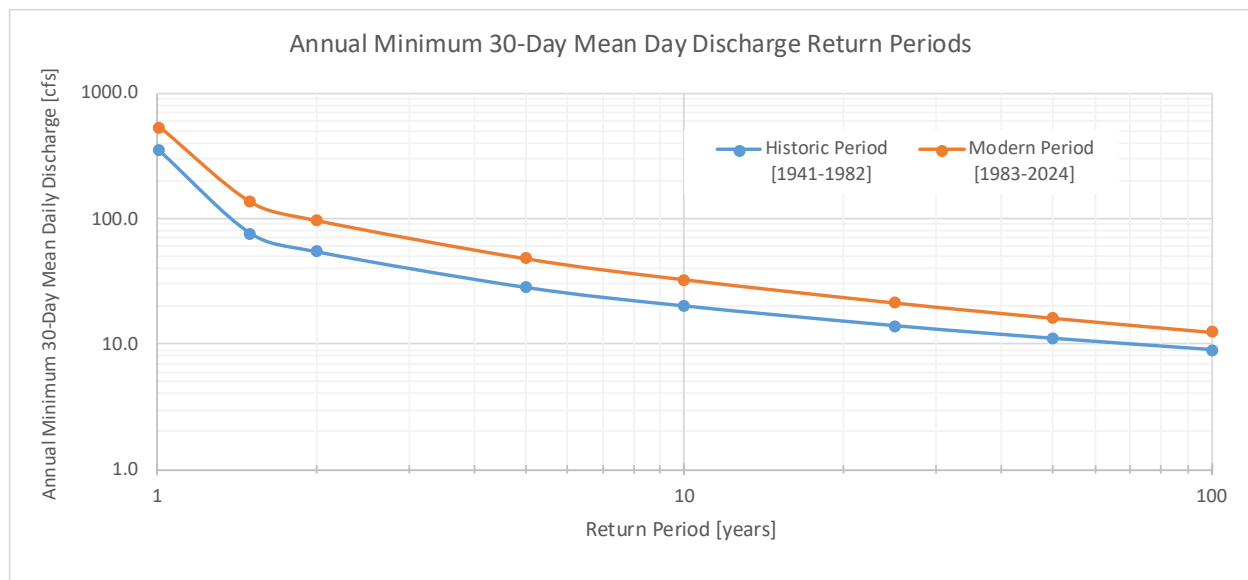


Figure A.1. Historical versus modern annual minimum 30-day mean daily discharge versus return period for Blue Earth River near Rapidan, MN (USGS# 05320000).

Table A.1: Summary of annual minimum 30-day mean daily discharge by return periods for the Blue Earth River near Rapidan, MN (USGS# 05320000).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
1.01	348.2	537.5	54.4%	+
1.5	76.4	136.5	78.6%	+
2	54.4	96.9	78.3%	+
5	28.1	48.1	70.8%	+
10	20.0	32.7	63.7%	+
25	13.9	21.4	53.9%	+
50	11.0	16.2	46.6%	+
100	8.9	12.5	39.5%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.1.2 Annual Minimum 7-Day Mean Daily Discharge

Like the annual minimum 30-day mean daily discharge, the annual minimum 7-day mean daily discharge is the minimum of the 7-day moving average flow in the year. **Figure A.2** shows the annual minimum 7-day mean daily discharges for select return periods (1.01-year, 1.5-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year). **Table A.2** summarizes the data shown in **Figure A.2**.

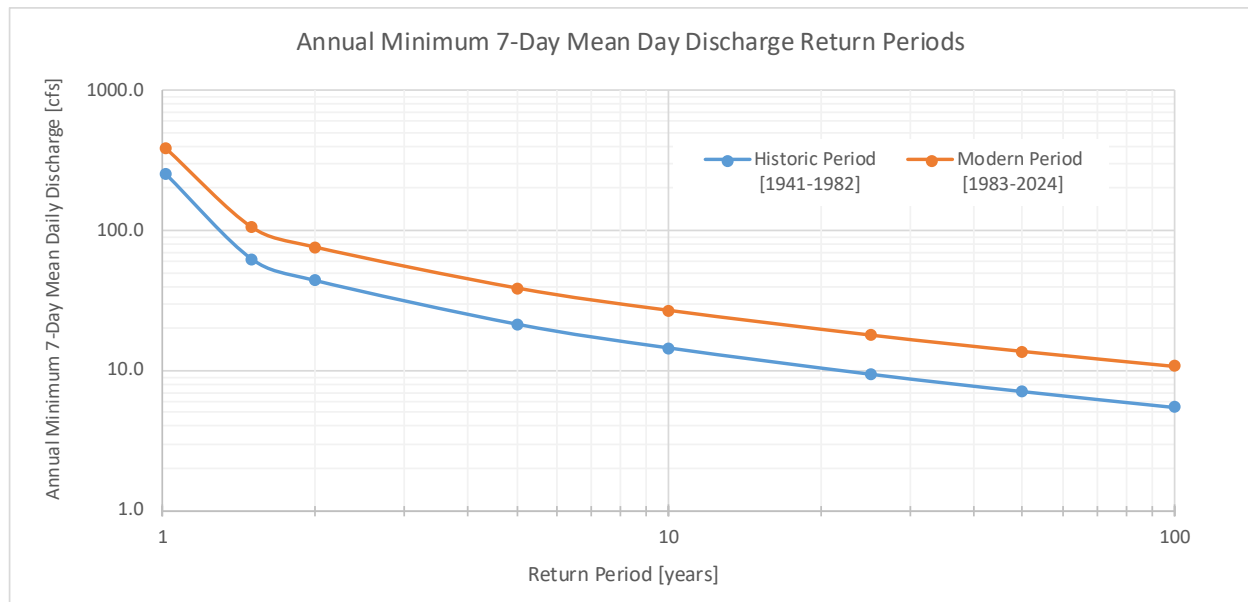


Figure A.2. Historical versus modern annual minimum 7-day mean daily discharge return periods for Blue Earth River near Rapidan, MN (USGS# 05320000).

Table A.2: Summary of annual minimum 7-day mean daily discharge return periods for the Blue Earth River near Rapidan, MN (USGS# 05320000).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
1.0101	254.9	388.9	52.5%	+
1.5	62.3	105.2	68.8%	+
2	43.9	75.9	72.7%	+
5	21.5	38.8	80.7%	+
10	14.5	26.9	85.0%	+
25	9.5	17.9	89.8%	+
50	7.1	13.7	92.9%	+
100	5.5	10.7	95.7%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.1.3 November Median Daily Discharge

The median daily mean discharge for November is another indicator of baseflow. This metric is intended to represent baseflow condition during the winter months. **Table A.3** provides the median November flow for each period.

Table A.3: Historical and modern median November flow for the Blue Earth River near Rapidan, MN (USGS# 05320000).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
Period median November flow [cfs]	209.0	430.5	106.0%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.2 AQUATIC ORGANISM LIFE CYCLE

The shape of the annual hydrograph and timing of discharges are associated with ecological cues. Metrics related to the aquatic organism life cycle include the shape of the annual hydrographs, timing of the annual minimum flow, and timing of the annual peak flow.

A.2.1 Annual Distribution of Discharges

The annual distribution of runoff is shown two ways: as average monthly runoff volume in acre-feet per month (**Figure A.3**) and as a percentage of average annual runoff volume (**Figure A.4**). **Table A.4** summarized the data used to generate **Figures A.3** and **A.4**.

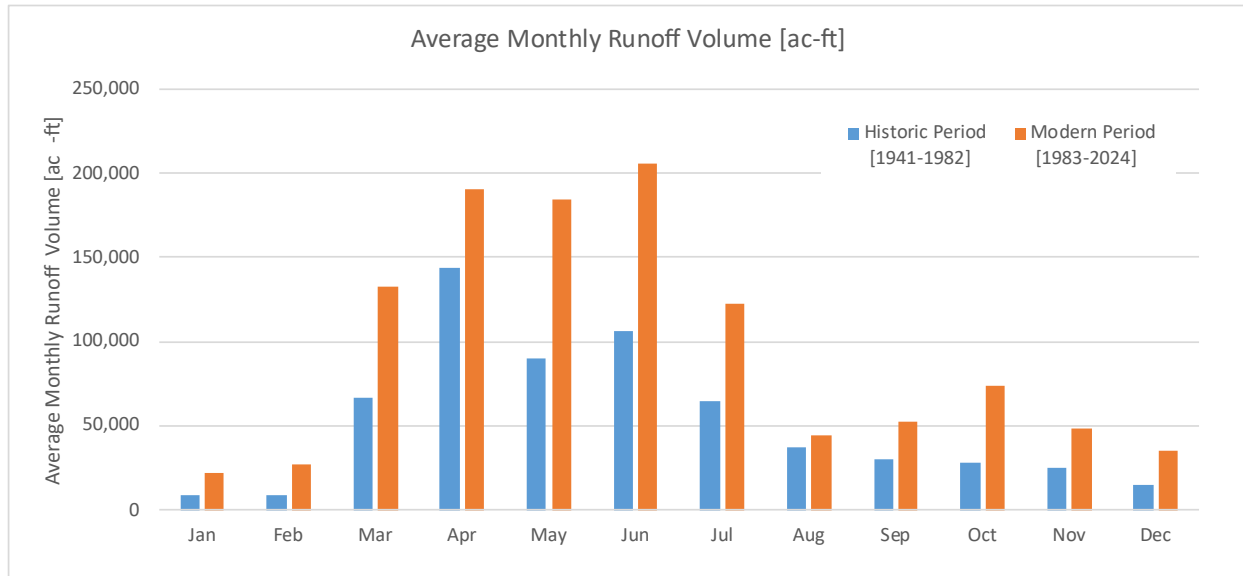


Figure A.3. Average monthly runoff volume [ac-ft] in the Blue Earth River near Rapidan, MN (USGS# 05320000).

