Appendix A

Planning Memorandum of Agreement

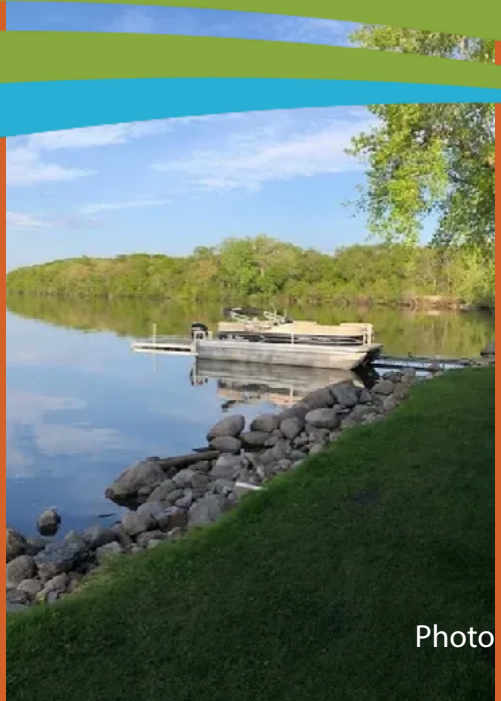


Photo Credits: Minnesota River Valley National Scenic Byway, Lake Benton, and RCRCA

MEMORANDUM OF AGREEMENT

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

The Counties of Lincoln, Lyon, Murray, Pipestone and Redwood by and through their respective County Board of Commissioners, (Counties) and
The Lincoln, Lyon, Pipestone and Redwood Soil and Water Conservation Districts ("SWCDs"), by and through their respective Soil and Water Conservation District Board of Supervisors, and
The Area II Minnesota River Basin Projects and Redwood-Cottonwood Rivers Control Area Joint Powers Organizations, by and through their respective Board of Directors, and
The City of Marshall, by and through its City Council, and
The City of Redwood Falls, by and through its City Council, and
The City of Ghent, by and through its City Council,
Collectively referred to 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 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, Area II Minnesota River Basin Projects is a political subdivision of the State of Minnesota, with authority to carry out conservation of natural resources with floodwater retention and retardation, pursuant to Minnesota Statutes Chapter 103F.171-103F.187 and as otherwise provided by law; and

WHEREAS, Redwood-Cottonwood Rivers Control Area is a political subdivision of the State of Minnesota, with authority to carry out conservation of natural resources, pursuant to Minnesota Statutes Chapter 471, Section 471.59 and as otherwise provided by law; and

WHEREAS, the Cities of Marshall, Redwood Falls, and Ghent are municipal corporations of the State of Minnesota, with statutory and, if applicable, charter authority to control, regulate and/or prevent stormwater pollution along with soil erosion and sedimentation within its boundary, and to establish standards and specifications for conservation 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 or, if applicable, charter; and

WHEREAS, the Parties of this Agreement have a common interest and statutory authority to prepare, adopt, and assure implementation of a comprehensive watershed management plan in the Redwood River Watershed 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 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; and

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

NOW, THEREFORE, the Parties hereto agree as follows:

1. **Purpose:** The Parties recognize the importance of partnerships to plan and implement protection and restoration efforts for the Redwood River Watershed as illustrated in Attachment A. 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 Redwood River One Watershed, One Plan 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 adoption of the plan by all parties, unless cancelled according to the provisions of this Agreement or earlier terminated by law.

3. **Adding Additional Parties:** An Optional Participant, as defined in BWSR Operating Procedures for One Watershed, One Plan Section II. Participation Requirements, desiring to become a member of this Agreement shall indicate its intent by resolution of its governing body prior to March 30, 2024. Prior to becoming a Party to this Agreement the Optional Participant will agree in writing to abide by all terms and conditions of this Agreement.

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. The notice must be provided at least 30 days in advance of leaving the Agreement.

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

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.

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. All official records of the *One Watershed, One Plan* will be stored at the Redwood-Cottonwood Rivers Control Area office located at 1424 East College Drive, Suite 300, Marshall, MN. The Parties are not responsible for ensuring that transitory correspondence or messages of the individual parties related to the *One Watershed, One Plan* are stored at the Redwood-Cottonwood Rivers Control Area.

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.

6. **Administration:**

a. **Establishment of Committees for Development of the Plan.** Each Party agrees to designate one representative, who must be an elected or appointed member of the governing board of the Party, to a Policy Committee for development of the watershed-based plan and may appoint one or more technical representatives to an Advisory Committee for 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 90 days of execution of this document to describe the functions and operations of the committee(s).

iv. The Parties agree to create a Steering Team as recommend and defined in BWSR Operating Procedures for *One Watershed, One Plan* Section IV.A.1.a. The Steering Team will meet

monthly or as needed to assist and provide technical support and make recommendations to the Policy Committee on plan development and content.

v. The Steering Team will consult with the Advisory Committee as needed to provide public comments and recommendations. This will occur no less than once per year until the plan is approved.

vi. Members of the Advisory Committee may not be a current board or council member 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, and approval of the plan for submittal by each party, 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**: The Redwood-Cottonwood Rivers Control Area will act as the grant administrator of the One Watershed, One Plan Planning Grant 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. Provide the Policy Committee with the records necessary to describe the planning condition of the BWSR grant agreement.

c. The Scope of Services provided to the Redwood River One Watershed, One Plan Partnership is outlined in Attachment C.

8. **Fiscal Agent:** The Redwood-Cottonwood Rivers Control Area will act as the 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 grant agreement and necessary 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 Fiscal Agent's records retention schedule.

f. The Scope of Services provided to the Redwood River Minnesota One Watershed, One Plan is outlined in Attachment B.

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

Lincoln County
Dustin Hauschild, or successor
PO Box 66, Ivanhoe, MN 56142-0066
Email: dhauschild@co.lincoln.mn.us
Telephone: (507) 694-1344

Lincoln SWCD
Dale Sterzinger, or successor
200 S Co. Hwy 5, Suite 2, Ivanhoe, MN 56142
Email: dale.sterzinger@mndistrict.org
Telephone: (507) 694-1630 x 3

Lyon County
John Biren, or successor
1424 E. College Dr, Ste 600, Marshall, MN 56258
Email: johnbiren@co.lyon.mn.us
Telephone: (507) 532-8207 x 3

Lyon SWCD
Blake Giles, or successor
1424 E. College Dr, Ste 600, Marshall, MN 56258
Email: blakegiles@co.lyon.mn.us
Telephone: (507) 532-8207 x 3

Murray County
Sarah Soderholm, or successor
2500 28th Street, Slayton, MN 56172
Email: ssoderholm@co.murray.mn.us
Telephone: (507) 836-1165

Pipestone County
Kyle Krier, or successor
PO Box 307, Pipestone, MN 56164-0307
Email: kyle.krier@pcmn.us
Telephone: (507) 825-1185

Pipestone SWCD
Nicole Schwebach, or successor
PO Box 307, Pipestone, MN 56164-0307
Email: Nicole.schwebach@pcmn.us
Telephone: (507) 825-1185

Redwood County
Nick Brozek, or successor
403 S. Mill Street, Redwood Falls, MN 56283
Email: nick_b@co.redwood.mn.us
Telephone: (507) 637-4023

Redwood SWCD
Kurt Mathiowetz, or successor
1241 E. Bridge St, Ste C, Redwood Falls, MN 56283
Email: kurt_m@co.redwood.mn.us
Telephone: (507) 637-2427 x 3

Area II Minnesota River Basin Projects
Kerry Netzke, or successor
1424 E. College Dr, Ste 300, Marshall MN 56258
Email: kerry.netzke@area2.org
Telephone: (507) 537-6369

Redwood-Cottonwood Rivers Control Area
Kerry Netzke, or successor
1424 E. College Dr, Ste 300, Marshall MN 56258
Email: kerry.netzke@rcrca.com
Telephone: (507) 532-1325

City of Marshall
Jason Anderson, or successor
344 West Main Street, Marshall MN 56258
Email: jason.anderson@ci.marshall.mn.us
Telephone: (507) 537-6051

City of Redwood Falls
Jim Doering, or successor
PO Box 526, Redwood Falls, MN 56286-0526
Email: jdoering@ci.redwood-falls.mn.us
Telephone: (507) 616-7400

City of Ghent
Dawn Vlaminck, or successor
107 N. Chapman Street, Ghent, MN 56239
Email: dawn@ghentmn.com
Telephone: (507) 428-3214

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

PARTNER: **LINCOLN COUNTY**

APPROVED:

BY: Steve Dawsedall 2-6-2024
Vice Board Chair Date

ATTEST: Deb Vierhout Auditor Treasurer 2-6-24
Name Title Date

APPROVED AS TO FORM *(use if necessary)*

BY: _____
County Attorney Date

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

PARTNER: **LINCOLN SWCD**

APPROVED:

BY: Ronald D Bunjes 1-24-24
Board Chair Date

BY: Dale Stenzel 1-24-2024
District Manager/Administrator Date

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

PARTNER: **LYON COUNTY**

APPROVED:

BY: Gary Crowley 2-20-24
Board Chair Date

ATTEST: Karen Stanbary Admin. 2-20-24
Name Title Date

APPROVED AS TO FORM *(use if necessary)*

BY: Abby Nichols 2/20/24
County Attorney Date

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

PARTNER: **LYON SWCD**

APPROVED:

BY: _____ 2/14/2024
Board Chair Date

BY: _____ 2/14/2024
District Manager/Administrator Date

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

PARTNER: **MURRAY COUNTY**

APPROVED:

BY: _____ 02/06/2024
Board Vice Chair — Date

ATTEST: Carolyn McDonald County Administrator 02/06/2024
Name — Title — Date

APPROVED AS TO FORM (use if necessary)

BY: _____ 9 February 2024
County Attorney — Date

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

PARTNER: **PIPESTONE COUNTY**

APPROVED:

BY: Dallas Torkelson 1/23/2024
Board Chair Date

ATTEST: Kim Cerny Administrator 1-22-24
Name Title Date

APPROVED AS TO FORM *(use if necessary)*

BY: _____
County Attorney Date

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

PARTNER: **PIPESTONE SWCD**

APPROVED:

BY: _____ 1-26-24
Board Chair Date

BY: _____ 1-24-24
District Manager/Administrator Date

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

PARTNER: **REDWOOD COUNTY**

APPROVED:

BY: _____ 1·16·24
Board Chair Date

ATTEST: _____ Administrator 1·16·24
Name Title Date

APPROVED AS TO FORM *(use if necessary)*

BY: _____ 1.24.2024
County Attorney Date

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

PARTNER: **REDWOOD SWCD**

APPROVED:

BY: _____ 2/14/24
Board Chair Date

ATTEST: Jeff Potter Pres 2/14/24
Name Title Date

APPROVED AS TO FORM *(use if necessary)*

BY: _____
County Attorney Date

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

PARTNER: **AREA II MINNESOTA RIVER BASIN PROJECTS**

APPROVED:

BY: _____ 02/01/2024
Board Chair Date

BY: _____ 2/1/2024
Executive Director Date

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

PARTNER: **REDWOOD-COTTONWOOD RIVERS CONTROL AREA**

APPROVED:

BY: _____ 2-1-24
Board Chair Date

BY: _____ 2/1/2024
Executive Director Date

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

PARTNER: **CITY OF MARSHALL**

APPROVED:

BY: _____ 1-24-24
Mayor Date

BY: _____ 1-24-24
City Administrator Date

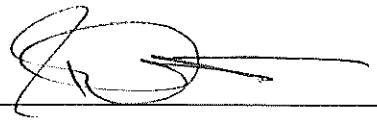
APPROVED AS TO FORM *(use if necessary)*

BY: _____
City Attorney Date

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

PARTNER: **CITY OF REDWOOD FALLS**

APPROVED:

BY:  12-20-23

Mayor Date

BY: Nick Meyer 12-20-23

City Manager Date

APPROVED AS TO FORM *(use if necessary)*

BY: _____

City Attorney Date

PARTNER: **CITY OF GHENT**

APPROVED:

BY: _____

Mayor Date

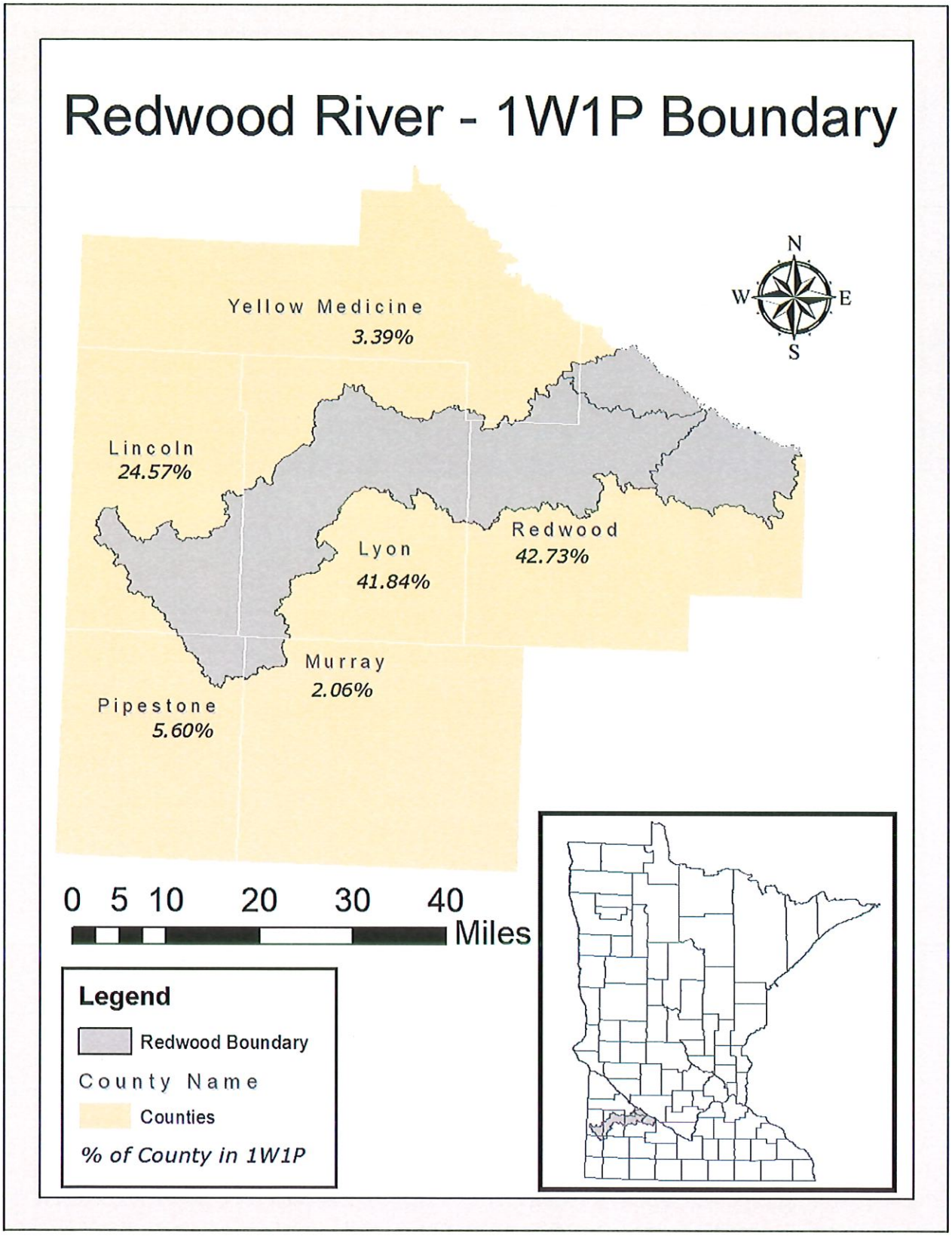
BY: Dawn Vlamuk 2/5/24

City Administrator/Clerk Date

APPROVED AS TO FORM *(use if necessary)*

BY: _____

City Attorney Date


Redwood River - 1W1P Boundary
N
W
E
S
Yellow Medicine
3.39%
Lincoln
24.57%
Lyon
41.84%
Redwood
42.73%
Murray
2.06%
Pipestone
5.60%
0 5 10 20 30 40
Miles
Legend
Redwood Boundary
County Name
Counties
% of County in 1W1P

Attachment B

Scope of Services Provided by the
REDWOOD-COTTONWOOD RIVERS CONTROL AREA (RCRCA)

RCRCA will have the following fiscal duties:

1. Account for grant funds and provide prompt payment of bills incurred,
2. Complete annual eLINK reporting,
3. Present an annual audit of grant funds and their usage,
4. Maintain all financial records and accounting,
5. Contract for Services with the chosen consultant for plan preparation and writing of the watershed-based plan, including:
   a. Execute the services agreement, and
   b. Oversee expenditures incurred by the consultant.
6. Administer the grant with BWSR for the purposes of developing a watershed-based plan, including:
   a. Submit this Agreement, work plan, budget, and other documents as required, and
   b. Execute the grant agreement.

Attachment C

Scope of Services Provided by the
REDWOOD-COTTONWOOD RIVERS CONTROL AREA (RCRCA)

RCRCA will have the following administrative duties:

1. Coordination of Policy Committee meetings, including:
    a. Provide advance notice of meetings,
    b. Prepare and distribute the Agenda and related materials,
    c. Prepare and distribute Policy Committee Minutes,
    d. Maintain all records and documentation of the Policy Committee,
    e. Provide public notices to the counties for publication, and
    f. Coordinate public meetings as required by Minnesota Statutes Chapter 103B as part of the formal review process for the watershed-based plan, gather public comments from public hearings, and prepare document for submittal.
2. Coordination of Steering Team meetings, Technical and Advisory subcommittees, including:
    a. Provide advance notice of meetings,
    b. Prepare and distribute the Agenda and related materials,
    c. Prepare and distribute Minutes, and
    d. Maintain all records and documentation of the committees.

Appendix B

Responses to 60-Day Notification

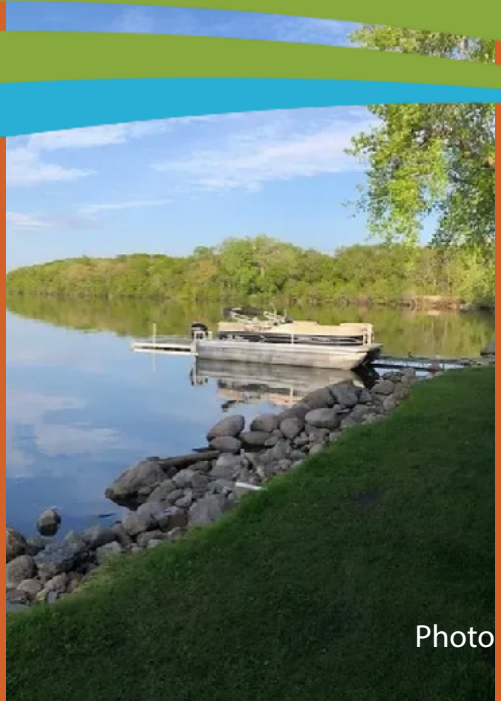


Photo Credits: Minnesota River Valley National Scenic Byway, Lake Benton, and RCRCA

DEPARTMENT OF NATURAL RESOURCES

06/10/2024

Director Kerry Netzke
Redwood-Cottonwood River Control Area (RCRCA)
1424 E. College Drive
Marshall, MN 56258

Dear Kerry,

Thank you for inviting the Minnesota Department of Natural Resources (DNR) to provide input in developing your Comprehensive Watershed Management Plan. I am writing on behalf of DNR Commissioner Sarah Strommen to share our priorities and convey that we are committed to supporting the plan development process.

Attached are natural resource priority concerns we encourage you to incorporate into the comprehensive plan. We encourage you to discuss and prioritize water quality and storage, land use and management, and outdoor recreation opportunities during the planning process for the Redwood River 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 Kyle Jarcho, DNR Area Hydrologist. He can be reached at (507) 718-1574 or kyle.jarcho@state.mn.us. Kyle reports from the DNR office in Marshall and can address questions, or offer more information about the attached priorities and types of technical support 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 support 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,

Scott W. Roemhildt
South Region Director
Minnesota Department of Natural Resources

cc: Korey Woodley, Tim Gieseke, Ethan Jenzen, Barbara Weisman, John Shea, Mike Weckwerth and Amanda Strommer

DNR Priorities for the Redwood River 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 are grouped around four high-level issues: Altered Hydrology & Drainage; Surface Water Quality & Groundwater Protection; Land Use & Management, and Biology & Natural Resources; and Outdoor Recreation.

High-Level Issue	Priority Resource Concerns & Opportunities
Altered Hydrology and Drainage	**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 from the long-term USGS gage in Redwood Falls going back to 1910 indicates a significant increase in river flows over historical averages. After analyzing the entire flow record, a change point in the relationship between precipitation and streamflow was identified in approximately 1982. Since 1982, 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. DNR's Evaluation of Hydrologic Change (EHC) Technical Summary Redwood River Watershed describes and quantifies different types of hydrologic changes, and can be useful background information to identify strategies where altered hydrology has been identified as a stressor. • **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. • **Water Storage Projects** – Water storage projects in the upper reaches of a watershed offer multiple benefits, including flood water storage, groundwater recharge, nutrient filtration, that reduce discharge and mitigate negative impacts of altered hydrology. Off channel, dry impoundments and wetland restorations are two potential water storage practices that could be effectively implemented to meet storage goals. Dry impoundments are engineered water storage solutions designed to temporarily hold and slowly release flood waters to reduce peak flows by maximizing floodplain storage in the upper watershed for these projects, while minimizing impacts to low/moderate flow events within natural stream systems. Wetland restorations are also effective in storing excess flood waters, and they additionally filter nutrients, recharge groundwater, and provide a host of ecological services. These projects are most effective when implemented in upper watershed and headwaters areas. • **Early Coordination** – Early coordination in drainage improvement project proposals benefits all parties by providing more opportunities to find creative

High-Level Issue	Priority Resource Concerns & Opportunities
	solutions to addressing high priority concerns and issues. Engaging in early coordination efforts can help landowners, drainage authorities, and watershed groups identify potential impacts, and areas of restoration or storage that may qualify for assistance/cost-share. These could benefit all involved, and the natural resources, while achieving project goals. Examples of early coordination success include JD 71 and CD 17 in Lyon County. The drainage authority has been able to improve the existing drainage conditions while providing storage on the landscape, and protecting receiving public waters. • **Flood Damage Reduction** - Promote adaptive floodplain strategies and healthy corridors by reestablishing floodplain connectivity and implementing nature-based solutions supporting climate-resilient systems. Utilize or develop effective floodplain management resources to address increased flood risk due to altered hydrology, thereby reducing public expenditures related to flood damages. The DNR can provide guidance on floodplain culvert designs that lower maintenance costs, improve water quality, and reduce flood risk.
Surface Water Quality and Groundwater Protection	**Concern:** One of the State's goals is to improve water quality to ensure Minnesota's lakes, rivers, and streams are fishable and swimmable. There are many impaired resources that will require significant attention in the watershed to improve water quality conditions. The plan should work to address the water quality goals established in the Watershed Restoration and Protection Strategies (WRAPS) report and TMDL studies. The DNR Watershed Health Assessment Framework (WHAF), Explore Watershed Health: Minnesota Department of Natural Resources (state.mn.us) and Redwood River Watershed Characterization Report, 2020 explain watershed conditions and can help identify priority areas and assist with watershed planning and implementaiton strategies. • **Agricultural BMP Implementation** –Significant benefits could be realized by addressing feedlot surface water runoff issues and targeting conservation best management practices (BMPs) such as cover crops and conservation tillage. Healthy soils protected by cover crops and conservation tillage reduce nutrient loading, increase residue, reduce runoff, and increase water storage within the soil profile. There are several high-gradient areas within the watershed, and a good example would be the transition area coming off the Coteau des Prairie in the Middle Redwood River and Three Mile Creek subwatersheds. The DNR recommend contacting the Minnesota Soil Health Coalition (MN Soil Health Coalition – MN Soil Health Coalition). An option would be a landowner/farmer lead tour providing information and examples of these benefits. • **Urban BMP Implementation** –Urban runoff can carry pollutants and cause fluctuations in stream flows and lake levels if not properly mitigated. A substantial portion of the watersheds urban area is Marshall and Redwood Falls where the Redwood River flows through. Residential property owners could be encouraged to use rain barrels and infiltration gardens to treat and reduce runoff while promoting groundwater recharge (Residential Pollinator Habitat | MN Board of Water, Soil Resources (state.mn.us). Other practices, such as proper management of garden waste and grass clippings would prevent additional nutrient loading to lakes and rivers. Riparian landowners should be

High-Level Issue	Priority Resource Concerns & Opportunities
	encouraged to implement best management practices along shorelines and urban areas. Effective implementation of shoreland ordinances would provide additional protection to sensitive shoreland areas. Also see the DNR's Innovative Shoreland Standards Showcase | Minnesota DNR (state.mn.us). **Concern: Developing Lake Shores** – Lakes in many areas are experiencing increased development pressure; Lake Benton and Shoakatan in Lincoln County are examples. Upper watershed restorations and protections are needed for nearly all water basins. However, new development can create additional pressure and it is imperative that shoreland ordinance standards are enforced to prevent degradation. Additional protections may be possible in the way of higher standards in previously undeveloped shoreland areas. See the DNR's Shoreland Management Program | Minnesota DNR (state.mn.us). **Concern: Groundwater** - Supplies 75% of Minnesota's drinking water and 90% of agricultural irrigation. Buried surficial aquifers are often limited in extent and water availability. In such situations, surface water infiltration plays a vital role in increasing aquifer recharge, reducing the amount of surface water runoff and decreasing flooding. • **Geologic Atlas** – Complete geologic atlases for Lincoln, Lyon and Redwood Counties. A comprehensive examination of the groundwater component and its connection to surface resources is critical to ensuring a complete understanding of the watershed. • **Information and Education** – The DNR provides the Community-based Aquifer Management Partnership (CAMP) program to raise awareness of water supply issues, infrastructure and water availability considerations for future need with local government units. At the LGU/watershed level, relevant strategies include making information available for irrigators on application rates, timing, irrigation endgun discharge and scheduling. There are also opportunities to work with local communities to instrument and monitor local water usage work with the DNR to expand the groundwater monitoring network (Cooperative Groundwater Monitoring (CGM) | Minnesota DNR (state.mn.us).

High-Level Issue	Priority Resource Concerns & Opportunities
Land Use and Management, Biology and Natural Resources	**Concern:** The Redwood River Watershed has hundreds of stream and river miles, and a limited number of water basins that are home to diverse plants, wildlife, and aquatic organisms. While few native landscapes and natural areas remain in the watershed, those that do remain support a wide variety of plant and animal species that warrant protection. The remaining high quality resources are primarily concentrated in three areas within the watershed: the southwestern border (Lake Benton area) aligning with the Prairie Coteau Conservation Focus Area, Threemile Creek and Redwood River (Camden State Park) southwest of Marshall and eastern border along the Minnesota River in and around Redwood Falls. Within the Minnesota River Valley, a stretch of river (Lac qui Parle Dam to Franklin) has been designated under the Minnesota Wild and Scenic River program. Healthy, intact natural areas are essential for a functioning and resilient ecosystem, which can help mitigate weather events, and provide nutrient management, water treatment and erosion control. • **Private Forest Stewardship Assistance** – Raise awareness of the DNR Forestry Stewardship program available to private landowners for stewardship activites in floodplain and upland forest areas (Forest stewardship | Minnesota DNR (state.mn.us)). Landowners and communities are encouraged to reach out to the local DNR Forester or NRCS to discuss options. DNR forester contact map for woodland assistance | Minnesota DNR (state.mn.us) • **Land Use Resource -** Land restrictions and conservation goals should address protection of sand and gravel deposits, while keeping them available for local use. Redwood County has been mapped for deposits. Aggregate Resource Mapping | Minnesota DNR (state.mn.us) • **Native Plant Communities** – Native prairie, rock outcrops, restored grassland, and forested riparian corridors with floodplain wetlands are home to many different diverse communities, rare plant and animal species listed as endangered (Where to See Prairie | Minnesota DNR (state.mn.us); Species in Greatest Conservation Need (SGCN) identified in Minnesota's Wildlife Action Plan 2015-2025 | Minnesota DNR (state.mn.us); and rare or sensitive natural features, including those vulnerable to a single catastrophic event, as detailed in the Natural Heritage Information System | Minnesota DNR (state.mn.us). • Calcareous Fens – There are three calcareous fens located southwest of Marshall focus area in the Redwood River watershed. Calcareous Fens (state.mn.us) • **Biological Resources** - Minnesota's Wildlife Action Plan aims to ensure the long-term health and viability of the state's wildlife, with emphasis on species that are rare, declining or vulnerable to decline. See also the Minnesota Conservation Explorer. ○ The DNR recommends protection efforts focusing on remnant native habitats within or adjacent to Wildlife Action Network (Minnesota's Wildlife Action Plan 2015-2025 | Minnesota DNR (state.mn.us)-identified priority areas, specifically those lands not already in some form of protected conservation land status. Riparian zones along streams, wetland and shallow lakes are also high priority, as is enforcing