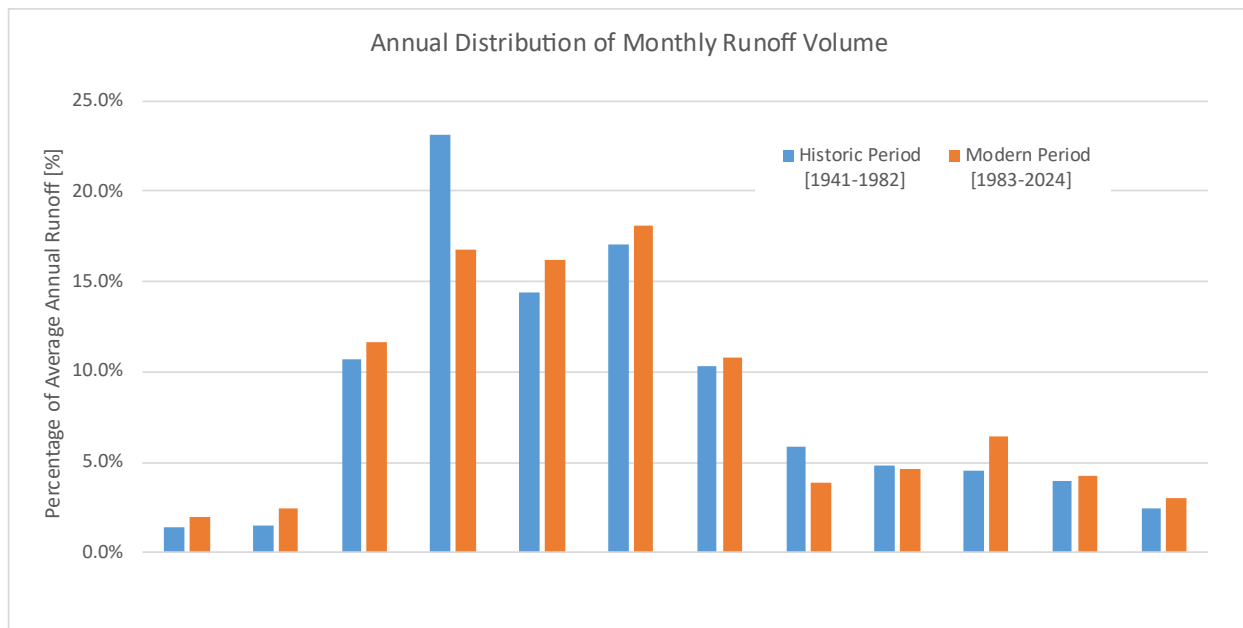


Figure A.4. Annual distribution of average monthly runoff volume as a percentage of annual total volume in the Blue Earth River near Rapidan, MN (USGS# 05320000).

Table A.4. Average monthly runoff volume and annual distribution of monthly runoff volumes in Blue Earth River near Rapidan, MN (USGS# 05320000).

Month	Average Monthly Volumes [ac-ft]				Distribution of Annual Volume			
	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Jan	9,000	22,187	146.5%	+	1.4%	1.9%	35.0%	+
Feb	9,207	27,467	198.3%	+	1.5%	2.4%	63.4%	+
Mar	66,724	132,997	99.3%	+	10.7%	11.7%	9.2%	o
Apr	144,199	190,704	32.3%	+	23.1%	16.7%	-27.6%	-
May	89,647	184,567	105.9%	+	14.4%	16.2%	12.8%	+
Jun	106,230	205,930	93.9%	+	17.0%	18.1%	6.2%	o
Jul	64,202	122,817	91.3%	+	10.3%	10.8%	4.8%	o
Aug	36,752	44,274	20.5%	+	5.9%	3.9%	-34.0%	-
Sep	29,905	52,320	75.0%	+	4.8%	4.6%	-4.2%	o
Oct	28,429	73,478	158.5%	+	4.6%	6.4%	41.5%	+
Nov	24,969	48,761	95.3%	+	4.0%	4.3%	6.9%	o
Dec	15,242	34,846	128.6%	+	2.4%	3.1%	25.2%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

AH means altered hydrology criterion

A.2.2 Timing of Annual Maximum and Minimum Flows

The timing of the annual maximum daily discharge and annual minimum daily discharge are important metrics of the annual distribution of flows. The timing of the annual maximum typically occurs during the spring flood and the timing of the annual minimum usually occurs during the winter months. **Table A.5** provides statistics on the Julian day of the annual maximum flow and **Table A.6** provides the Julian day for the annual minimum flow. The statistics include the average, the median, and the standard deviation of the Julian days when the maximum or minimum flow occur.

Table A.5. Julian Day of annual maximum in the Blue Earth River near Rapidan, MN (USGS# 05320000).

Statistic	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Average	13-May	28-May	11.09%	+
Median	19-May	21-May	1.43%	o
Standard Deviation	45 days	66 days	46.27%	+

¹Based on 365-day year.

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

AH means altered hydrology criterion

Table A.6. Julian Day of annual minimum flow in the Blue Earth River near Rapidan, MN (USGS# 05320000).

Statistic	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Average	16-May	31-Jul	55.13%	+
Median	24-Feb	24-Sep	386.36%	+
Standard Deviation	126 days	108 days	-14.32%	-

¹Based on 365-day year.

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

AH means altered hydrology criterion

A.3 RIPARIAN FLOODPLAIN (LATERAL) CONNECTIVITY (PEAK FLOWS)

The riparian floodplain connectivity metrics represent the frequency and duration of flooding of the riparian area and the lateral connectivity between the stream and the riparian area. Functions include energy flow, deposition of sediment, channel formation and surface water – groundwater interactions. The riparian floodplain connectivity metrics include the discharge rates for the 10-year, the 25-year, the 50-year, and the 100-year peak discharges. The annual peak discharge rates for select return periods (1.01-year, 1.5-year, 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, and 200-year) are shown in **Figure A.5**.

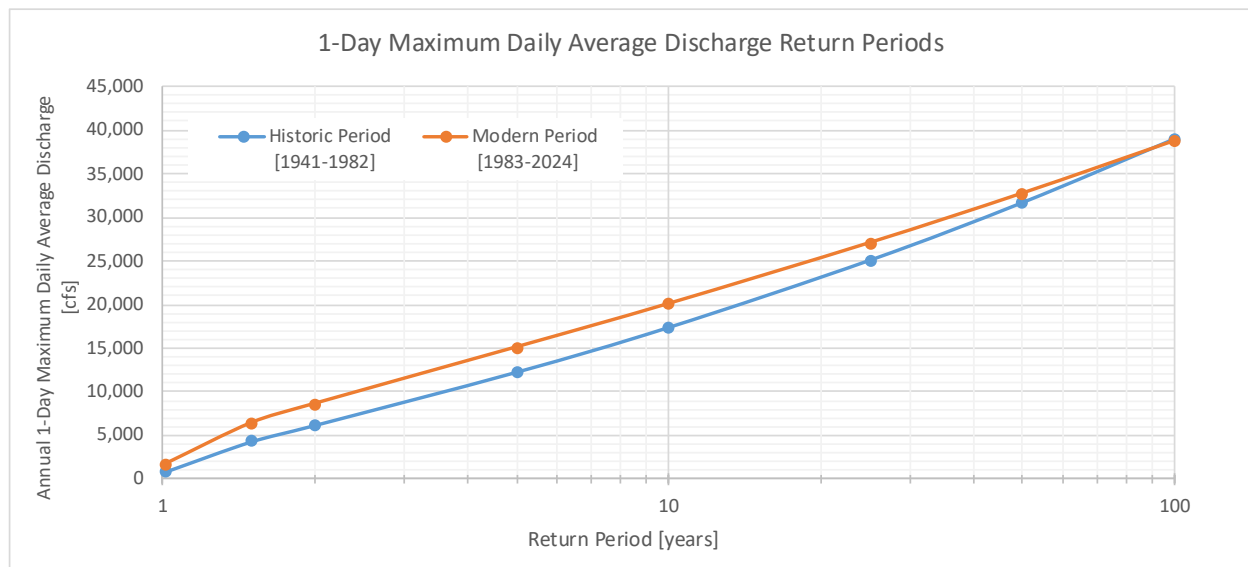


Figure A.5. Historical (1940-1975) versus modern (1980-2015) peak discharge return periods for Blue Earth River near Rapidan, MN (USGS# 05320000).

In addition, the number of years with discharges exceeding the historic peak discharge within a period, the average number of days above the historic peak discharge rates, and the average cumulative volume of discharge above the historic peak discharges are provide (**Table A.7**).

Table A.7. Riparian floodplain connectivity metrics for the Blue Earth River near Rapidan, MN (USGS# 05320000).

Flow Metric	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff. ¹	Altered Hydrology
5-Year Peak Discharge, Q(5) [cfs]	12,274	15,081	22.9%	+
Number of years with Discharge (Q) > Q _H (5)	7	12	71.4%	+
Average number of days per year Q > Q _H (5)	6	9	60.0%	+
Average annual cumulative volume > Q _H (5) [ac-ft]	72,314	80,639	11.5%	+
10-Year Peak Discharge, Q(10) [cfs]	17,404	20,060	15.3%	+
Number of years with Discharge (Q) > Q _H (10)	3	5	66.7%	+
Average number of days per year Q > Q _H (10)	5	6	16.0%	+
Average annual cumulative volume > Q _H (10) [ac-ft]	90,212	64,699	-28.3%	-
25-Year Peak Discharge, Q(25) [cfs]	25,098	27,049	7.8%	o
Number of years with Discharge (Q) > Q _H (25)	2	3	50.0%	+
Average number of days per year Q > Q _H (25)	4	3	-23.8%	-
Average annual cumulative volume > Q _H (25) [ac-ft]	56,843	20,707	-63.6%	-
50-Year Peak Discharge, Q(50) [cfs]	31,685	32,713	3.2%	o
Number of years with Discharge (Q) > Q _H (50)	1	1	0.0%	o
Average number of days per year Q > Q _H (50)	3	2	-33.3%	-
Average annual cumulative volume > Q _H (50) [ac-ft]	51,260	4,223	-91.8%	-
100-Year Peak Discharge, Q(100) [cfs]	38,987	38,740	-0.6%	o
Number of years with Discharge (Q) > Q _H (100)	1	0	NA	o
Average number of days per year Q > Q _H (100)	2	0	NA	o
Average annual cumulative volume > Q _H (100) [ac-ft]	11,753	0	NA	o

¹No events occurred above return period discharge.

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.4 GEOMORPHIC STABILITY AND CAPACITY TO TRANSPORT SEDIMENT

The geomorphic stability and capacity to transport sediment metrics are related to the channel forming discharge. An increase in these metrics would be interpreted as an increase in the risk of the stream channel susceptibility to erosion. These metrics include changes to the flow duration curves, the 1.5-year peak flow, the 2-year peak flow. The 1.5-year to 2-year peak flows are generally consider the range of channel forming flow. In addition, the number of years within a period exceeding the historic peak flows, the average number of days above the historic peak flow rates, and the average volume of flow above the historic peak flows are provide (**Table A.8**). **Figure A.6** is the flow duration curves for the historic and modern periods and **Table A.8** provides a summary of flows for select percent exceedances. Both show

that discharges across the flow spectrum have increased substantially, with the exception of the very high flows.

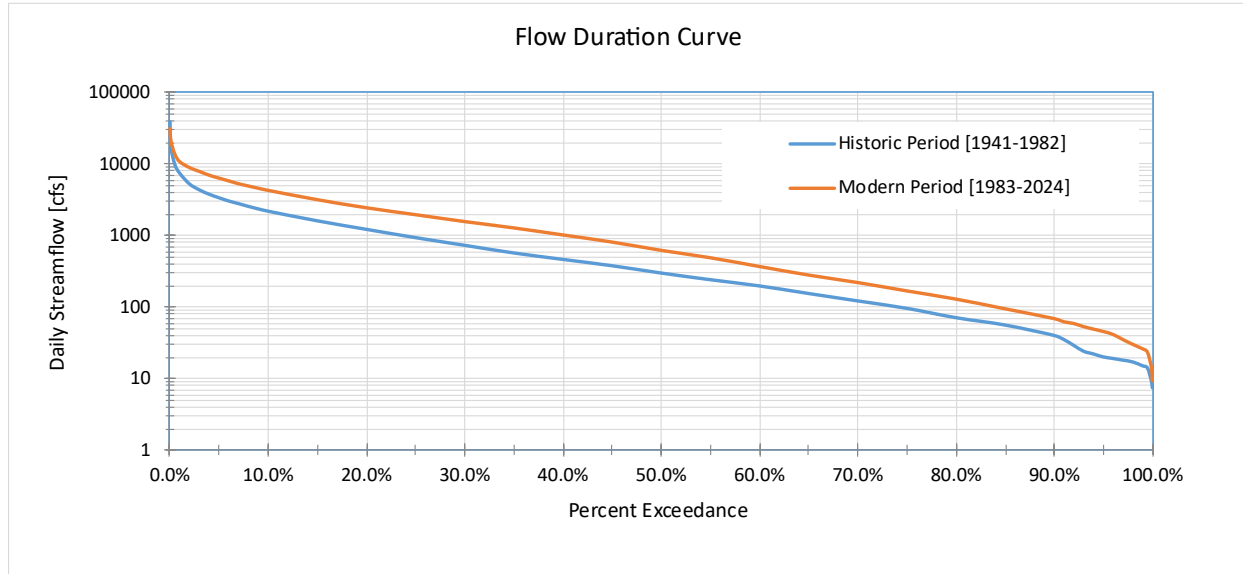


Figure A.6. Historical (1940-1975) versus modern (1980-2015) flow duration for Blue Earth River near Rapidan, MN (USGS# 05320000).

Table A.8. Select summary of the flow duration curves for the Blue Earth River near Rapidan, MN (USGS# 05320000).

Percent Exceedance	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology
0.10%	17,799	21,166	18.9%	+
1.0%	7,520	10,800	43.6%	+
10.0%	2,210	4,290	94.1%	+
25.0%	942	1,960	108.1%	+
50.0%	300	621	107.0%	+
75.0%	122	220	80.3%	+
90.0%	40	69	72.0%	+
99.0%	15	26	73.3%	+
99.9%	9	14	55.9%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

Table A.9 provides the 1.5-year and 2-year annual peak flows and flow statistics, including peak discharge, number of years with flow rates above the historic return period flow, average number of days per year above the historic return period flow, and average volume above the historic return period flow.

Table A.9. Geomorphic stability and capacity to transport sediment metrics for the Blue Earth River near Rapidan, MN (USGS# 05320000).

Flow Metric	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology
1.5-Year Peak Discharge, Q(1.5) [cfs]	4,329	6,427	48.5%	+
Number of years with Discharge (Q) > Q _H (1.5)	27	35	29.6%	+
Average number of days per year Q > Q _H (1.5)	16	43	170.1%	+
Average annual cumulative volume > Q _H (1.5) [ac-ft]	103,638	261,529	152.3%	+
2-Year Peak Discharge, Q(2) [cfs]	6,194	8,618	39.2%	+
Number of years with Discharge (Q) > Q _H (2)	20	28	40.0%	+
Average number of days per year Q > Q _H (2)	10	29	177.1%	+
Average annual cumulative volume > Q _H (2) [ac-ft]	83,852	179,349	113.9%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.5 SETTING GOALS

A summary of the storage goals is provided in **Table 4** in **Section 4**. The following are the methods used to develop those goals. Goals for addressing the change in hydrology were estimated using three methods. Each method is based on different assumptions and altered the metrics for a specific “altered hydrology” group (see Table 11). The first method is focused on the aquatic habitat and geomorphic and ability to transport sediment metric group and uses the change in the cumulative volume for mean daily discharges, exceeding the 1.5-year return period event. The cumulative total volume when the daily average discharge exceeds the 1.5-year peak discharge includes all flows above the 1.5-year peak, i.e. can include storms with much larger return periods. The change in average annual cumulative volume above the 1.5-year peak flow (see **Table A.9**) This method is based on the changes in the observed data and since it includes all flows above the 1.5-year flow relies on the two periods to have a similar distribution of flows. The storage goal based on observed flows is **157,892 AF or 1.23 inches** across the drainage area.

The second method is based on the changes in hydrology across the entire annual hydrograph and integrates the differences in return period discharges between the modern and historic period (see **Table A.10**) and finding a probability-weighted representative change in flow rate. A volume is then found by assuming a flow period equal to the change in flow period for the 1.5-year flow (i.e. the change in the number of days above the 1.5-year flow; see **Table A.9**).

Table A.10. Estimated goal for the drainage area of the Blue Earth River near Rapidan, MN (USGS# 05320000) using method 2.

Return Period	Historic Period Discharges (cfs)	Modern Period Discharges (cfs)	Difference (cfs)	Probability of Occurrence	Difference*Probability (cfs)
1.5	4,329	6,427	2098	0.67	1,398.9
2	6,194	8,618	2425	0.50	1,212.4
5	12,274	15,081	2807	0.20	561.4
10	17,404	20,060	2657	0.10	265.7
25	25,098	27,049	1951	0.04	78.0
50	31,685	32,713	1028	0.02	20.6
100	38,987	38,740	-247	0.01	0.0
				Sum (cfs):	3,537
				Sum (ac-ft/day):	7,017
Number of days:			27	Total Volume Goal:	191,411 AF (1.49 in.)

The third method is also based on addressing the effects through the entire flow range and is a revision to Method 2. Method 3 considers incorporates the observed change in the timing of the peak discharge for each return period event. This method uses the probability-weighted representative change in flow rate and multiplies the flow rates by the change in the number of days exceeding the return period flow for each return period (see **Table A.11**).

Table A.11. Estimated goal for the drainage area of the Blue Earth River near Rapidan, MN (USGS# 05320000) using method 3.

Return Period	Change in Flow ($Q_m - Q_h$) [cfs]	Probability of Occurrence	Probability Weighted Flow [AF/day]	Change in number of days above flow (days)	Storage Volume
1.5	2,098	0.67	2,775.3	27	75,704
2	2,425	0.50	2,405.4	18	44,088
5	2,807	0.20	1,113.8	3	3,726
10	2,657	0.10	527.1	1	422
25	1,951	0.04	154.8	0	0
50	1,028	0.02	40.8	0	0
100	-247	0.01	0.0	0	0
				Total Volume Goal:	123,939 AF (0.96 in.)

The fourth method integrates the changes in the FDC (see Figure A.6) and the probability of occurrence of each flow. The fourth method estimated a storage goal of **99,520 AF, or 1.11 inches**, across the drainage area.

APPENDIX C: METRICS OF ALTERED HYDROLOGY FOR THE LE SUEUR RIVER NEAR RAPIDAN, MN (USGS# 05320500).

The following is the summary statistics used to determine the altered hydrology metrics in detail and develop the storage goals. A summary of these statistic is shown in **Table 4** in **Section 3.3**.

A.1 CONDITION OF AQUATIC HABITAT

The condition of aquatic habitat includes a group of metrics that primarily reflect the flow characteristics of the annual hydrograph, needed to maintain adequate habitat for fish and aquatic life. The 7-day low flow, the 30-day low flow, and the median November mean daily discharge are metrics used to represent changes in the availability of flow for aquatic habitat.

A.1.1 Annual minimum 30-day mean daily discharge

The annual minimum 30-day mean daily discharge is the minimum of the 30-day moving mean daily discharge within a year (an annual minimum series). **Figure A.1** shows the annual minimum 30-day mean daily discharge for select return periods (1.01-year, 1.5-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year). **Table A.1** summarizes the data shown in **Figure A.1**.