High-Level Issue	Priority Resource Concerns & Opportunities
	existing shoreland and floodplain ordinances. Suggested additional goals include restoring or improving degraded resources, targeting the creation of larger habitat areas and restoring drained wetlands and basins. ○ Work with state and local partners and lake associations to understand and improve the health and biology of local lakes. Coordinate with DNR Fisheries to discuss efforts for walleye natural reproduction. Nutrient loading can be one of the biological stressors in lakes hindering game fish, such as walleye reproduction. • **Improve Aquatic Connectivity** - Fish passage barriers like dams, perched culverts, and undersized crossings impede seasonal migration of fish species and can result in fish bioassessment impairments. Removal of these barriers can significantly improve species richness and diversity. For example, the removal of Flandrau Dam in New Ulm in the neighboring Cottonwood River Watershed resulted in a substantial increase in fish diversity. A post-dam removal survey showed 21 of 24 native fish species previously only recorded downstream of the dam were now sampled in habitats upstream of the dam for the first time. According to the Redwood River Watershed Characterization Report of the 20 barriers were identified. Opportunities exist for reconnection projects, especially in the Marshall area. DNR has many resources and staff specialists able to assist with natural channel restorations, dam removals, and fish passage projects; more information can be found here: Reconnecting Rivers: Natural Channel Design in Dam Removals and Fish Passage | Minnesota DNR (state.mn.us) • **Trout Streams** – There are two trout streams, Redwood River within Camden State Park and Ramsey Creek near Redwood Falls. These put-grow-and-take trout fishing opportunities can be negatively impacted by increasing water temperatures due to a reduction in riparian habitat and poor water quality due to erosion issues. Fisheries is also adding trout to Brawner Lake within Camden State Park (Trout fishing in southwestern Minnesota | Minnesota DNR (state.mn.us)). • **Lakes of High Biological Significance** ○ Lake Benton, Coon Creek Marsh, Highpoint and Schrunk Slough. ○ East Twin is a landlocked public water basin that has no permanent outlet.

High-Level Issue	Priority Resource Concerns & Opportunities
Outdoor Recreation	**Public Recreation Opportunities** –The Minnesota River is a designated State Water Trail and the valley within this planning area is recognized for its rich diversity of natural, cultural, and historical resources. The Minnesota River Valley Recreation and Conservation Master Plan describes desired resource conditions, and outlines goals and implementation opportunities. TheRedwood River from Marshall to the confluence with the Minnesota River near Redwood Falls is also a State Water Trail (Redwood River State Water Trail | Minnesota DNR. Existing Public Water Access sites on the Redwood River are experiencing erosion issues; repairs to these sites or redesigns to allow for accessibility and climate change resiliency should be a priority. Work with DNR Parks and Trails to identify areas suitable for additional water access and carry-in sites along the Redwood River State Water Trail. • **Recreation Infrastructure –** Prioritize and augment sustainable outdoor recreation infrastructure along riparian and upland areas. Continue to support public resources that promote outdoor recreation like biking, hiking, fishing, and boating. • **Recreational Fishing**- Many valuable recreational fishing resources in this watershed are in poor condition, with low IBI scores. 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 include the Redwood River, 3 Mile, Coon and Ramsey Creeks, Lake Benton, Dead Coon, Goose, Island, and East and West Twin Lakes. • Local partners should work with DNR Fisheries to identify potential ponds/lakes that may provide additional fishing opportunities. Example would be Independence Park in Marshall. City of Marshall is working on identifying additional ponds and working with fisheries on a management/fish stocking plan. • **Programs** – Work with DNR as a part of several State and Local programs such as the Walk in Access (WIA) program (Walk-In Access (WIA) Program | Minnesota DNR (state.mn.us)) and Outdoor Recreation Grant Program to enhance outdoor opportunities for watershed communities (Outdoor Recreation Grant Program | Minnesota DNR (state.mn.us). • **Public Lands** – Public lands include Camden State Park, two Scientific and Natural Areas, six Aquatic Management Areas and 54 State Wildlife Management Areas, which consist of approximately 12,395 acres of a 447, 531-acre watershed, that account for 2.8% of the watershed.

BOARD OF WATER AND SOIL RESOURCES

670 W Main Street
#103
Marshall, MN 56258

June 14, 2024

Kerry Netzke
RCRCA
1424 East College Drive, Suite 300
Marshall, MN 56258
Kerry.netzke@rcrca.com

Dear Kerry,

Thank you for providing the opportunity to provide priority issues and plan expectations for the development of the watershed name comprehensive watershed management 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, available on the BWSR website: https://bwsr.state.mn.us/one-watershed-one-plan-policies. More specifically, the planning process must:

- 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.

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, available on the BWSR website: https://bwsr.state.mn.us/one-watershed-one-plan-policies. More specifically, the plan must have:

- 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 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 not separate entities) and evaluation.

BWSR has the following specific priority issues:

- **Altered Hydrology/Flooding/Water Quantity** – The hydrologic conditions of the Redwood River watershed and lake sheds 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. BWSR believes the watershed plan should examine these causes and identify specific areas within the watershed where implementation of BMPs could help contribute to the reduction of peak flows, frequency of flooding events, and streambank/riparian erosion and sedimentation. Significant artificial drainage that has occurred in the watershed, primarily for more productive agricultural land and infrastructure; this should be examined for impacts to increased peak flows and flooding as well as opportunities for wetland restorations in targeted areas as one component. 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.
- **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. BWSR suggest aligning goals and partnering with all state and nonstate agencies to maximize common resource restoration and protection goals. Most of the land use in the Redwood 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. The Minnesota Office of Soil Health provide technical resources and assistance to local partners.
- **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 boundary should be included as stakeholders in the plan development process. Additionally, the planning partners are strongly encouraged to include projects and activities consistent with multipurpose drainage criteria outlined in Minnesota Statutes §103E.011, Subd. 1a and §103E.015, Subd. 1, BWSR suggest 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; consider using or encouraging the development of a separate planning to systematically prioritize select 103E systems that will accelerate plan goals the greatest. Multipurpose drainage management be included in the approach for targeting best management practices (BMPs) within the drainage area of Chapter 103E drainage systems

c. 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** – 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 statewide plan in the future.

  a. **Wetland Management:** Protection and restoration of wetlands provides benefits for water quality, peak flow reduction, habitat and wildlife. 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 one resource that can be used to help identify areas for wetland restoration.

- **Conservation Easements** – The RIM reserve easement program considers several site specific and landscape scale factors when funding applications. In addition, BWSR has established a program for RIM easements that accomplish water quality and habitat priorities in comprehensive watershed management plans. Getting specific about habitat goals will improve eligibility for this funding. 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. Another factor to consider is the acres of Conservation Reserve Program (CRP) practices are schedule to expire within the partnership's counties. The plan should recognize the potential impact of these expiring contracts may have in the planning area and consider prioritizing working with producers regarding the management of those acres. BWSR easement programs can be found at https://bwsr.state.mn.us/what-programs-are-available and should be included into the comprehensive water plan to help achieve goals.

- **GRAPS** - The Groundwater Restoration and Protection Strategies (GRAPS) will be available in the future. This report will help identify specific groundwater issues in the planning area; therefore, implementation actions to address these issues should be addressed in the plan. The Department of Natural Resources (DNR) now hosts groundwater and drinking water information in their Watershed Health Assessment

Framework (WHAF) tool https://arcgis.dnr.state.mn.us/ewr/whaf2/which provides an organized approach for understanding natural resource conditions and challenges.

- **WRAPS** - The Watershed Restoration and Protection Strategies (WRAPS) for the Redwood River Watershed is complete and is available from the MPCA. The WRAPS outlines water quality reduction goals for excess sediment, phosphorus, nitrogen, and E. coli Bacteria. It also identifies areas for protection within the watershed and goals to address degraded stream habitat. These recommended strategies to meet restoration goals and protection targets, should be reviewed and incorporated into your planning effort. A reference to how WRAPS Reports can be incorporated within your One Watershed One Plan effort can be found: Using WRAPS Reports in Local Water Planning
- **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. BWSR suggest aligning goals and partnering with all state and nonstate agencies to maximize common resource restoration and protection goals. 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. Minnesota landscapes are under stress from a wide range of factors including invasive species, extreme rain events and flooding, nutrients, pollutants, habitat fragmentation, soil compaction, and changes to historic patterns within plant communities. A major climate trend in Minnesota has been an increase in intense rainfall events that stress aquatic systems, causes erosion, and transports sediment and nutrients. The BWSR Climate Change Trends and Action Plan summarizes current climate trends as well as strategies for climate adaptation and mitigation. That State Climatology Office also has a tool that helps assess Minnesota Climate Trends by major watershed. The BWSR Climate Resiliency Toolbox has been developed to guide efforts for urban and rural landscapes to address a wide range of landscape stressors to maintain long-term ecological, economic and social benefits; the Minnesota Climate Action Framework (see goals 2 and 3) contains Minnesota's priorities and next steps for this important issue. Consider strategies in the plan that can accomplish climate adaptation and mitigation and increase overall landscape resiliency.
- **Local Controls** - BWSR suggests a comparative review of local ordinance and regulations across the watershed with the purpose of identifying commonalities, significant differences as well as opportunities for coordination. Gaps or inconsistencies within local ordinances, policies, or enforcement could affect the success of your plan's implementation. Examples of this evaluation include (but are not limited to) redetermination of ditches, SSTS compliance inspection requirements (property transfer, variance, etc.), shoreland regulations, level III feedlot inventories. The purpose of this effort is to identify commonalties, differences, and opportunities for coordination when planning implementation goals.
- **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 BWSR's Pollinator Toolbox provides guidance for projects and a Minnesota State Agency Pollinator Report is focused on meeting state pollinator goals.
- **Invasive Species and Landscape Management**: A cooperative approach across the watershed is recommended for invasive species (AIS & Terrestrial) management to address invasive species and noxious weeds or specially regulated plants across geographic and ownership boundaries. Invasive

species should be prioritized based on their risk to ecosystems, agriculture, recreation, and human health, as well as focusing on emerging weed threats. A new state Tactical Invasive Species Management Plan helps with the prioritization of species. Adaptive management strategies should be used to address invasive species and to maintain ecological functions and services within landscapes. The development of Cooperative Weed Management Area's should be considered to help coordinate invasive species management between partners.

- **Riparian Management:** Protecting and restoring riparian areas, including adjacent floodplains, have multiple benefits by reducing soil erosion, stream channel instability, phosphorus and nitrogen loading, and restoring flood attenuation, wildlife habitat and wetland functions. The Plan should identify high priority areas for riparian buffer easements, riparian erosion and sediment reduction, wetland restoration and other water storage and nutrient treatment opportunities, and target implementation efforts to those areas.
- **Natural Habitat Protection/Restoration**: Protecting and restoring diverse prairies and other habitats has multiple benefits including water quality protection for groundwater and surface water, stable plant community composition to resist invasive species, protecting pollinator populations, and wildlife habitat and increasing resiliency to weather extremes. The plan should identify high priority natural habitats including wildlife and water quality complexes and corridors, and promote a combination of conservation plantings, wetland projects and riparian activities that will protect, restore and link water quality and habitat corridors.
- **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 Marshal within the planning area. The MS4 permit holder should be invited to participate in the planning effort to ensure that their Stormwater Pollution Prevention Programs are incorporated into the plan.

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 [Board Conservationist Name and contact info].

Sincerely,

John Shea

John Shea

Board Conservationist

Mark L. Hiles

Mark Hiles

Clean Water Specialist

cc: Rachel Olm Huston Engineering (via email)

Barbara Weisman, Clean Water Operations Consultant DNR (via email)

Korey Woodley, Regional Manager DNR (via email)

Kyle Jarcho, Area Hydrologist DNR (Via email)

Reid Christianson, Supervisor Clean Water Technical Assistance Unit MDA (via email)

Carrie Raber, Groundwater Restoration and Protection Strategies Coordinator, MDH (via email)

Amanda Strommer, Regional Planner, MDH (via email)

Jeff Risberg, Watershed Unit Coordinator, PCA (via email)

Mike Weckwerth, Watershed Project Manager, PCA (via email)

Catherine Neuschler, MN Environmental Quality Board* (via email)

Julie Westerlund, 1W1P Program Coordinator BWSR (via email)

Ed Lenz, Southern Region Manager BWSR

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June 25, 2024

Kerry Netzke
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Redwood-Cottonwood Rivers Control Area
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RE: Priority Water Management Concerns - City of Marshall, MN
Redwood River One Watershed, One Plan (1W1P)

Dear Kerry:

Thank you for the opportunity to submit the City of Marshall's priority water management concerns for the Redwood River One Watershed One Plan. Water management of the Redwood River has played an important role in Marshall's history. The City of Marshall has had two large federal flood control projects completed in its past; the 1963 levee and Diversion Channel project and the 1996-2000 Stage 1 and Stage 2 levee and channel cleaning project. The City of Marshall is heavily reliant upon its federal flood control project because significant portions of the City of Marshall receive protection from the project. According to information obtained from the US Army Corps of Engineers (USACE) National Levee database, there is nearly $1.7B in structures and property value that receive protection from the flood control project.

The headwaters of the Redwood River reside atop the Buffalo Ridge near Ruthton. The high elevation of the Redwood River at its source makes the Redwood River one of the "flashiest" rivers in the state. Water moves quickly from the top of the watershed and down toward Marshall as the river drops over 500 feet from its headwater to Marshall, with much of the elevation difference occurring between Russell and Marshall.

There are five (5) earthen levees that protect the City from high water events in the Redwood River. In addition to the five levee segments, there is a Redwood River Diversion Channel that routes flood waters around Marshall's perimeter. The entire flood control project is owned and operated by the City of Marshall. This includes engineered segments of the Redwood River, earthen embankment levees, control and drop structures, and interior drainage ways and drainage piping. The US Army Corps of Engineers completes regular inspections of the flood control project to help ensure that the flood control project can perform in a time of need.