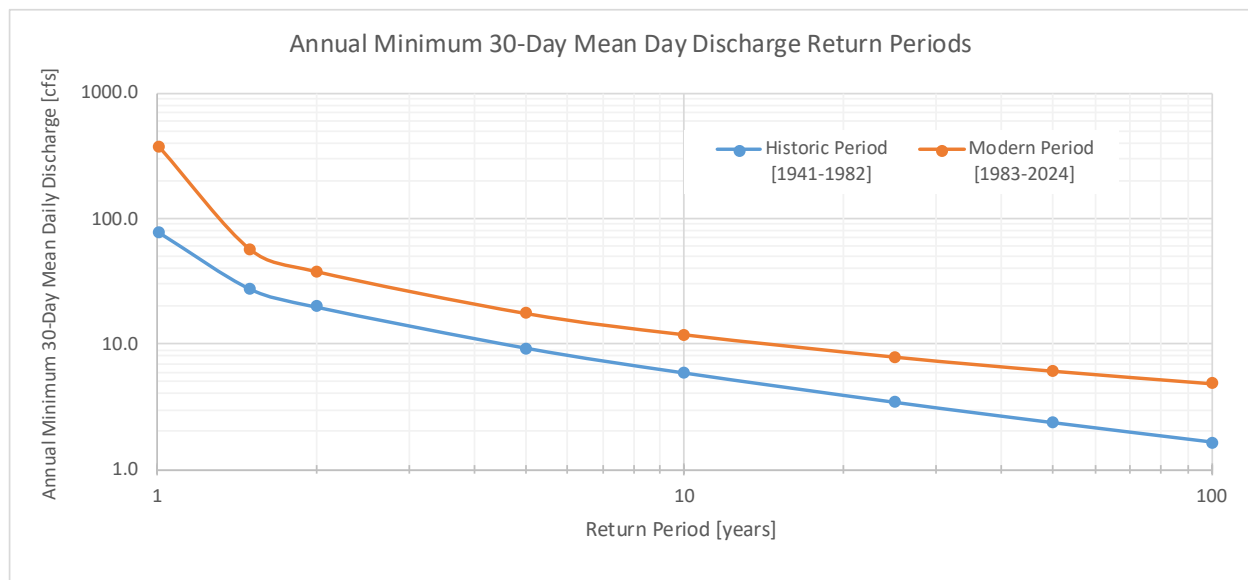


Figure A.1. Historical versus modern annual minimum 30-day mean daily discharge versus return period for Le Sueur River near Rapidan, MN (USGS# 05320500).

Table A.1: Summary of annual minimum 30-day mean daily discharge by return periods for the Le Sueur River near Rapidan, MN (USGS# 05320500).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
1.01	77.8	370.5	376.1%	+
1.5	27.6	57.0	106.6%	+
2	19.9	38.1	91.6%	+
5	9.3	17.6	89.5%	+
10	5.9	11.9	102.8%	+
25	3.4	7.9	131.1%	+
50	2.4	6.1	159.8%	+
100	1.6	4.9	195.0%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.1.2 Annual Minimum 7-Day Mean Daily Discharge

Like the annual minimum 30-day mean daily discharge, the annual minimum 7-day mean daily discharge is the minimum of the 7-day moving average flow in the year. **Figure A.2** shows the annual minimum 7-day mean daily discharges for select return periods (1.01-year, 1.5-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year). **Table A.2** summarizes the data shown in **Figure A.2**.

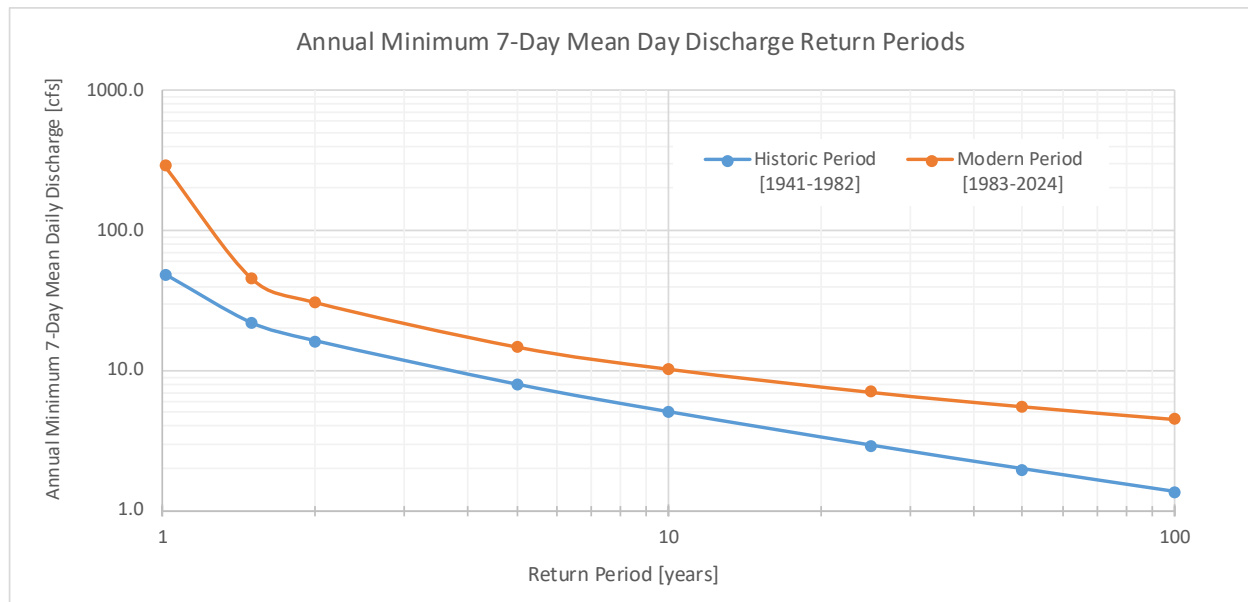


Figure A.2. Historical versus modern annual minimum 7-day mean daily discharge return periods for Le Sueur River near Rapidan, MN (USGS# 05320500).

Table A.2: Summary of annual minimum 7-day mean daily discharge return periods for the Le Sueur River near Rapidan, MN (USGS# 05320500).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
1.0101	48.4	289.9	498.9%	+
1.5	21.7	45.5	109.2%	+
2	16.2	30.8	89.7%	+
5	7.9	14.8	86.4%	+
10	5.0	10.2	103.2%	+
25	2.9	7.0	140.5%	+
50	2.0	5.5	179.7%	+
100	1.4	4.5	229.9%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.1.3 November Median Daily Discharge

The median daily mean discharge for November is another indicator of baseflow. This metric is intended to represent baseflow condition during the winter months. **Table A.3** provides the median November flow for each period.

Table A.3: Historical and modern median November flow for the Le Sueur River near Rapidan, MN (USGS# 05320500).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
Period median November flow [cfs]	80.0	238.0	197.5%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.2 AQUATIC ORGANISM LIFE CYCLE

The shape of the annual hydrograph and timing of discharges are associated with ecological cues. Metrics related to the aquatic organism life cycle include the shape of the annual hydrographs, timing of the annual minimum flow, and timing of the annual peak flow.

A.2.1 Annual Distribution of Discharges

The annual distribution of runoff is shown two ways: as average monthly runoff volume in acre-feet per month (**Figure A.3**) and as a percentage of average annual runoff volume (**Figure A.4**). **Table A.4** summarized the data used to generate **Figures A.3** and **A.4**.

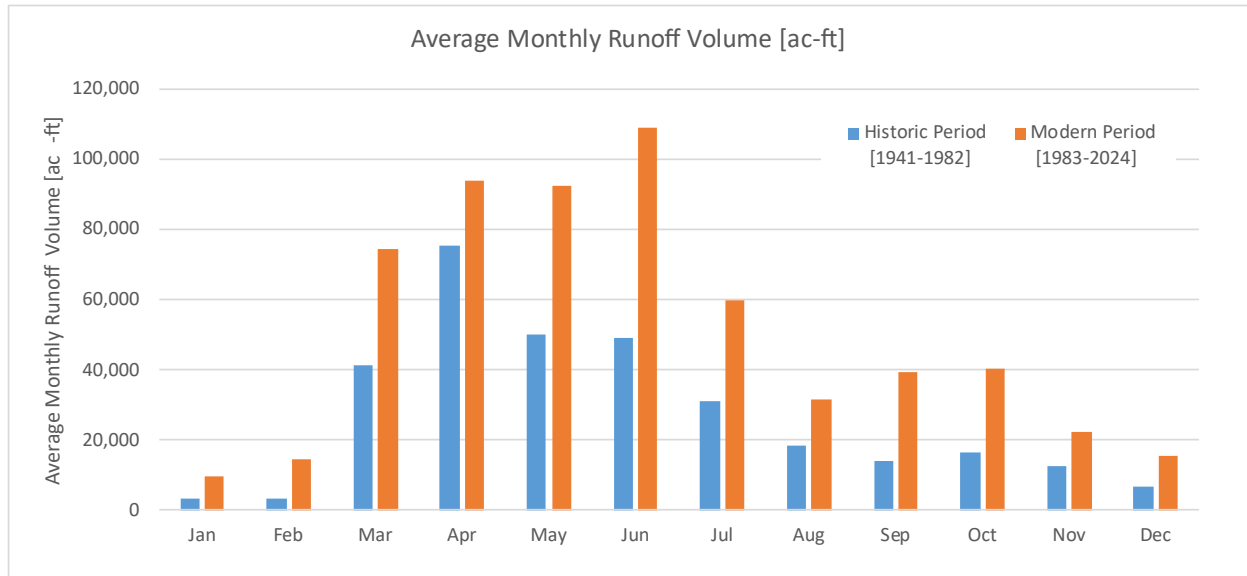


Figure A.3. Average monthly runoff volume [ac-ft] in the Le Sueur River near Rapidan, MN (USGS# 05320500).