It is with the above statements in mind that the City proposes its primary concerns in the watershed to be streambank stabilization upstream of Marshall and water storage and infiltration opportunities upstream of Marshall.

Water storage and infiltration: It is well-documented that we are more frequently experiencing high-intensity rainfall events. Further, it is documented that a 100-year rain event today is a higher intensity and higher volume rain event than a 100-year rain event of the past. With a flood control project that was designed decades ago with older data, we are concerned that we likely do not have protection from today's 100-year storm events. Finding opportunities to store and control water could be very important to the adequacy of the City of Marshall's flood control project and the ultimate flood protection for the City.

Streambank stabilization: Streambank stabilization is vitally important for water quality and protection of surrounding property. In addition to damaging water quality, the loss of soils from river slopes transports and deposits sediments downstream. In Marshall, the sediments are frequently deposited in various locations along our federal flood control project. In one location, between the beginning of the Redwood River Diversion Channel and roughly Lyon County 7/Airport Road, there is at least 18,000 cubic yards of sediment deposition that the City of Marshall will eventually be required to remove. Finding opportunities to stabilize streambanks benefits the City of Marshall by relieving the City of significant sediment deposition along our flood control project, which would require large sums of local dollars to remove.

Thank you for the opportunity to submit these comments on behalf of the City of Marshall. It is our hope that the Redwood River One Watershed One Plan will result in funding for projects in the Redwood River watershed that help improve water storage and water quality in a manner that provides significant benefits for all stakeholders in the region.

Respectfully,

Jason R. Anderson, P.E.
Director of Public Works/City Engineer

JRA:lrk

DEPARTMENT OF AGRICULTURE

June 12, 2024

Kerry Netzke
Redwood-Cottonwood Rivers Control Area (RCRCA)
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Thank you for the opportunity to provide priority issues and relevant information for the development of the Redwood River One Watershed One Plan (1W1P). The Minnesota Department of Agriculture (MDA) looks forward to working with local government units, stakeholders, and other partners in the 1W1P process to help provide technical information to the planning groups and organizations in the watershed.

One of the MDA's roles, related to the 1W1P process, is technical assistance. The MDA maintains a variety of water quality programs including research, on-farm demonstrations, ground and surface water monitoring, as well as programs to provide incentives and financial assistance to the agricultural community. The MDA's goal is to provide the watershed planning groups with outreach and data from the programs to help understand the resource concerns to further engage the agricultural community in local problem solving. The MDA's monitoring, research, and on-farm demonstration projects help ensure that current scientific information is made available to help address water quality concerns and to support farmer-led discussion.

MDA Priority Concerns

Nitrate and pesticides in groundwater are the priority resource concerns for the MDA statewide. The MDA is interested in working with local and state partners to engage the agricultural community, support on-farm demonstrations, promote the Minnesota Ag Water Quality Certification Program, and use relevant research and tools to share information about conservation practices that can benefit agriculture and the 1W1P process.

Nitrogen Fertilizer Management Plan (NFMP)
http://www.mda.state.mn.us/nfmp
Submitted by: luke.stuewe@state.mn.us

The NFMP is the state's blueprint for preventing or minimizing impacts of nitrogen fertilizer on groundwater. The primary goal of the Nitrogen Fertilizer Management Plan (NFMP) is to involve the agricultural community in problem solving at the local level and work together to

respond and address localized concerns about unsafe levels of nitrate in groundwater with a focus on Drinking Water Supply Management Areas (DWSMAs).

Groundwater Protection Rule (GPR)
https://www.mda.state.mn.us/nfr

The Groundwater Protection Rule minimizes potential sources of nitrate pollution to the state's groundwater and protects our drinking water. The first part of the rule restricts fall application of nitrogen fertilizer in areas vulnerable to contamination and is identified by the purple highlighted areas in **Figure 1** shown below. There are approximately 28,192 acres in the watershed that fall under part 1 of the rule.

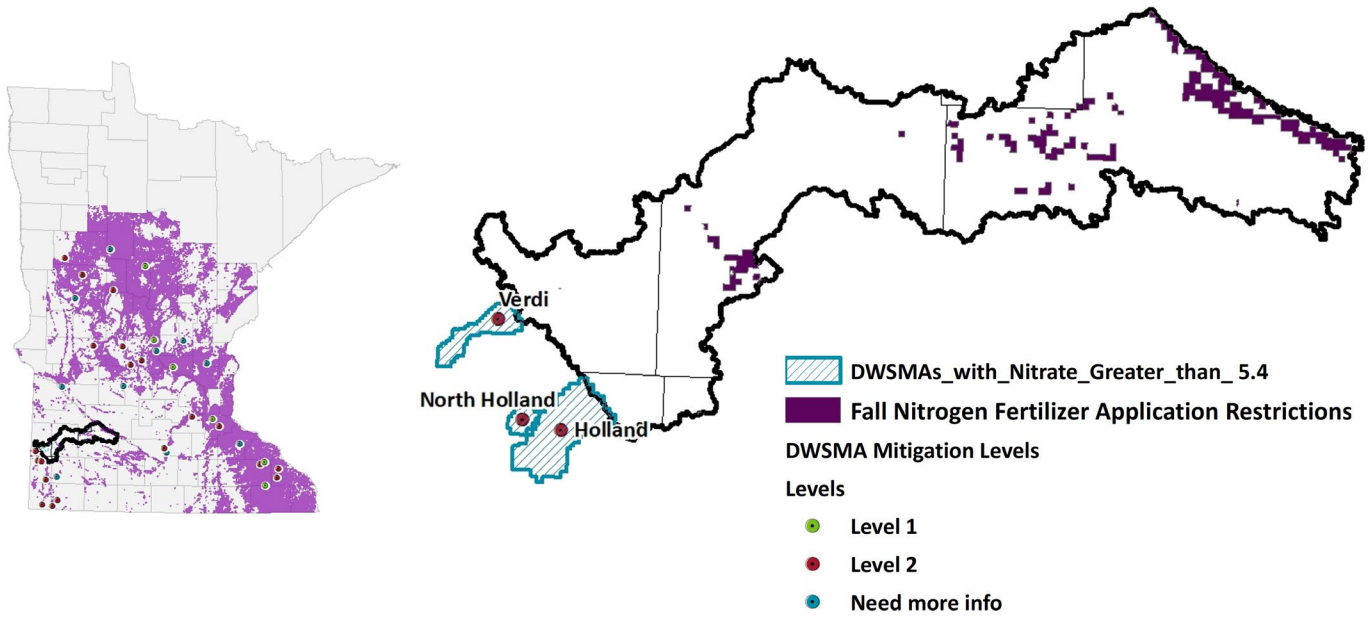

Figure 1. Land affected by the Groundwater Protection Rule in the Redwood River Watershed.

The second part of the rule outlines steps to reduce the severity of the problem in areas where nitrate in public water supply wells is elevated. Currently, there are no areas in the watershed affected by Part 2 of the GPR.

MDA Water Quality Monitoring
Submitted by: kimberly.kaiser@state.mn.us

The MDA has been conducting pesticide monitoring in ground water since 1985, and in surface waters since 1991. Annually, the MDA completes approximately 250 sample collection events from ground water and 800 sample collection events from rivers, streams, and lakes across the state. In general, the MDA collects water samples from agriculture and urban areas of Minnesota and analyzes water for up to approximately 180 different pesticide compounds that are widely used and/or pose the greatest risk to water resources.

Groundwater monitoring is conducted by MDA and Minnesota Pollution Control Agency staff. Surface water monitoring is conducted by the MDA and a variety of cooperators. All monitoring is completed following annual work plans and standard operating procedures (SOP's) developed by the MDA.

The purpose of the MDA's pesticide monitoring program is to determine the presence and concentration of pesticides in Minnesota waters, and present long-term trend analysis. Trend analysis requires long-term investments in monitoring within the MDA's established networks.

The MDA releases an annual water quality monitoring report that includes all pesticide water quality data and long term trends available at **www.mda.state.mn.us/monitoring.** The MDA will continue to conduct statewide pesticide monitoring in the future and will provide additional information related to the occurrence of pesticides in Minnesota waters.

The MDA Township Testing Program (TTP) was a seven-year statewide effort (2013-2019), that offered free nitrate-nitrogen (nitrate) tests to private well owners. Townships that are vulnerable to groundwater contamination and have significant row crop production were selected for nitrate testing. Some factors that make groundwater vulnerable are soil type and geology, which control how quickly nitrate can travel from the root zone to groundwater.

This extensive sampling effort was conducted because of a major revision of the Nitrogen Fertilizer Management Plan (NFMP). Find more information about the NFMP at **www.mda.state.mn.us/nfmp.**

The MDA began evaluating pesticide presence and magnitude in private residential drinking water wells as part of the Private Well Pesticide Sampling (PWPS) Project in 2014 as a companion program to the MDA Township Testing Program (TTP). Townships in different counties were sampled every year for the PWPS project. The initial project concluded in June 2021, but ongoing sampling in select counties continues. Townships in the PWPS Project depend on the participation of well owners and may not reflect all the townships sampled in the TTP.

Water samples were collected by trained MDA hydrologists and analyzed by a private contract lab for compounds similar to the MDA ambient water quality monitoring program. All monitoring is completed following annual work plans and standard operating procedures (SOP's) developed by the MDA.

Results of the PWPS sampling can be found at the MDA's website for the PWPS Project at **www.mda.state.mn.us/pesticide-fertilizer/private-well-pesticide-sampling-project.**

The figure below presents the locations of the MDA's groundwater and surface water monitoring locations and the TTP/PWPS townships that were sampled.

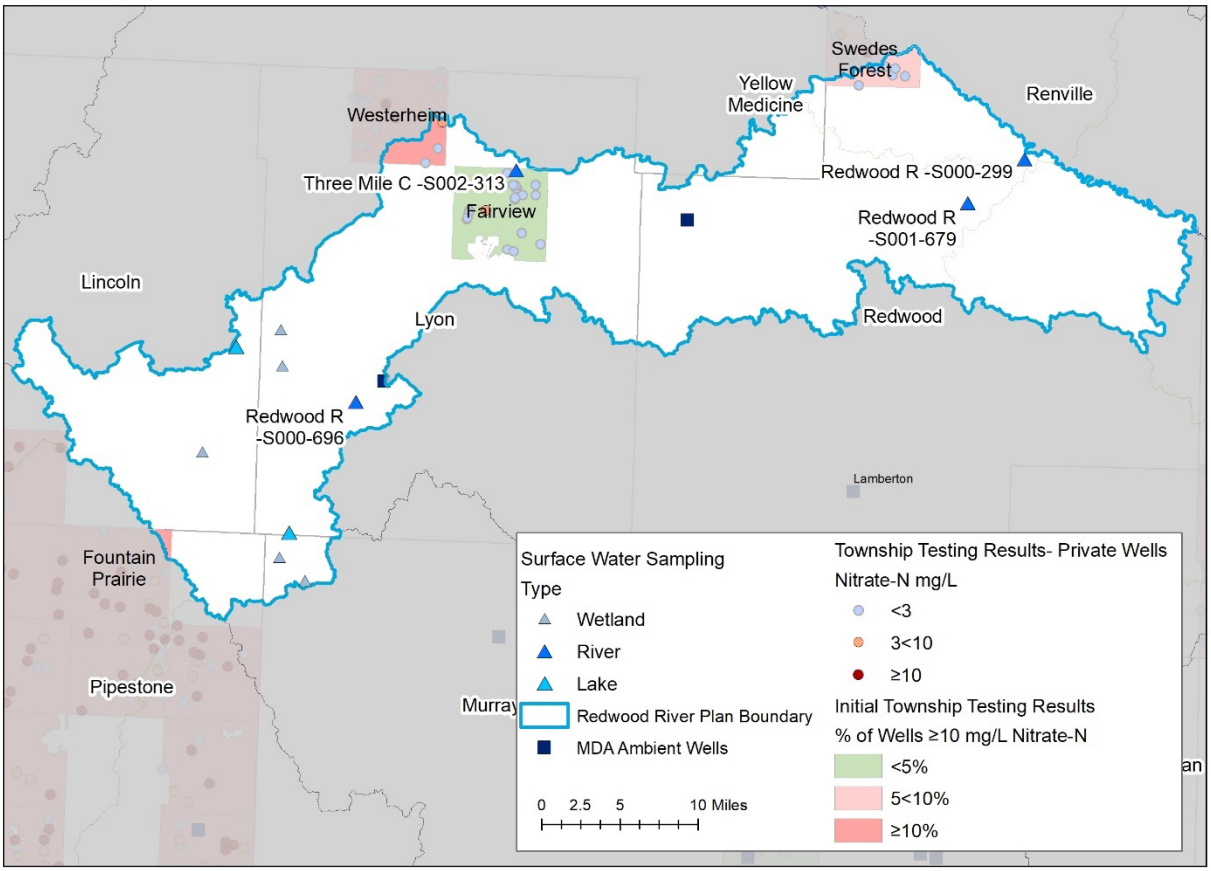

Figure 2. MDA Ground and Surface Water sampling locations.

Groundwater

Ambient Monitoring Results

The MDA currently samples two sites within the watershed. One site has been sampled since 2006 and the other since 2020.

Eight different pesticides or pesticide breakdown products (degradates) have been detected in the wells. All pesticide detections have been low relative to the human health drinking water reference values.

Nitrate-nitrite (nitrate) has not been detected at either site since monitoring began. The health risk limit (HRL) for nitrate is 10 mg/L. Monitoring of the MDA's sites in the watershed is expected to continue.

Township Testing Program: Private Well Nitrate Results

Four townships across 3 counties were tested through the TTP, however, only 3 of the townships had wells within the boundary of the Redwood River Plan boundary. Two townships (Fairview and Westerheim) in Lyon County were tested in 2018 and one township (Swedes

Forest) was tested in Redwood County in 2019. Fountain Prairie in Pipestone County was tested as part of the program, but just a very small portion of the township is within the plan boundary and none of the private wells are within the plan boundary. A total of 33 wells were tested in the Redwood River boundary. There were 27 wells from Lyon County, the minimum nitrate concentration was below the detection limit of 0.03 mg/L, the average was 0.92 mg/L, and the maximum was 7.95 mg/L. In Redwood County 6 wells were tested for nitrate, the minimum nitrate concentration was below 0.03 mg/L, the average was 0.042 mg/L, and the maximum was 0.136 mg/L.

Private Wells Pesticide Sampling (PWPS) Project Results

As part of the PWPS Project, wells in two townships in Lyon County, in one township in Pipestone County, and one township in Redwood County that lie entirely or partly within the watershed were sampled for approximately 130 pesticide compounds during 2019 or 2020. The chemistry data is available for the wells; however, due to privacy rules, the well locations cannot be shared.

The county, the year it was sampled, number of wells, and the number of townships that were sampled are listed below:

- Lyon (2019) – 4 wells in two townships
- Pipestone (2020) – 6 wells in one township
- Redwood (2019) – 3 wells in one township

The number of pesticides or pesticides degradates that were detected in wells in each county is listed below:

- Lyon – 3
- Pipestone – 13
- Redwood – 5

None of the wells had a concentration that exceeded an established human health reference value for the compounds.

Nitrate concentrations within the townships tested ranged from <0.05 to 29.0 mg/L. The HRL for nitrate is 10 mg/L. The list below presents the number of wells in each county that had a nitrate concentration that exceeded the nitrate health reference value.

- Lyon – 0
- Pipestone – 3
- Redwood – 0

The MDA does not currently plan to continue this sampling within the watershed.

Surface Water

Rivers and Streams

The MDA has completed 317 pesticide water quality sample collection events from 4 river and stream locations from 1991 through 2022. One location (S000-299; Redwood River at CSAH 101 at North Redwood) was sampled 9 times between 1991 and 1993 and 1 location (S000-696; Redwood River at CSAH 15 in Russel) was sampled 12 times between 2005 and 2007. The MDA is currently monitoring 2 locations: Redwood River at CSAH 17; S001-679 (44.523694, -95.1715) and Three Mile Creek; S002-313 (44.5411, -95.7564).

The MDA has monitored the Redwood River at CSAH 17 (S001-679), 3 miles southwest of Redwood Falls since 2002. Through 2022, the MDA has completed 149 sample collection events at this location. Three pesticides have been detected over a numeric water quality reference value including 2 detections of acetochlor (2022 (2)), 5 detections of clothianidin (2019 (3) and 2022 (2)), and 6 detections of imidacloprid (2019 (5) and 2022 (1)). None of these detections led to a violation of a water quality standard that would result in a waterbody impairment.

The MDA has monitored Three Mile Creek at CR67 1 mile north of Green Valley since 2005. Through 2022, the MDA has completed 147 sample collection events at this location. Two pesticides have been detected over a numeric water quality reference value including 1 detection of acetochlor (2022) and 1 detection of chlorpyrifos (2020). The detection of acetochlor did not violate a water quality standard; however, the detection of chlorpyrifos violated the maximum (acute) water quality standard and was designated as impaired for the insecticide chlorpyrifos on the 2020 Impaired Waters List. There are currently 10 waterbodies designated as impaired for chlorpyrifos and 1 waterbody designated as impaired for acetochlor in Minnesota (Figure 2).

The MDA requires all pesticide applications be completed following guidelines on the pesticide label and encourages the use of Best Management Practices (BMPs) to limit the movement of pesticides into waterbodies.

Lakes

The MDA completed 2 pesticide water quality sample collection events from 2 lake locations in 2017. The focus of this monitoring was glyphosate and glyphosate degradate, AMPA. No pesticides were detected in the lakes.

Wetlands

The MDA completed 5 pesticide water quality sample collection events from 5 wetland locations in 2014 for 133 different pesticide compounds. A total of 6 herbicides, 7 herbicide breakdown products and 1 insecticide were detected at least once in the wetlands. All detections were well below the applicable water quality reference value.

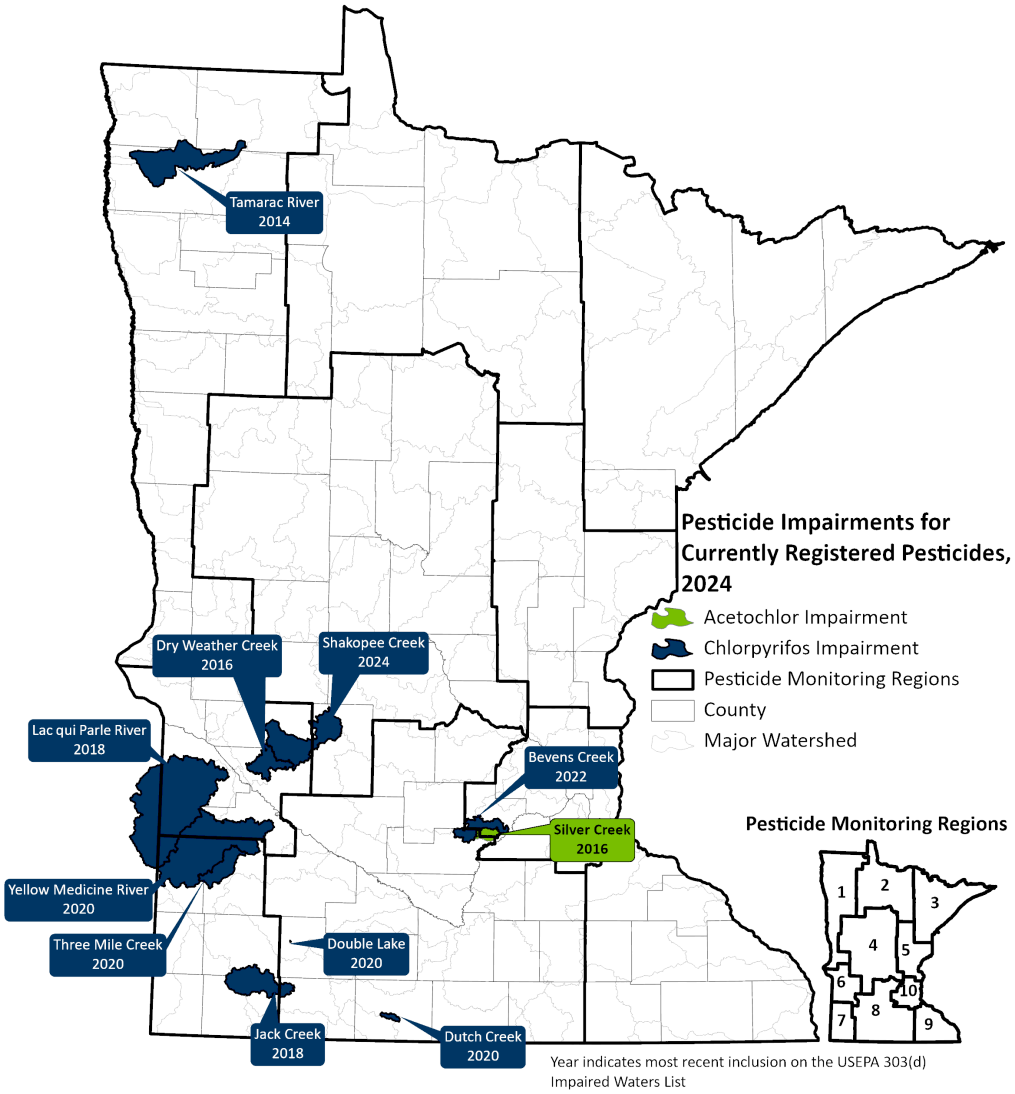

Figure 3. Waterbodies designated as impaired for currently registered pesticides.

Additional Resources and Opportunities for BMP funding and Cost-Share

Since there is a significant portion of the watershed in agricultural production, the MDA would like to provide the following resources to consider during the 1W1P planning and implementation process.

Minnesota Agricultural Water Quality Certification Program (MAWQCP)

www.mda.state.mn.us/awqcp
Submitted by: **william.fitzgerald@state.mn.us**

The MAWQCP is a voluntary opportunity for farmers and agricultural landowners to take the lead in implementing conservation practices that protect water quality. Participants that implement and maintain approved farm management practices will be certified and in turn obtain regulatory certainty for a period of ten years. This is a planning program that should be

included in the 1W1P because it is an opportunity for agricultural producers to evaluate nutrient and field management practices within the watershed to help reduce losses.

MAWQCP has funding available to assist producers in implementing conservation practices through a financial assistance grant that provides 75% cost share, up to $5,000, as well as through the RCPP- Land Management from USDA-NRCS partners. This program is designated for producers that are either certified or working towards certification.

- There are currently 38 producers and 22,266 certified acres in the watershed. Among the newly adopted practices by these producers are 2,300 acres of cover crops.

Soil Health Financial Assistance Program Grant
https://www.mda.state.mn.us/soil-health-grant
Contact: **Brad.JordahlRedlin@state.mn.us**

The Soil Health Financial Assistance Grant provides cost-share for the purchase and retrofit of soil health equipment. Adopting soil health practices often requires expensive and specific pieces of equipment, creating a need for a cost-share opportunity to offset those costs. The application will require the cost of the equipment, an explanation of how the equipment will be used to advance soil health on your farm, the number of acres the equipment will be used on, and other information.

Quick facts:

- One of the first and only programs to reimburse for equipment
- Covers purchase of new equipment, used equipment, and parts to retrofit existing equipment
- Awards range from $500-$50,000 (up to 50% cost share)
- Individual producers, producer groups, and local government units are eligible to apply
- Eligible equipment purchases must advance soil health in Minnesota
- These grants are competitive. Awarded contracts will last for 12 months

Minnesota Discovery Farms
https://discoveryfarmsmn.org/
Submitted by: **katie.rassmussen@state.mn.us**

Discovery Farms Minnesota is a farmer-led effort to gather field scale water quality information from different types of farming systems in landscapes across Minnesota. The program is designed to collect credible and accurate measurements of sediment, nitrogen, and phosphorus movement over the soil surface and through subsurface drainage tiles. This work leads to a better understanding of the relationship between agricultural management and water quality.

There is one Discovery Farm within the Redwood River watershed (RW1). The site, which is a paired watershed, is located less than ¼ mile from the mainstem of the Redwood River, just east of Seaforth, MN. The site has six full years of data and the paired monitoring locations are

installed within the same field. The north watershed is 12.2 acres, and the south watershed is 10.2 acres. Both sites monitor subsurface tile as well as surface runoff. The six-year averages and range of losses are presented in the tables below and are summarized based on the water year (October 1 through September 30).

Near real-time data for these stations are available on the MDA's Contrail Website **https://mda.onerain.com** > click on Dashboards > and then Discovery Farms Minnesota. The site IDs are **RW1N** (north watershed), and **RW1S** (south watershed).

Subsurface Tile Loss	Runoff (inches)		Total Suspended Solids (lbs/ac)		Total Phosphorus (lbs/ac)		Total Nitrogen (lbs/ac)	
	RW1N	RW1S	RW1N	RW1S	RW1N	RW1S	RW1N	RW1S
Average	4.33	5.04	5.1	6.1	0.1	0.1	13.8	17.1
Range	0.87 - 9.40	0.85 - 12.21	1.0 - 9.7	0.3 - 14.2	<0.1 - 0.1	<0.1 - 0.1	1.8 - 32.1	0.9 - 44.6

Table 1. Six -year average subsurface tile losses at the Redwood Discovery Farm.

Surface Loss	Runoff (inches)		Total Suspended Solids (lbs/ac)		Total Phosphorus (lbs/ac)		Total Nitrogen (lbs/ac)	
	RW1N	RW1S	RW1N	RW1S	RW1N	RW1S	RW1N	RW1S
Average	2.26	2.56	203.8	99.3	0.8	0.9	3.6	3.5
Range	0.46 - 5.56	0.41 - 6.98	1.9 - 1,164.7	1.2 - 521.5	0.1 - 2.6	0.1 - 2.4	0.4 - 14.3	0.3 - 14.5

Table 2. Six-year average surface water losses at the Redwood Discovery Farm.

Nutrient Management Initiative (NMI)
www.mda.state.mn.us/nmi
Contact: **ryan.lemickson@state.mn.us**

The NMI assists farmers and crop advisers in evaluating nutrient management practices on their own fields utilizing on-farm trials in corn. This is a great opportunity to promote and compare new strategies to improve yield, nitrogen use efficiency, and help open the door to include local farmers and agronomists in the 1W1P discussion. Ideas in other watersheds included cover crop, fertilizer placement, tillage, and precision agriculture trials. Advanced trials working with University of Minnesota (U of M) researchers help to guide nitrogen rate recommendations.

The Minnesota Wheat Growers also conduct an On-Farm Research Network that has funding to support wheat trials. **https://mnwheat.org/council/farm-research-network/**

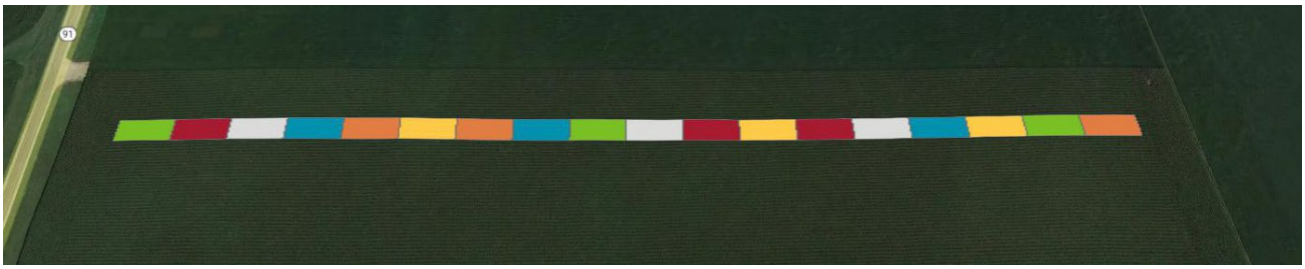

Figure 4. U of M/MDA Advanced Nitrogen rate trial in southwest Minnesota (3.1 acres total). Six side-dress nitrogen rates replicated three times across the field. (0 - 221 lbs. N/acre) Results are used to help evaluate and refine current U of M recommendations.