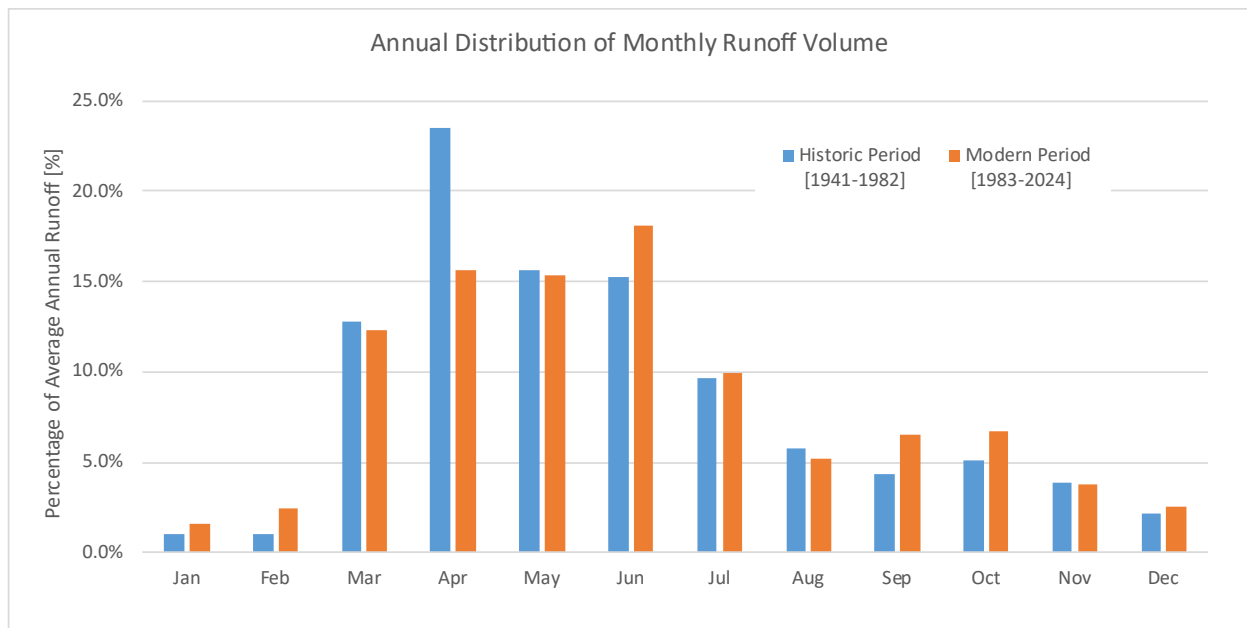


Figure A.4. Annual distribution of average monthly runoff volume as a percentage of annual total volume in the Le Sueur River near Rapidan, MN (USGS# 05320500).

Table A.4. Average monthly runoff volume and annual distribution of monthly runoff volumes in Le Sueur River near Rapidan, MN (USGS# 05320500).

Month	Average Monthly Volumes [ac-ft]				Distribution of Annual Volume			
	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Jan	3,392	9,409	177.4%	+	1.1%	1.6%	48.0%	+
Feb	3,375	14,508	329.9%	+	1.1%	2.4%	129.4%	+
Mar	41,059	74,329	81.0%	+	12.8%	12.3%	-3.4%	o
Apr	75,437	93,902	24.5%	+	23.5%	15.6%	-33.6%	-
May	50,067	92,560	84.9%	+	15.6%	15.4%	-1.4%	o
Jun	48,860	108,871	122.8%	+	15.2%	18.1%	18.9%	+
Jul	30,910	59,583	92.8%	+	9.6%	9.9%	2.8%	o
Aug	18,406	31,382	70.5%	+	5.7%	5.2%	-9.0%	o
Sep	14,051	39,178	178.8%	+	4.4%	6.5%	48.8%	+
Oct	16,279	40,294	147.5%	+	5.1%	6.7%	32.1%	+
Nov	12,402	22,473	81.2%	+	3.9%	3.7%	-3.3%	o
Dec	6,889	15,373	123.1%	+	2.1%	2.6%	19.1%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

AH means altered hydrology criterion

A.2.2 Timing of Annual Maximum and Minimum Flows

The timing of the annual maximum daily discharge and annual minimum daily discharge are important metrics of the annual distribution of flows. The timing of the annual maximum typically occurs during the spring flood and the timing of the annual minimum usually occurs during the winter months. **Table A.5** provides statistics on the Julian day of the annual maximum flow and **Table A.6** provides the Julian day for the annual minimum flow. The statistics include the average, the median, and the standard deviation of the Julian days when the maximum or minimum flow occur.

Table A.5. Julian Day of annual maximum in the Le Sueur River near Rapidan, MN (USGS# 05320500).

Statistic	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Average	10-May	29-May	15.09%	+
Median	2-May	14-May	9.80%	o
Standard Deviation	47 days	70 days	49.71%	+

¹Based on 365-day year.

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

AH means altered hydrology criterion

Table A.6. Julian Day of annual minimum flow in the Le Sueur River near Rapidan, MN (USGS# 05320500).

Statistic	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Average	22-Jun	8-Aug	27.15%	+
Median	21-Aug	21-Sep	13.52%	+
Standard Deviation	121 days	99 days	-18.16%	-

¹Based on 365-day year.

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

AH means altered hydrology criterion

A.3 RIPARIAN FLOODPLAIN (LATERAL) CONNECTIVITY (PEAK FLOWS)

The riparian floodplain connectivity metrics represent the frequency and duration of flooding of the riparian area and the lateral connectivity between the stream and the riparian area. Functions include energy flow, deposition of sediment, channel formation and surface water – groundwater interactions. The riparian floodplain connectivity metrics include the discharge rates for the 10-year, the 25-year, the 50-year, and the 100-year peak discharges. The annual peak discharge rates for select return periods (1.01-year, 1.5-year, 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, and 200-year) are shown in **Figure A.5**.

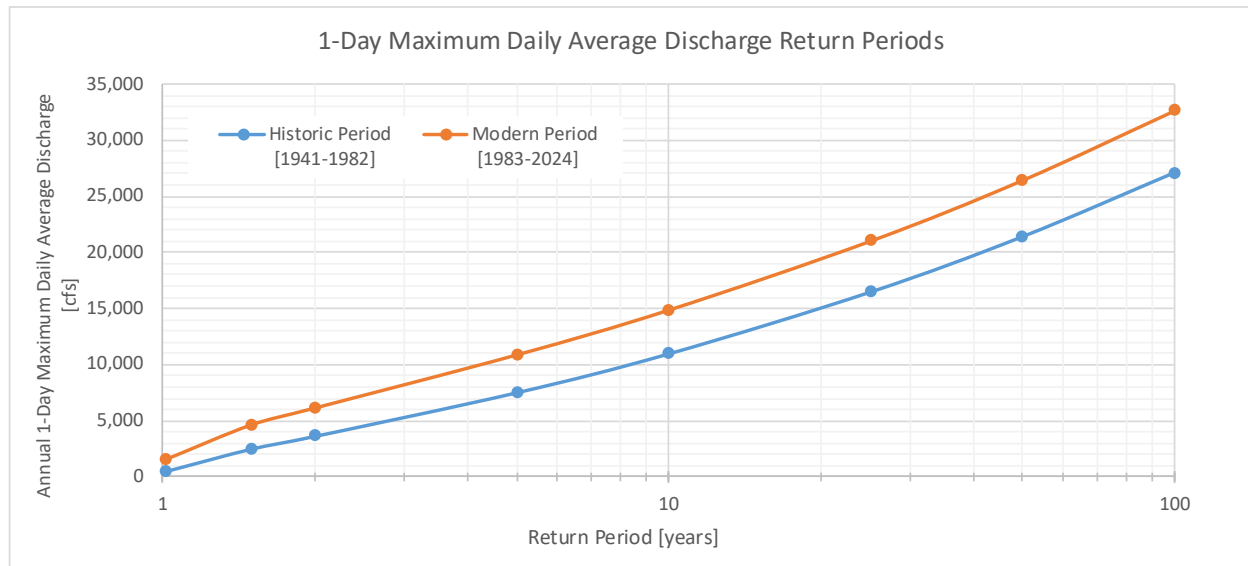


Figure A.5. Historical (1940-1975) versus modern (1980-2015) peak discharge return periods for Le Sueur River near Rapidan, MN (USGS# 05320500).

In addition, the number of years with discharges exceeding the historic peak discharge within a period, the average number of days above the historic peak discharge rates, and the average cumulative volume of discharge above the historic peak discharges are provide (**Table A.7**).

Table A.7. Riparian floodplain connectivity metrics for the Le Sueur River near Rapidan, MN (USGS# 05320500).

Flow Metric	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff. ¹	Altered Hydrology
5-Year Peak Discharge, Q(5) [cfs]	7,526	10,925	45.2%	+
Number of years with Discharge (Q) > Q _H (5)	8	15	87.5%	+
Average number of days per year Q > Q _H (5)	5	7	36.4%	+
Average annual cumulative volume > Q _H (5) [ac-ft]	35,660	61,575	72.7%	+
10-Year Peak Discharge, Q(10) [cfs]	10,990	14,918	35.7%	+
Number of years with Discharge (Q) > Q _H (10)	3	9	200.0%	+
Average number of days per year Q > Q _H (10)	4	5	25.6%	+
Average annual cumulative volume > Q _H (10) [ac-ft]	41,604	45,571	9.5%	o
25-Year Peak Discharge, Q(25) [cfs]	16,476	21,050	27.8%	+
Number of years with Discharge (Q) > Q _H (25)	2	4	100.0%	+
Average number of days per year Q > Q _H (25)	3	3	30.0%	+
Average annual cumulative volume > Q _H (25) [ac-ft]	18,465	28,070	52.0%	+
50-Year Peak Discharge, Q(50) [cfs]	21,415	26,471	23.6%	+
Number of years with Discharge (Q) > Q _H (50)	1	1	0.0%	o
Average number of days per year Q > Q _H (50)	1	3	200.0%	+
Average annual cumulative volume > Q _H (50) [ac-ft]	3,937	37,001	839.8%	+
100-Year Peak Discharge, Q(100) [cfs]	27,121	32,679	20.5%	+
Number of years with Discharge (Q) > Q _H (100)	0	1	NA	o
Average number of days per year Q > Q _H (100)	0	2	NA	o
Average annual cumulative volume > Q _H (100) [ac-ft]	0	8,445	NA	o

¹No events occurred above return period discharge.

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.4 GEOMORPHIC STABILITY AND CAPACITY TO TRANSPORT SEDIMENT

The geomorphic stability and capacity to transport sediment metrics are related to the channel forming discharge. An increase in these metrics would be interpreted as an increase in the risk of the stream channel susceptibility to erosion. These metrics include changes to the flow duration curves, the 1.5-year peak flow, the 2-year peak flow. The 1.5-year to 2-year peak flows are generally consider the range of channel forming flow. In addition, the number of years within a period exceeding the historic peak flows,

the average number of days above the historic peak flow rates, and the average volume of flow above the historic peak flows are provide (**Table A.8**). **Figure A.6** is the flow duration curves for the historic and modern periods and **Table A.8** provides a summary of flows for select percent exceedances. Both show that discharges across the flow spectrum have increased substantially, with the exception of the very high flows.