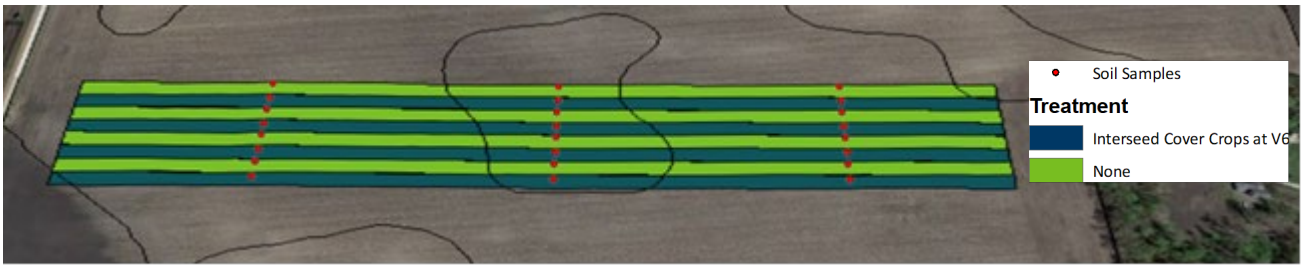

Figure 5. On-farm side by side demonstration trial evaluating cover crops to none in west central Minnesota. Red dots are the residual nutrients and soil health testing locations of each treatment.

Runoff Risk Advisory Tool
www.mda.state.mn.us/rraf

The Minnesota Runoff Risk Advisory Forecast (RRAF) system is a tool designed to help farmers and commercial applicators determine the best time to apply manure. Precipitation, snow melt or other conditions can cause recently applied manure to move off target. The movement can decrease productivity and increase the risk of impairing local bodies of water. This model accounts for soil moisture content, forecast precipitation, temperatures, snow accumulation and melt to predict the likelihood of daily, next day, and 72-hour runoff events. People use an interactive map to locate their field and find the forecasted risk. The webpage offers a sign-up for text message or email alerts when a designated county is in a severe risk for runoff.

Agriculture Best Management Practices (BMP) Loan Program
www.mda.state.mn.us/agbmploans

The AgBMP Loan Program is a water quality program that provides low interest loans to farmers, rural landowners, and agriculture supply businesses. The purpose is to encourage agricultural best management practices that prevent or reduce runoff from feedlots, farm fields, and other pollution problems identified by the county in local water plans.

Agricultural Land Preservation Program
https://www.mda.state.mn.us/environment-sustainability/farmland-protection

The MDA assists local government in protection of farmland through its Agricultural Land Preservation Program. This includes online tools and programmatic support.

Agricultural Growth, Research, and Innovation (AGRI) Program
The AGRI program has funding that may be helpful in water quality protection. Specifically:

- The AGRI Livestock Investment Grant encourages long-term industry development for Minnesota livestock farmers and ranchers by helping them improve, update, and modernize their livestock operation infrastructure and equipment. More information is available at **www.mda.state.mn.us/livestockinvestment.**

- The AGRI Sustainable Agriculture Demonstration Grant supports innovative on-farm research and demonstrations. It funds projects that explore sustainable agriculture practices and systems that could make farming more profitable, resource efficient, and personally satisfying. Findings are published in the MDA's annual **Greenbook.** More information is available at **www.mda.state.mn.us/sustagdemogrant.**

Ag BMP Handbook
This handbook provides a comprehensive summary of BMPs that are practical for Minnesota: **www.mda.state.mn.us/agbmphandbook** .

Nitrogen and Pesticide Use Surveys

The MDA surveys farmers through the National Agricultural Statistics Service (NASS). The most recent nitrogen use survey was for the 2015 crop year, **Survey Results of Nitrogen Fertilizer BMPS on Minnesota 2015 Corn Acres.** The most recent pesticide use survey was from the 2013 crop year. For reference, University of Minnesota fertilizer recommendations are found here: **https://extension.umn.edu/nutrient-management/crop-specific-needs**

Thank you again for the opportunity to provide background and relevant information as we look forward to being involved in the 1W1P process.

Sincerely,

Ryan Lemickson

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MINNESOTA POLLUTION CONTROL AGENCY

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May 14, 2024

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RE: Response to Request for Priority Issues and Concerns to be addressed in the Redwood One Watershed, One Plan

Dear Kerry and John:

The Minnesota Pollution Control Agency (MPCA) appreciates the opportunity to provide priority resource concerns and issues for consideration in the Redwood River One Watershed, One Plan (1W1P). Our priority resource concerns and issues focus primarily on information available through the Watershed Approach process for the Redwood River Watershed (RRW) that began in 2017. The Watershed Approach process for the Minnesota River- Mankato Watershed (MRMW) portion of the planning area 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 RRW and MRMW HUC-8 watersheds. 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 MRMW and RRW (Lincoln, Yellow Medicine, Lyon, Murray, Redwood, and Cottonwood 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 RRW and MRMW.

Monitoring and Assessment

In 2017, a comprehensive approach was taken to monitor and assess surface water bodies in the RRW for aquatic life, recreation, and fish consumption use support. For details on the data collected, refer to the Redwood River Watershed Monitoring and Assessment Report. For more information about the RRW and links to reports visit: Redwood River Watershed Information Page.

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 water body are compared to relevant standards. When pollutants/parameters in a water body do not meet the water quality standard, the water body 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 water body 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 and RRW as part of Minnesota's Water Quality Monitoring Strategy. Intensive Watershed Monitoring (IWM), the Watershed Pollutant Load Monitoring Network (WPLMN), and Volunteer Stream and Lake Monitoring Program (VSMP and VLMP) data provide a periodic but intensive "snapshot" of water quality conditions throughout the watershed.

Within the entire 1W1P planning area there are 101 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 and RRW planning area.

MRMW portion of planning area			
Impairment Type	**Impairments**	**Beneficial Use**	**Completed TMDL**
Benthic Macroinvertebrates Bioassessments	4	Aquatic Life	0
Escherichia coli (*E. coli*)	2	Aquatic Recreation	2
Fish Bioassessments	2	Aquatic Life	0

RRW HUC-8			
Impairment Type	**Impairments**	**Beneficial Use**	**Completed TMDL**
Benthic Macroinvertebrates Bioassessments	24	Aquatic Life	0
E. coli	2	Aquatic Recreation	2
Fecal Coliform	12	Aquatic Recreation	12
Fish Bioassessments	20	Aquatic Life	0
Mercury in Fish Tissue	12	Aquatic Consumption	12
Nitrate	1	Drinking Water	0
Nutrients	7	Aquatic Recreation	7
Turbidity/TSS	10	Aquatic Life	10
Aquatic Plant Bio Assessments	5	Aquatic Life	0

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 Redwood River Stressor Identification Report and Minnesota River Mankato Stressor Identification Report for the reaches listed for aquatic life impairments (fish, aquatic macroinvertebrate impairments). SID was completed for biota (fish and/or macroinvertebrates) impairments on 4 stream reaches in the MRMW portion and 22 stream reaches in the RRW. In these two studies, primary stressors are identified as summarized below. Details of each stream reach are in the SID reports.

SID summary for the aquatic life impaired streams in the MRMW portion of planning area.

Stressor	Number of stream reaches with stressor
Dissolved Oxygen	2
Eutrophication	2
Nitrate	2
Total Suspended Solids	0
Habitat	2
Connectivity	0
Altered Hydrology	4

SID summary for the aquatic life impaired streams in the RRW HUC-8.

Stressor	Number of streams with stressor
Dissolved Oxygen	3
Eutrophication	11
Nitrate	13
Total Suspended Solids	8
Habitat	18
Connectivity	8
Altered Hydrology	19

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 43 of the 93 impairments on water bodies for the RRW HUC-8. TMDL studies have been completed for two of the eight impairments on water bodies for the MRMW part of the planning area.

TMDL reports containing impaired water bodies in the RRW HUC-8, and pollutant reductions are found here:

Redwood River Eutrophication Total Maximum Daily Load Report

Redwood River Watershed Total Maximum Daily Load Report

Redwood River Fecal Coliform Total Maximum Daily Load Report

The TMDL report containing impaired water bodies in the MRMW HUC-8, and pollutant reductions are found here:

Minnesota River - Mankato Watershed TMDL Report

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 reports was synthesized from the Monitoring and Assessment, SID, and TMDL reports. However, the WRAPS reports present 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 RRW WRAPS Report can be found here: Redwood River WRAPS Report. The MRMW WRAPS report can be found here: Minnesota River - Mankato WRAPS Report.

To ensure the WRAPS strategies and other analyses appropriately represent the RRW and MRMW, local county, SWCD staff, and state natural resource and conservation professionals were convened to inform the reports and advise technical analyses. Two key products of these WRAPS reports are the strategies tables and the priorities sections. The strategies tables outline high level strategies necessary to restore and protect water bodies in the watersheds, including social strategies that are key to achieving the physical strategies. The priorities sections present criteria to identify priority areas for water quality improvement, including examples of water bodies and areas that meet the prioritizing criteria.

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

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 reports. 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 groups identified initial priorities for restoration in the watersheds. The 1W1P 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 priorities, and any water bodies that meet the criteria of that priority if applicable from both WRAPS reports. More details are in the priority table and sections of the WRAPS reports.

Redwood River Watershed HUC-8 Watershed Priorities

The RRW HUC-8 WRAPS work group identified initial priorities for restoration for the watershed. The 1W1P planning group should utilize these priorities and develop/modify as needed to fit the goals of the plan.

Some of the top priorities that were identified by the work group during the Redwood River WRAPS process include:

Implementing grade stabilization structures and practices e.g., water and sediment control basins (638) and grassed waterways (412) in higher sloped areas of the watershed that experience significant erosion and soil loss.

Continue educating and working with landowners to manage the health of their soils to promote infiltration/filtration, minimize soil loss, and protect surface and groundwater quantity and quality (e.g., cover crops, no-till/reduced till, manure and fertilizer management).

Restore and/or protect lakes and stream reaches with high recreational use and value:

- Lake Benton and upstream contributing areas (Norwegian Creek)
- Redwood River in Camden State Park (trout stream)
- Lower Ramsey Creek upstream of Ramsey Falls (trout stream)

Restore and/or protect lakes and stream reaches that are nearly impaired or barely impaired (i.e., within 30% of water quality standards):

- Three Mile Creek Reach 564/565/566 (impaired by TSS, within 27% of standard)
- Clear Creek Reach 567/568 (impaired by TSS, within 13% of standard)
- School Grove Lake (impaired, within 14% of standard)
- East Twin Lake (not impaired, within 8% of standard)
- Sanderson Lake (not impaired, within 9% of standard)

Protect vulnerable and sensitive groundwater areas throughout the watershed, particularly wellhead protection areas (WHPAs) and drinking water supply management areas (DWSMAs) with higher vulnerability:

- City of Marshall
- Lincoln Pipestone Rural Water

Minnesota River-Mankato Watershed HUC-8 Watershed Priorities

The MRMW WRAPS work group identified initial priorities and applicable water bodies for restoration for the watershed. The 1W1P planning group should utilize these priorities and develop/modify as needed to fit the goals of the plan.

"Tipping Point: Barely Impaired" Water bodies that are impaired but have a relatively smaller reduction or improvement goal: No water bodies in the planning area, but there are some located elsewhere in the HUC-8.

"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: No water bodies in the planning area, but there are some located elsewhere in the HUC-8.

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

"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: No water bodies in the planning area, but there are some located elsewhere in the HUC-8.

"Local Priority" Water bodies that are of high social importance to restore or protect: Wabasha Creek and Crow Creek.

"Highly hydrologically altered" Subwatersheds identified as highly hydrologically altered: Wabasha Creek.

"Drinking water and Groundwater" Areas contributing water or risks to drinking and ground water resources: City of Redwood Falls and City of Morton.

"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: No water bodies in the planning area, but there are some located elsewhere in the HUC-8.

"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: No waterbodies in the planning area, but there are some located elsewhere in the HUC-8.

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 WHPAs and 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, Redwood Falls and Morton, 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 WRAPS update process for both HUC-8 watersheds, the MPCA is 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 (arcgis.com)

MPCA and environmental justice | Minnesota Pollution Control Agency (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 Suggested Water Management Priorities

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 in each HUC-8 as identified by monitoring and assessment, SID, and the WRAPS for both watersheds. These focus priorities should be considered applicable to the 1W1P planning area wide.

MPCA Water Management Priorities mentioned in Redwood River Watershed WRAPS:

Agricultural Practices

Although agricultural land often contributes higher levels of pollutants/stressors compared to undisturbed land, the impacts can be reduced by adequately managing/mitigating with sufficient BMPs.

Drainage Management

Minnesota drainage law is found in Minn. Stat. ch. 103.E. Counties within the RRW have varying levels of ditch record management. Drainage systems in Minnesota are managed under the jurisdiction of one of several authorities.

Feedlot Management

All feedlots in Minnesota are regulated by Minn. R. ch. 7020. The MPCA has regulatory authority of feedlots but counties may choose to participate in a delegation of the feedlot regulatory authority to the local unit of government.

SSTS (Septic System) Improvements SSTS

Septic systems, are regulated by Minn. Stat. §§ 115.55 and 115.56. Counties and other LGUs that regulate SSTS must meet the requirements for local SSTS programs in Minn. R. ch. 7082.

Culvert Replacement and Other Barriers

Minnesota Department of Natural Resources (DNR) staff, as part of the RRW Characterization Report, reviewed the Minnesota Department of Transportation (MNDOT) bridge and culvert GIS dataset to determine that there are 154 bridges and 131 culverts on perennial streams within the RRW.

Urban Stormwater Management

Although land cover in the RRW is predominantly cultivated crops, there are a few large cities located throughout the watershed. The city of Marshall (MS400241; population 12,735) and Redwood Falls (MS400236; population 5,459) are located in the central and eastern portion of the watershed, respectively.

Wastewater Treatment Improvements

Recently, the State of Minnesota placed a chloride (salt) limitation on the permit given to the City of Marshall Wastewater Treatment Facility.

In-Lake Management

There are eight lakes in the RRW that have been assessed for AqR, all of which are considered shallow lakes by DNR definition (maximum depth of 15 feet or less, or greater than 80% littoral area).

Climate Protection Co-benefit of Strategies

Many agricultural BMPs that reduce the load of nutrients and sediment to receiving waters also act to decrease emissions of greenhouse gases (GHGs) to the air.

MPCA Water Management Priorities mentioned in the MRMW 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; Redwood 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 fertilizer 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. The 1W1P work has been completed in the Hawk - Middle Minnesota Planning area. The Cottonwood – Middle Minnesota is nearing completion. The Minnesota River- Mankato Watershed is still under

development. Priorities and goals from these planning efforts may be beneficial in helping develop the Comprehensive Management plan for the 1W1P Planning Area.

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 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 DNR and the Board of Water and Soil Resources (BWSR) 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 1W1P Planning Area 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 Mike Weckwerth at michael.weckwerth@state.mn.us or 507-476-4267 at the MPCA's Marshall office, and Bryan Spindler at bryan.spindler@state.mn.us, or 507-344-5267 at the MPCA's Mankato office.