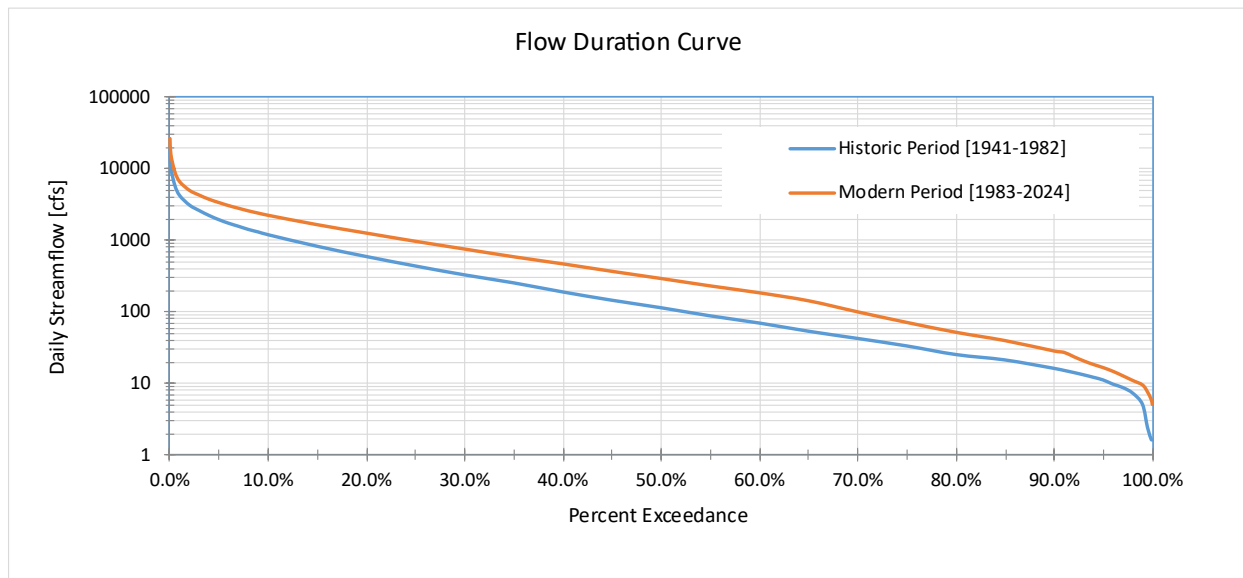


Figure A.6. Historical (1940-1975) versus modern (1980-2015) flow duration for Le Sueur River near Rapidan, MN (USGS# 05320500).

Table A.8. Select summary of the flow duration curves for the Le Sueur River near Rapidan, MN (USGS# 05320500).

Percent Exceedance	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology
0.10%	10,418	15,664	50.4%	+
1.0%	4,202	6,542	55.7%	+
10.0%	1,190	2,230	87.4%	+
25.0%	434	969	123.3%	+
50.0%	113	294	160.2%	+
75.0%	42	101	140.5%	+
90.0%	16	29	80.0%	+
99.0%	5	10	94.0%	+
99.9%	2	6	275.0%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

Table A.9 provides the 1.5-year and 2-year annual peak flows and flow statistics, including peak discharge, number of years with flow rates above the historic return period flow, average number of days per year above the historic return period flow, and average volume above the historic return period flow.

Table A.9. Geomorphic stability and capacity to transport sediment metrics for the Le Sueur River near Rapidan, MN (USGS# 05320500).

Flow Metric	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology
1.5-Year Peak Discharge, Q(1.5) [cfs]	2,531	4,716	86.3%	+
Number of years with Discharge (Q) > Q _H (1.5)	26	38	46.2%	+
Average number of days per year Q > Q _H (1.5)	17	33	96.6%	+
Average annual cumulative volume > Q _H (1.5) [ac-ft]	61,855	133,060	115.1%	+
2-Year Peak Discharge, Q(2) [cfs]	3,657	6,205	69.7%	+
Number of years with Discharge (Q) > Q _H (2)	19	33	73.7%	+
Average number of days per year Q > Q _H (2)	9	19	105.2%	+
Average annual cumulative volume > Q _H (2) [ac-ft]	50,914	91,698	80.1%	+

+ symbol indicates metric exhibits altered hydrology and an increase for the modern period compared to the historic period

o symbol indicates fails to exhibit altered hydrology for the modern period compared to the historic period

- symbol indicates metric exhibits altered hydrology and a decrease for the modern period compared to the historic period

A.5 SETTING GOALS

A summary of the storage goals is provided in **Table 4** in **Section 4**. The following are the methods used to develop those goals. Goals for addressing the change in hydrology were estimated using three methods. Each method is based on different assumptions and altered the metrics for a specific “altered hydrology” group (see Table 11). The first method is focused on the aquatic habitat and geomorphic and ability to transport sediment metric group and uses the change in the cumulative volume for mean daily discharges, exceeding the 1.5-year return period event. The cumulative total volume when the daily average discharge exceeds the 1.5-year peak discharge includes all flows above the 1.5-year peak, i.e. can include storms with much larger return periods. The change in average annual cumulative volume above the 1.5-year peak flow (see **Table A.9**) This method is based on the changes in the observed data and since it includes all flows above the 1.5-year flow relies on the two periods to have a similar distribution of flows. The storage goal based on observed flows is **71,206 AF or 1.20 inches** across the drainage area.

The second method is based on the changes in hydrology across the entire annual hydrograph and integrates the differences in return period discharges between the modern and historic period (see **Table A.10**) and finding a probability-weighted representative change in flow rate. A volume is then found by assuming a flow period equal to the change in flow period for the 1.5-year flow (i.e. the change in the number of days above the 1.5-year flow; see **Table A.9**).

Table A.10. Estimated goal for the drainage area of the Le Sueur River near Rapidan, MN (USGS# 05320500) using method 2.

Return Period	Historic Period Discharges (cfs)	Modern Period Discharges (cfs)	Difference (cfs)	Probability of Occurrence	Difference*Probability (cfs)
1.5	2,531	4,716	2185	0.67	1,456.6
2	3,657	6,205	2548	0.50	1,274.2
5	7,526	10,925	3400	0.20	679.9
10	10,990	14,918	3928	0.10	392.8
25	16,476	21,050	4573	0.04	182.9
50	21,415	26,471	5056	0.02	101.1
100	27,121	32,679	5558	0.01	55.6
				Sum (cfs):	4,143
				Sum (ac-ft/day):	8,220
Number of days:			16	Total Volume Goal:	132,869 AF (2.24 in.)

The third method is also based on addressing the effects through the entire flow range and is a revision to Method 2. Method 3 considers incorporates the observed change in the timing of the peak discharge for each return period event. This method uses the probability-weighted representative change in flow rate and multiplies the flow rates by the change in the number of days exceeding the return period flow for each return period (see **Table A.11**).

Table A.11. Estimated goal for the drainage area of the Le Sueur River near Rapidan, MN (USGS# 05320500) using method 3.

Return Period	Change in Flow ($Q_m - Q_h$) [cfs]	Probability of Occurrence	Probability Weighted Flow [AF/day]	Change in number of days above flow (days)	Storage Volume
1.5	2,185	0.67	2,890.0	16	46,713
2	2,548	0.50	2,528.0	10	25,058
5	3,400	0.20	1,349.0	2	2,642
10	3,928	0.10	779.3	1	866
25	4,573	0.04	362.9	1	272
50	5,056	0.02	200.6	2	401
100	5,558	0.01	110.3	2	221
				Total Volume Goal:	76,173 AF (1.29 in.)

The fourth method integrates the changes in the FDC (see Figure A.6) and the probability of occurrence of each flow. The fourth method estimated a storage goal of **52,999 AF, or 0.90 inches**, across the drainage area.

Appendix G.

Total Maximum Daily Load Summary





Total Maximum Daily Load (TMDL) Summary

Note that this is a summary of the TMDLs in the Minnesota-River Mankato HUC8 watershed, which is larger than the planning area.

Table 1. Total Suspended Solids (TSS) TMDL Summary (MPCA, 2020)

	Name	AUID	TSS % reduction
Little Cottonwood River-Nicollet	Little Cottonwood River	07020007-676	58%
	Little Cottonwood River	07020007-677	78%
	Minneopa Creek	07020007-534	35%
Mankato-St. Peter	County Ditch 46A	07020007-679	-
	Seven- Mile Creek	07020007-703	-
	Seven-Mile Creek	07020007-562	96%

Table 2. Fecal Coliform TMDL (MPCA, 2020)

Name		Description (AUID)	Monthly TMDL by Flow Condition				
			Very High	High	Mid	Low	Very Low
Minnesota River-New Ulm	Crow Creek	07020007-569	175	41	13	2.7	-
	Birch Coulee Creek	07020007-587	275	92	40	20	9.2
	Purgatory Creek	07020007-645	189	36	6.1	0.43	-
	Wabasha Creek	07020007-527	468	106	26	6.0	-
	Three-Mile Creek	07020007-704	109	21	3.3	0.049	-
	Unnamed Creek	07020007-644	184	34	5.7	0.33	-
	Fort Ridgley Creek	07020007-689	581	126	28	4.7	-
	Spring Creek (Judicial Ditch 29)	07020007-622	198	51	13	2.7	-
	Spring Creek	07020007-573	308	79	19	4.1	-
	County Ditch 13	07020007-712	91	22	6.0	0.88	-
	County Ditch 10 (John's Creek)	07020007-571	106	26	7.0	1.1	-
	Little Rock Creek (Judicial Ditch 31)	07020007-687	460	119	32	7.4	-
	Eight-Mile Creek	07020007-684	226	58	17	3.7	-
	Huelskamp Creek	07020007-641	81	20	6.3	1.3	-
	Fritsche Creek (County Ditch 77)	07020007-709	128	30	10	1.9	-
	Heyman's Creek	07020007-640	119	27	8.9	1.6	-