Sincerely,

Mike Weckwerth

This document has been electronically signed.

Mike Weckwerth
Environmental Specialist
Watershed Division

Bryan Spindler

This document has been electronically signed.

Bryan Spindler
Environmental Specialist
Watershed Division

MW/BS:jdf

cc: John Shea, BWSR
Mark Hiles, BWSR
Kevin Hauth, MDA
Kelly Heather, NRCS
Cheryl Heard, USDA
Amanda Strommer, MDH
Tyler Knutson, Yellow Medicine County
Devin Ryan, Murray County
Jeff Risberg, MPCA

DEPARTMENT OF HEALTH

Protecting, Maintaining and Improving the Health of All Minnesotans

June 12, 2024

Kerry Netzke
RCRCA
1424 East College Drive, Suite 300
Marshall, MN 56258
Kerry.netzke@rcrca.com

Subject: Initial Comment Letter – *Redwood River 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 Redwood River 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 Nonpoint 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 Redwood River 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 nonmunicipal 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 DWSMAs in the watershed. Also, prioritize protection of tribal water supplies in the Redwood River Watershed 1W1P.

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 Redwood River 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 24.4% of the 234 arsenic samples taken from wells in the Redwood River 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.

Approximately 1.2% of the 685 nitrate samples collected from wells within the Redwood River 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.

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.

Prioritize and promote groundwater conservation & recharge.

The Redwood River Watershed has areas with deep wells with limited groundwater resources and aquifer availability. Promote conservation practices that improve groundwater recharge and wise water use.

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 Redwood River 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) 476-4241 or Amanda.strommer@state.mn.us.

Sincerely,

Amanda Strommer, Principal Planner
Minnesota Department of Health, Source Water Protection Unit
1400 E. Lyon Street, Marshall, MN 56282

Attachments

CC via email:

Mark Wettlaufer, MDH Source Water Protection Unit
Yarta Clemens-Billaigbakpu, MDH Source Water Protection Unit
Carrie Raber, MDH Source Water Protection Unit
John Shea, BWSR Board Conservationist
Mark Hiles, BWSR Clean Water Specialist
Kyle Jarcho, DNR
Michael Weckwerth, MPCA
Bryan Spindler, MPCA
Ryan Lemickson, MDA

MDH Data and information:

- Drinking Water Statistics – Where do people get their drinking water in the Redwood River Watershed? One hundred percent obtain their drinking water from groundwater sources. 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 of Near-Surface Materials" in the Redwood River Watershed. This information can help you understand the ease with which recharge and contaminants from the ground surface may be transmitted into the Cottonwood-Middle most aquifer on a watershed scale. Individual wellhead protection areas provide this same information on a localized scale. This is turn can be used to prioritize areas and implementation activities.
- A figure detailing "Primary Aquifers by Section" in the Redwood River 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 "Nitrate Results" in the Redwood River Watershed. This information can help you understand which wells in the watershed contain elevated nitrate levels.
- A figure detailing "Arsenic Results" in the Redwood River Watershed. This information can help you understand which wells in the watershed contain elevated arsenic levels.
- A figure detailing "DWSMA Vulnerability" in the Redwood River Watershed. This information can help you understand DWSMA vulnerability to contamination from the ground surface. This figure allows for targeting of implementation activities for public water suppliers.
- A figure detailing "Land Cover" within the Redwood River Watershed. This information can help target implementation efforts based upon our activities occurring throughout the watershed.

Redwood River Watershed Basin Public Water Supplies - Drinking Water Protection Concerns for Quality & Quantity

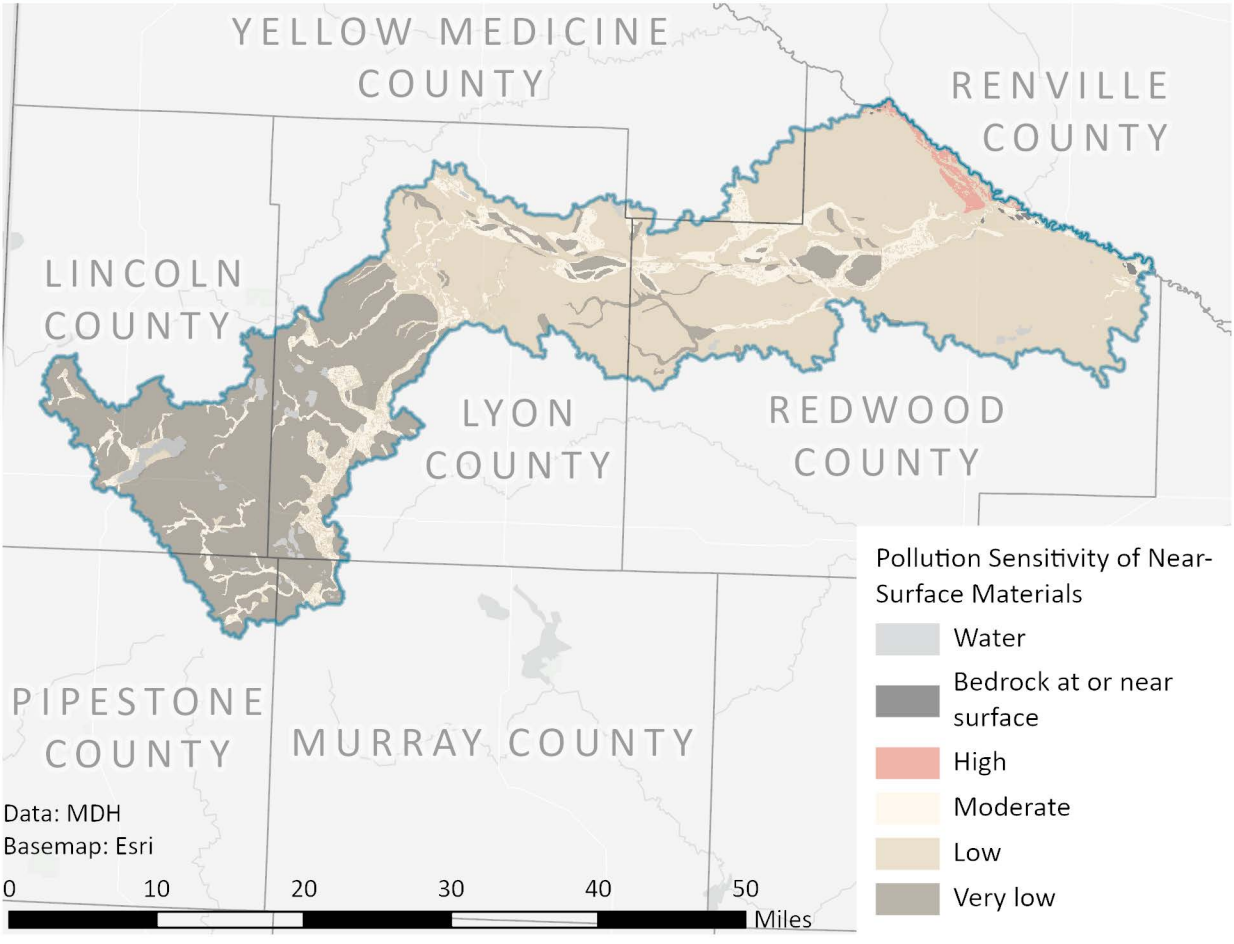
Aquifer Risk	Name	County	Watershed	Subwatershed	WHP Plan	DWSMA Vulnerability	Drinking Water Protection Notes
Very high potential contaminant risk due to connection with surface water - Focus on impacts from land use practices and surface water runoff							
	Lincoln Pipestone Rural Water - Verdi	Lincoln	Redwood	Lake Benton	Yes	High SWCA, High Groundwater	On Edge of Watershed
	Lincoln Pipestone Rural Water - Holland	Pipestone	Redwood	Judicial Ditch 12 & Redwood River Headwaters	Yes	High SWCA, High Groundwater	On Edge of Watershed
High potential contaminant risk - Focus on potential land use contaminant sources that may impact water quality							
	Marshall-Marshall Wellfield	Lyon	Redwood	Runholt Mellenthin Dam & Marshall Redwood River	Yes	High	Partially in Watershed
	Marshall-Dudley Wellfield	Lyon	Redwood	Upper Judicial Ditch 31	Yes	High	Partially in Watershed
	Redwood Falls - West	Redwood	Middle Minnesota	Crow Creek	Yes	Moderate	

Aquifer Risk	Name	County	Watershed	Subwatershed	WHP Plan	DWSMA Vulnerability	Drinking Water Protection Notes
Low potential contaminant risk - Focus on sealing of unused wells and old public water supply wells (funding available from MDH)							
	Belview	Redwood	MN River-Yellow Medicine	Rice Creek	No	Anticipate Low	
	Lucan	Redwood	Redwood	Lower Judicial Ditch 31	In Progress	Anticipate Low	
	Milroy	Redwood	Redwood	Lower Judicial Ditch 31 & Judicial Ditch 14 and 15	In Progress	Low	
	Morgan	Redwood	Middle Minnesota	County Ditch 109	Yes	Low	
	Redwood Falls - East	Redwood	Middle Minnesota	Crow Creek	Yes	Low	
	Ruthton	Pipestone	Redwood	Redwood River Headwaters	Yes	Low	

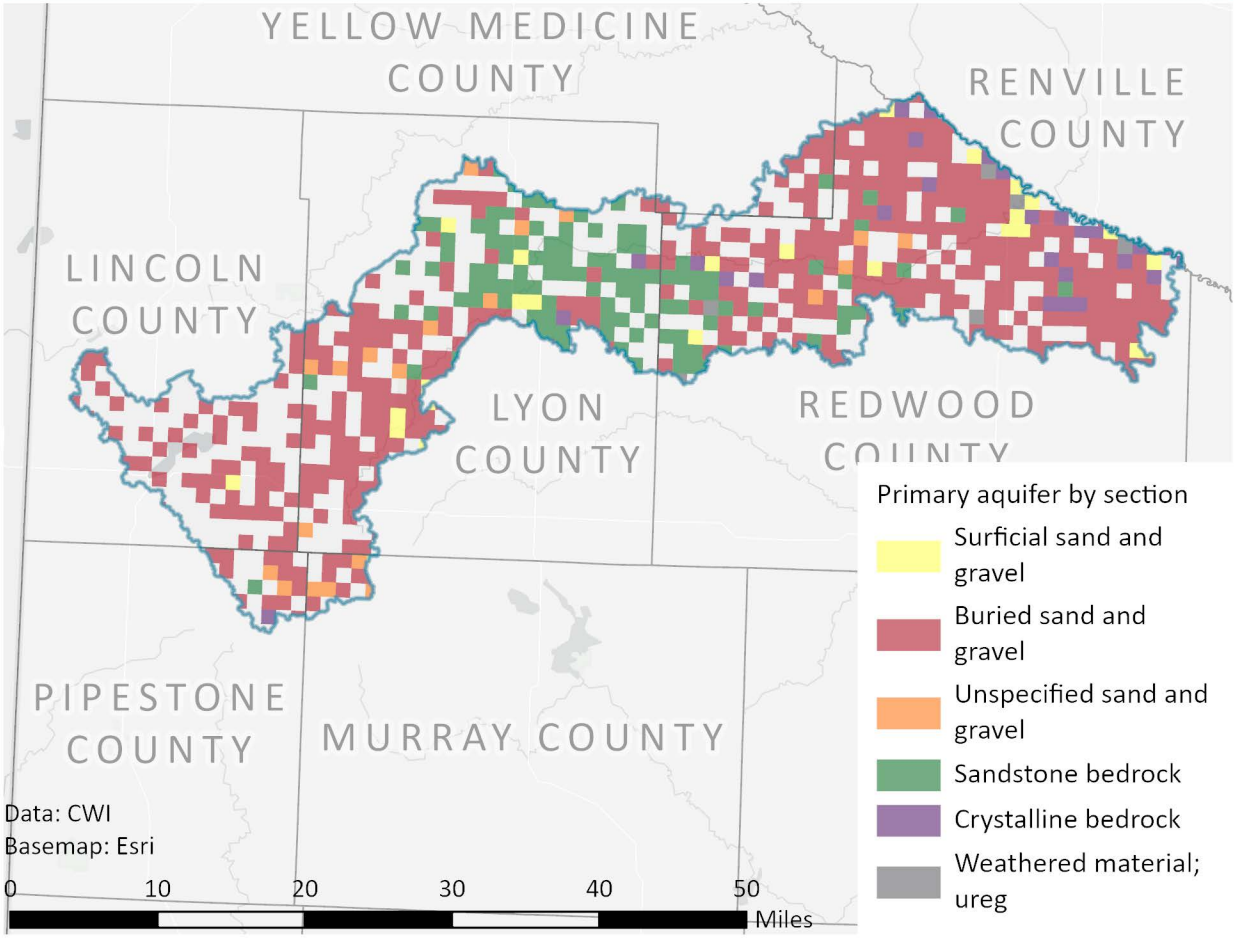
17 Non-Community Public Water Suppliers
Florence, Ghent, Lake Benton, Lynd, Russell, Seaforth, Tyler, and Vesta purchase water from Lincoln Pipestone Rural Water