Name		Description (AUID)	Monthly TMDL by Flow Condition				
			Very High	High	Mid	Low	Very Low
Little Cottonwood River-Nicollet	Altermatts Creek	07020007-518	788	194	64	22	0.049
	Little Cottonwood River	07020007-676	780	232	82	25	3.5
	Little Cottonwood River	07020007-677	933	278	98	30	4.2
	Morgan Creek	07020007-691	306	98	40	16.0	6.6
	Swan Lake Outlet	07020007-683	201	64	18	5.6	2.1
	County Ditch 56 (Lake Crystal Inlet)	07020007-557	99	28	10	4.1	1.0
	Minneopa Creek	07020007-534	503	142	58	22.0	7.3
Mankato-St. Peter	Unnamed Creek	07020007-604	8.1	1.4	0.41	0.10	-
	Unnamed Creek	07020007-603	14	2.5	0.78	0.25	-
	Unnamed Creek	07020007-602	3.3	0.53	0.16	0.024	-
	Unnamed Creek	07020007-600	26	4.9	1.6	0.41	-
	Unnamed Ditch	07020007-598	37	7.3	2.3	0.57	-
	County Ditch 46A	07020007-679	76	14	4.6	0.94	0.088
	Seven-Mile Creek	07020007-703	118	22	6.7	1.0	-
	Unnamed Creek (Seven-Mile Tributary)	07020007-637	12	2.8	0.73	0.046	-
	Seven-Mile Creek	07020007-562	300	64	14	2.6	1.3
	Shanaska Creek	07020007-693	214	46	12	2.0	-
	Rogers Creek (County Ditch 78)	07020007-613	171	29	7.3	0.92	-





Table 3. E. Coli TMDL Summary (MPCA, 2020)

	Name	Description (AUID)	Maximum monthly geometric mean	% reduction
Minnesota River-New Ulm	Crow Creek	07020007-569	1,331	91%
	Birch Coulee Creek	07020007-587	376	66%
	Purgatory Creek	07020007-645	959	87%
	Wabasha Creek	07020007-527	1,309	90%
	Three-Mile Creek	07020007-704	173	27%
	Unnamed Creek	07020007-644	679	81%
	Fort Ridgley Creek	07020007-689	237	47%
	Spring Creek (Judicial Ditch 29)	07020007-622	423	70%
	Spring Creek	07020007-573	655	81%
	County Ditch 13	07020007-712	722	83%
	County Ditch 10 (John's Creek)	07020007-571	1,270	90%
	Little Rock Creek (Judicial Ditch 31)	07020007-687	592	79%
	Eight-Mile Creek	07020007-684	561	78%
	Huelskamp Creek	07020007-641	411	69%
	Fritsche Creek (County Ditch 77)	07020007-709	408	69%
	Heyman's Creek	07020007-640	532	76%
Little Cottonwood River-Nicollet	Altermatts Creek	07020007-518	716	12%
	Little Cottonwood River	07020007-676	646	80%
	Little Cottonwood River	07020007-677	449	72%
	Morgan Creek	07020007-691	368	66%
	Swan Lake Outlet	07020007-683	779	84%
	County Ditch 56 (Lake Crystal Inlet)	07020007-557	634	80%
	Minneopa Creek	07020007-534	947	87%
Mankato-St. Peter	Unnamed Creek	07020007-604	1,631	92%
	Unnamed Creek	07020007-603	511	75%
	Unnamed Creek	07020007-602	777	84%
	Unnamed Creek	07020007-600	1,604	88%
	Unnamed Ditch	07020007-598	2,518	95%
	County Ditch 46A	07020007-679	860	85%
	Seven-Mile Creek	07020007-703	469	73%
	Unnamed Creek (Seven-Mile Tributary)	07020007-637	1,060	88%
	Seven-Mile Creek	07020007-562	209	40%





Name		Description (AUID)	Maximum monthly geometric mean	% reduction
	Shanaska Creek	07020007-693	318	60%
	Rogers Creek (County Ditch 78)	07020007-613	436	71%

Table 4. Phosphorus TMDL Summary (MPCA, 2020b and MPCA, 2012)

Name		AUID	Existing TP Load (lbs/yr)	TMDL (lbs/yr)	% reduction
Little Cottonwood River-Nicollet	Mills Lake	07-0097-00	1,862	487*	74%
	Loon Lake	07-0096-00	4,770	2,112*	56%
Mankato-St. Peter	Wita Lake	07-0077-00	1,707	425*	75%
	Duck Lake	07-0053-00	1,169	330*	72%
	George Lake	07-0047-00	499	154*	69%
	Washington Lake	40-0117-00	7,027	2,813*	60%
	Henry Lake	40-0104-00	7,749	735*	91%
	Scotch Lake	40-0109-00	12,400	2,198*	82%
	Crystal Lake			2,198	

*Percent reduction is greater than the difference between the existing load and TMDL to account for the margin of safety

Table 5. Nitrate TMDL Summary (MPCA, 2020)

Name		AUID	Nitrate % reduction
Minnesota River-New Ulm	County Ditch 10 (John's Creek)	07020007-571	52%
Little Cottonwood River-Nicollet	Unnamed Creek	07020007-577	57%
Mankato-St. Peter	Seven-Mile Creek	07020007-562	75%



Appendix H.

HSPF Scenario Application Manager Details





HSPF Scenario Application Manager Details

Scenario 1: Target \$2.5M over 10-years (or \$250,000 per year)

Priority distribution of 7% for high priority, 4% medium priority, and 1% low priority watersheds.

Table 1. BMP treated areas and costs

BMP	Treated Area (acres)	Annualized cost (\$/yr)	10-year costs (\$)
Grass waterways	990	\$14,856	\$148,560
WASCOBs	1,484	\$75,642	\$756,420
Restored wetlands	1,484	\$46,194	\$461,940
Soil health	3,958	\$77,264	\$772,640
Urban BMPs	196	\$22,378	\$223,780
Total	8,112	\$236,334	\$2,363,340

Table 2. Local in-stream reductions at outlet of watershed (Minnesota River @ St. Peter*).

	Sediment (tons/yr)	Nitrogen (lbs/yr)	Phosphorus
Local Loads (Outflow-Inflows)	26,593	4,022,814	118,011
Load Reductions	241	36,576	1,205
%Reduction	-0.91%	-0.91%	-1.02%

*only local loads contribute to total load in the Minnesota River.

Table 3. Landscape loads and reductions.

Parameter	Attribute	Grass waterways	WASCOBs	Restored Wetlands	Soil Health	Urban	Total
	Land type	Cropland	Cropland	Cropland	Cropland	Developed	Watershed
Sediment (tons/yr)	Total Landscape Load						18,518
	Reduction	47.18	75.82	63.18	112.32	15.87	314
	%Reduction	0.25%	0.41%	0.34%	0.61%	0.6%	1.70%
Nitrogen (lbs/yr)	Total Landscape Load						5,470,253
	Reduction	9,969	18,579	11,782	19,938	480	60,748
	%Reduction	0.18%	0.34%	0.22%	0.36%	0.10%	1.11%
Phosphorus (lbs/yr)	Total Landscape Load						219,850
	Reduction	516	962	610	1,032	29	3,150
	%Reduction	0.23%	0.44%	0.28%	0.47%	0.15%	1.43%



Scenario 2: Reduction Goal Scenario

Target reduction goals of 12% sediment, 10% nitrogen, and 10% phosphorus reductions of landscape loads.

Table 4. BMP treated areas and costs

BMP	Treated Area (acres)	Annualized cost (\$/yr)	10-year costs (\$)
Grass waterways	9,237	\$138,683	\$1,386,830
WASCOBs	13,856	\$706,124	\$7,061,240
Restored wetlands	13,856	\$431,215	\$4,312,150
Soil health	36,950	\$721,261	\$7,212,610
Urban BMPs	843	\$96,058	\$960,580
Total	74,742	\$2,093,341	\$20,933,410

Table 5. Local in-stream reductions at outlet of watershed (Minnesota River @ St. Peter*).

	Sediment (tons/yr)	Nitrogen (lbs/yr)	Phosphorus
Local Loads (Outflow-Inflows)	26,593	4,022,814	118,011
Load Reductions	2,108	328,296	11,037
%Reduction	-7.93%	-8.16%	-9.35%

*only local loads contribute to total load in the Minnesota River.

Table 6. Landscape loads and reductions.

Parameter	Attribute	Grass waterways	WASCOBs	Restored Wetlands	Soil Health	Urban	Total
	Land type	Cropland	Cropland	Cropland	Cropland	Developed	Watershed
Sediment (tons/yr)	Total Landscape Load						18,518
	Reduction	433	696	580	1,030	227	2,965
	%Reduction	2.34%	3.76%	3.13%	5.56%	8.3%	16.01%
Nitrogen (lbs/yr)	Total Landscape Load						5,470,253
	Reduction	90,950	169,498	107,487	181,900	6,857	556,692
	%Reduction	1.66%	3.10%	1.96%	3.33%	1.40%	10.18%
Phosphorus (lbs/yr)	Total Landscape Load						219,850
	Reduction	4,718	8,794	5,576	9,437	418	28,944
	%Reduction	2.15%	4.00%	2.54%	4.29%	2.17%	13.17%



Scenario 3: “All” Scenario

Cropland and urban treated by 10% grass waterways, 15% WASCObS, 15% restored wetlands, 40% soil health bmps, and 20% urban bmps.

Table 7. BMP treated areas and costs

BMP	Treated Area (acres)	Annualized cost (\$/yr)	10-year costs (\$)
Grass waterways	24,679	\$370,505	\$3,705,050
WASCObS	37,018	\$1,886,478	\$18,864,780
Restored wetlands	37,018	\$1,152,031	\$11,520,310
Soil health	49,358	\$963,459	\$9,634,590
Urban BMPs	2,804	\$319,682	\$3,196,820
Total	150,877	\$4,692,155	\$46,921,550

Table 8. Local in-stream reductions at outlet of watershed (Minnesota River @ St. Peter*).

	Sediment (tons/yr)	Nitrogen (lbs/yr)	Phosphorus
Local Loads (Outflow-Inflows)	26,593	4,022,814	118,011
Load Reductions	4,659	751,993	25,005
%Reduction	-17.5%	-18.7%	-21.2%

*only local load contributions to total load in the Minnesota River.

Table 9. Landscape loads and reductions.

Parameter	Attribute	Grass waterways	WASCObS	Restored Wetlands	Soil Health	Urban	Total
	Land type	Cropland	Cropland	Cropland	Cropland	Developed	Watershed
Sediment (tons/yr)	Total Landscape Load						18,518
	Reduction	1,170	1,880	1,566	2,785	227	7,628
	%Reduction	6.32%	10.15%	8.46%	15.04%	8.3%	41.19%
Nitrogen (lbs/yr)	Total Landscape Load						5,470,253
	Reduction	245,811	458,103	290,504	491,623	6,857	1,492,898
	%Reduction	4.49%	8.37%	5.31%	8.99%	1.40%	27.29%
Phosphorus (lbs/yr)	Total Landscape Load						219,850
	Reduction	12,753	23,766	15,071	25,505	418	77,514
	%Reduction	5.80%	10.81%	6.86%	11.60%	2.17%	35.26%

Appendix I. Local Funding Authorities



Local Funding Authorities

Purpose: This table provides an overview of Minnesota statutes and laws that provide authorities to local governments to fund water management projects, to be used by local governments while exploring funding options for locally funded water projects. Does not include fees, fines, or wetland banking, grants, etc. This is not a legal document and should not be considered comprehensive, complete, or authoritative.

note: "metro" refers to Anoka, Carver, Dakota, Hennepin, Ramsey, and Washington counties or watershed organizations in the 7-county metro area.

Citation	Applies to	Summary (please see details in the full text of each provision)
§40A.152	Counties (metro)	Money from the county conservation account (see chapter 287) must be spent by the county to reimburse the county and taxing jurisdictions within the county for revenue lost under the conservation tax credit under §273.119 or the valuation of agricultural preserves under §473H.10 . Money remaining in the account after reimbursement may be spent on: 1) agricultural land preservation and conservation planning and implementation of official controls under this chapter or chapter 473H ; 2) soil conservation activities and enforcement of soil loss ordinances; 3) incentives for landowners who create exclusive agricultural use zones; 4) payments to municipalities within the county for the purposes of clauses 1-3.
§103B.241	Watershed districts & watershed management organizations (metro)	May levy a tax to pay for plan preparation costs & projects in the adopted plan necessary to implement the Metropolitan Water Management Program.
§103B.245	Watershed districts & watershed management organizations (metro)	May establish a watershed management tax district within the watershed to pay the costs of: planning required under §§ 103B.231 and 103B.235 , the capital costs of water management facilities described in the capital improvement program of the plans, and normal & routine maintenance of the facilities.
§103B.251	Watershed districts & watershed management organizations (metro), counties	May certify for payment by the county all or any part of the cost of a capital improvement contained in the capital improvement program of plans developed in accordance with §103B.231 . Counties may issue general obligation bonds to pay all or part of the cost of project. The county may pay the principal and interest on the bonds by levying a tax on all property located in the watershed or subwatershed in which the bonds are issued. Loans from counties to watershed districts for the purposes of implementing this section are not subject to the loan limit set forth in §103D.335 .

Citation	Applies to	Summary <i>(please see details in the full text of each provision)</i>
§103B.331 Subdivisions 3 & 4	Counties	(3) May charge users for services provided by the county necessary to implement the local water management plan.
		(4) May establish one or more special taxing districts within the county and issue bonds to finance capital improvements under the Comprehensive Local Water Management Act. After adoption of the resolution, a county may annually levy a tax on all taxable property in the district.
§103B.335	Counties, municipalities, or townships	May levy a tax to implement the Comprehensive Local Water Management Act or a comprehensive watershed management plan (§103B.3363). A county may levy amounts needed to pay the reasonable costs to SWCDs and WDs of administering and implementing priority programs identified in an approved & adopted plan or comprehensive watershed management plan.
§103B.555 Subdivisions 1 & 3	Counties	(1) May establish a Lake Improvement District and impose service charges on the users of lake improvement district services within the district. May levy an ad valorem tax solely on property within the lake improvement district for projects of special benefit to the district; may impose or issue any combination of service charges, special assessments, obligations, and taxes.
		(3) A tax under Subd. 1 may be in addition to amounts levied on all taxable property in the county for the same/similar purposes.
§103C.331 Subdivision 16	County boards on behalf of soil and water conservation districts	May levy an annual tax on all taxable real property in the district for the amount that the board determines is necessary to meet the requirements of the district.
§103D.335	Watershed districts	A watershed district has the power to incur debts, liabilities, and obligations and to provide for assessments and to issue certificates, warrants, and bonds.
§103D.601	Watershed districts	May set up special taxing districts via petition to conduct larger, Capital Improvement Projects (CIP). The costs to the affected parties cannot exceed \$750,000.
§103D.615	Watershed districts	May declare an emergency and order that work be done without a contract. The cost of work undertaken without a contract may be assessed against benefitted properties or raised by an ad valorem tax levy if the cost is not more than 25% of the most recent administrative ad valorem levy and the work is found to be of common benefit to the watershed district.

Citation	Applies to	Summary <i>(please see details in the full text of each provision)</i>
§103D.729	Watershed districts	May establish a water management district or districts in the territory within the watershed to collect revenues and pay the costs of projects initiated under §§ 103B.231 , 103D.601 , 103D.605 , 103D.611 , or 103D.730 . (Guidelines for creating water management districts)
§103D.901	Watershed districts	County auditors assess the amount specified in an assessment statement filed by managers. The county may issue bonds (§103E.635). An assessment may not be levied against a benefited property in excess of the amount of benefits received.
§103D.905 Subdivisions 2,3, 7-9	Watershed districts	Established funds for watershed districts (not a complete list – see full statute language): Organizational expense fund - consisting of an ad valorem tax levy, shall be used for organizational expenses and preparation of the watershed management plan for projects. General fund - consisting of an ad valorem tax levy, shall be used for general administrative expenses and for the construction or implementation and maintenance of projects of common benefit to the watershed district. May levy a tax not to exceed 0.00798 percent of estimated market value to pay the cost attributable to projects initiated by petition. Repair and maintenance funds - established under §103D.631 , Subd. 2. Survey and data acquisition fund - consists of the proceeds of a property tax that can be levied only once every 5 years and may not exceed 0.02418 percent of estimated market value. Project tax levy - a WD may levy a tax: 1. To pay the costs of projects undertaken by the WD which are to be funded, in whole or in part, with the proceeds of grants or construction or implementation loans under the Clean Water Partnership Law; 2. To pay the principal of, or premium or administrative surcharge (if any), and interest on, the bonds and notes issued by the WD pursuant to §103F.725 ; 3. To repay the construction or implementation loans under the Clean Water Partnership Law.
§103E.011 Subdivision 5	Drainage authorities	A drainage authority can accept and use external sources of funds together with assessments from benefited landowners in the watershed of the drainage system for the purposes of flood control, wetland restoration, or water quality improvements.
§103E.015 Subdivision 1a	Drainage authorities	When planning a “drainage project” or petitioned repair, the drainage authority must investigate the potential use of external sources of funding, including early coordination for funding and technical assistance with other applicable local government units.
§103E.601 §103E.635 §103E.641	Drainage authorities	Funding of all costs for constructed “ drainage projects ” are apportioned to benefited properties within the drainage system pro rata on the basis of the benefits determined (§103E.601). After the contract for the construction of a drainage project is awarded, the board of an affected county may issue bonds of the county

Citation	Applies to	Summary <i>(please see details in the full text of each provision)</i>
		in an amount necessary to pay the cost of establishing and constructing the drainage project. (§103E.635). Drainage authorities may issue drainage funding bonds (§103E.641).
§103E.728 §103E.731 §103E.735	Drainage authorities	Costs for drainage system repairs are apportioned pro rata on all benefited properties of record. The drainage authority may charge an additional assessment on property that is in violation of §103E.021 (ditch buffers) or a county soil loss ordinance (§103E.728). If there is not enough money in the drainage system account to make a repair, the board shall assess the costs of the repairs on all property and entities that have been assessed benefits for the drainage system (§103E.731). To create a repair fund for a drainage system to be used only for repairs, the drainage authority may apportion and assess an amount against all property and entities benefited by the drainage system, including property not originally assessed and subsequently found to be benefited according to law. (§103E.735).
Chapter 287	Counties	Counties participating in the agricultural land preservation program impose a fee of \$5 per transaction on the recording or registration of a mortgage or deed that is subject to tax under §§ 287.05 and 287.21 .
Chapter 365A	Towns	Townships may create subordinate service districts with special taxing authority. Requires a petition signed by at least 50 percent of the property owners in the part of the town proposed for the subordinate service district.
§373.475	Counties	A county board must deposit the money received from the sale of land under Laws 1998, chapter 389, article 16, section 31, subd. 3, into an environmental trust fund. The county board may spend interest earned on the principal only for purposes related to the improvement of natural resources.
Chapter 429	Municipalities	May levy special assessments against properties benefitting from special services (including curbs, gutters and storm sewer, sanitary sewers, holding ponds, and treatment plants).
§444.075	Municipalities	May collect stormwater utility fees to build, repair, operate & maintain stormwater management systems.
§462.358 Subdivision 2b(c)	Municipalities	May accept a cash fee for lots created in a subdivision or redevelopment that will be served by municipal sanitary sewer and water service or community septic and private wells. May charge dedication fees for the acquisition and development or improvement of wetlands and open space based on an approved parks and open space plan.
M. L. 1998, Chapter 389 Article 3, Section 29	Red River Watershed Management Board	Watershed Districts that are members of the Red River Watershed Management Board may levy an ad valorem tax not to exceed 0.04836 percent of the taxable market value of all property within their district. This levy is in excess of levies authorized by §103D.905.