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

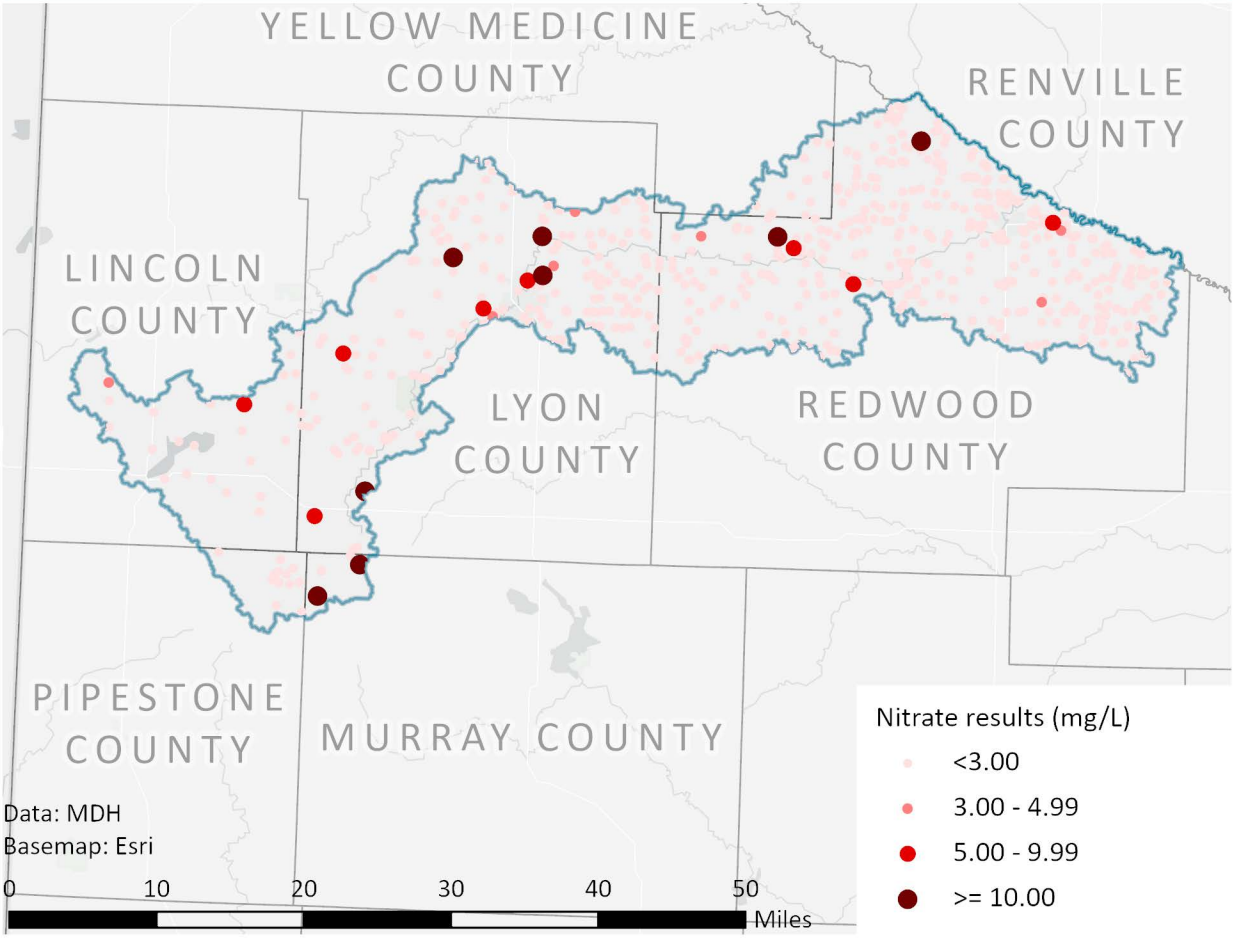
Pollution Sensitivity of Near-Surface Materials



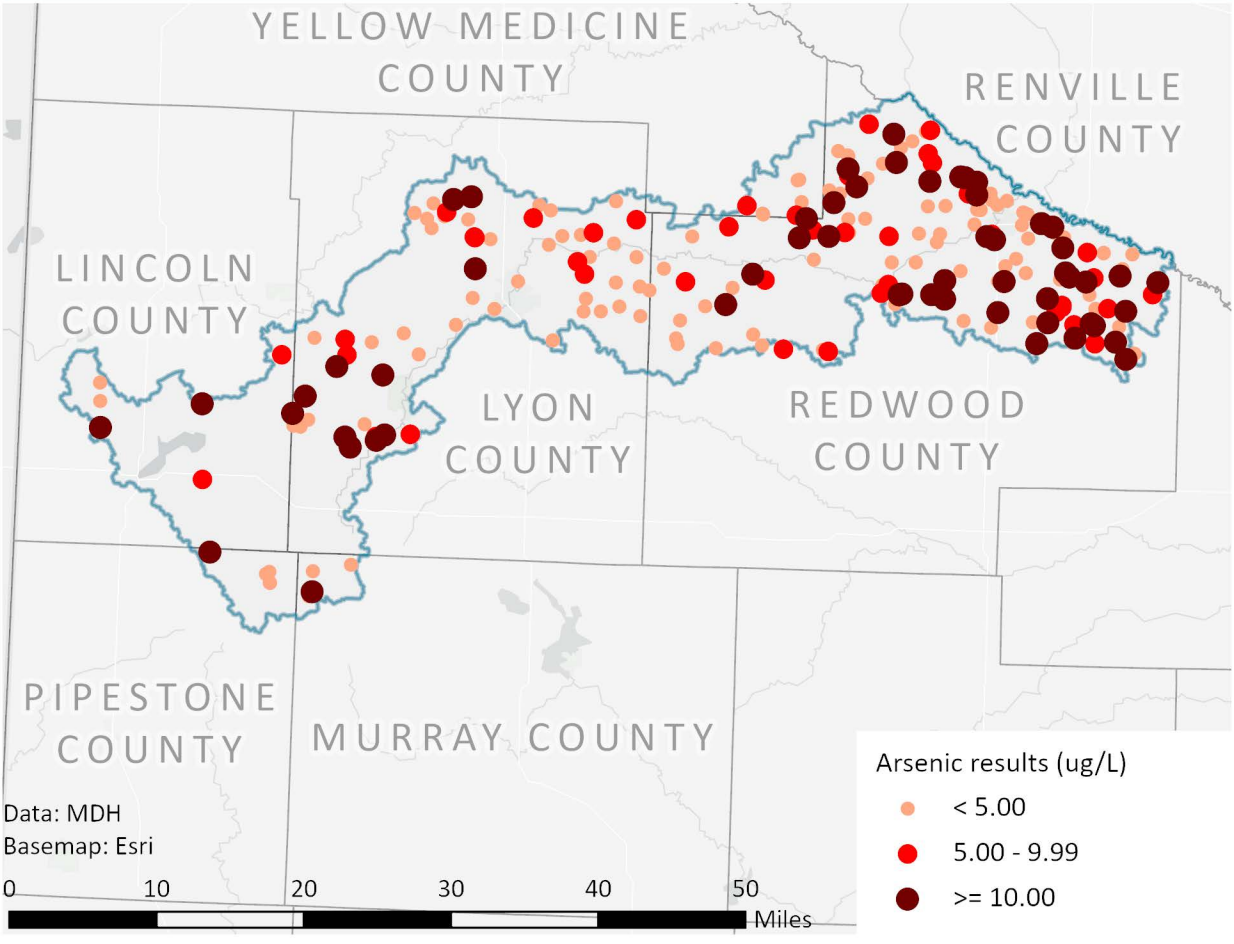
Primary Aquifers



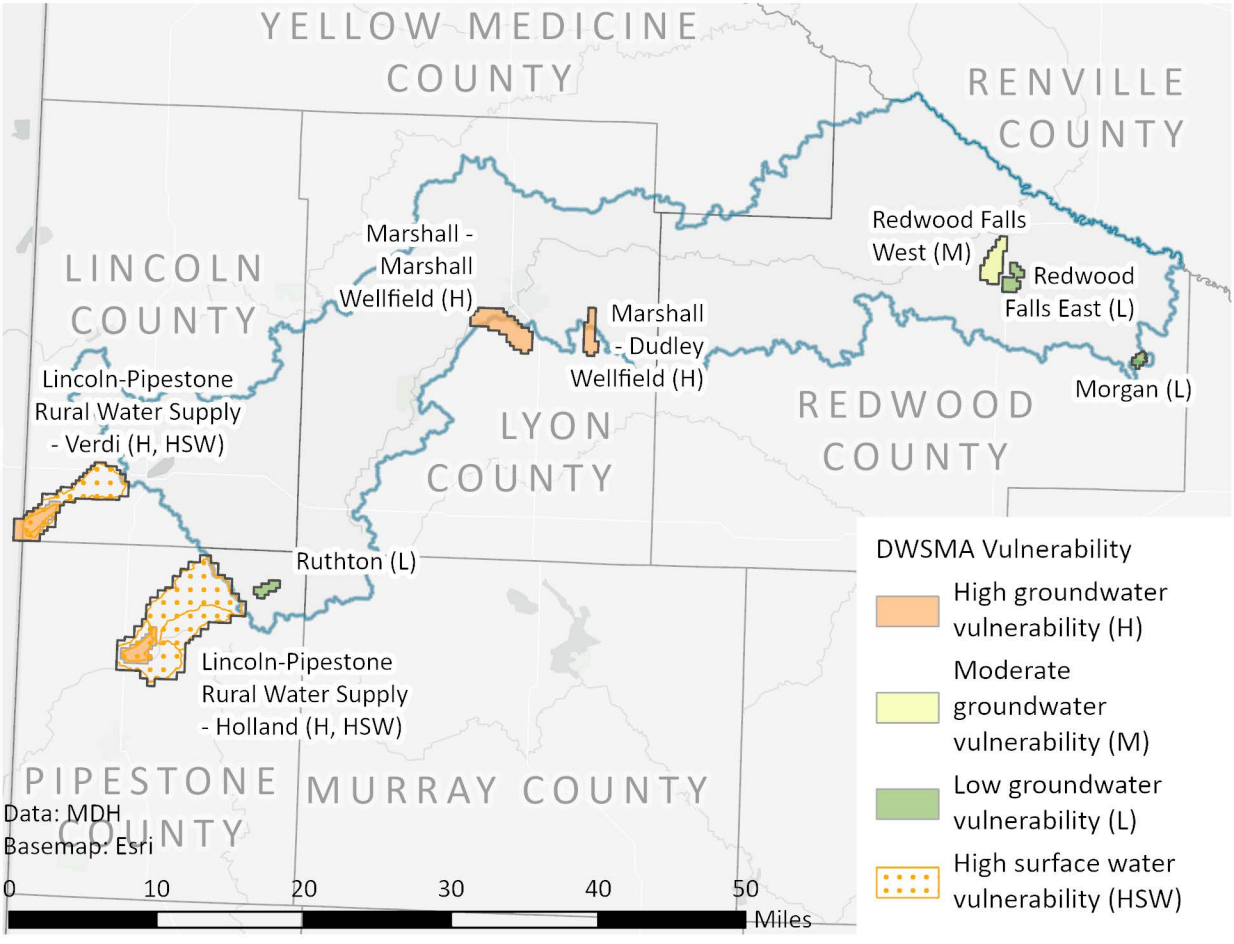
Nitrate Results



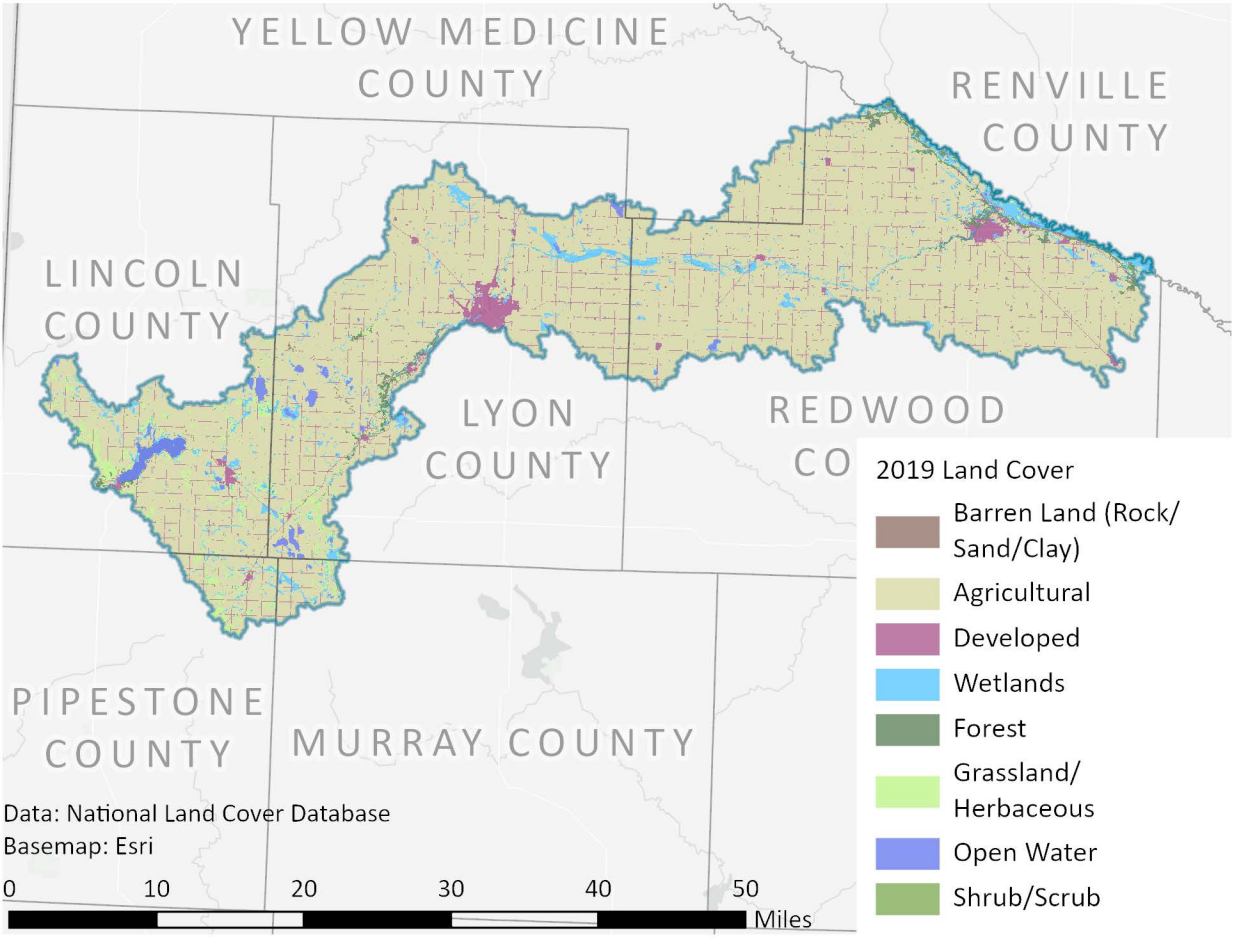
Arsenic Results



DWSMA Vulnerability



Land Cover


YELLOW MEDICINE COUNTY
RENVILLE COUNTY
LINCOLN COUNTY
LYON COUNTY
REDWOOD CO
PIPESTONE COUNTY
MURRAY COUNTY
2019 Land Cover
Barren Land (Rock/ Sand/Clay)
Agricultural
Developed
Wetlands
Forest
Grassland/ Herbaceous
Open Water
Shrub/Scrub
Data: National Land Cover Database
Basemap: Esri
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10
20
30
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50
Miles

Appendix C

Public Survey Results

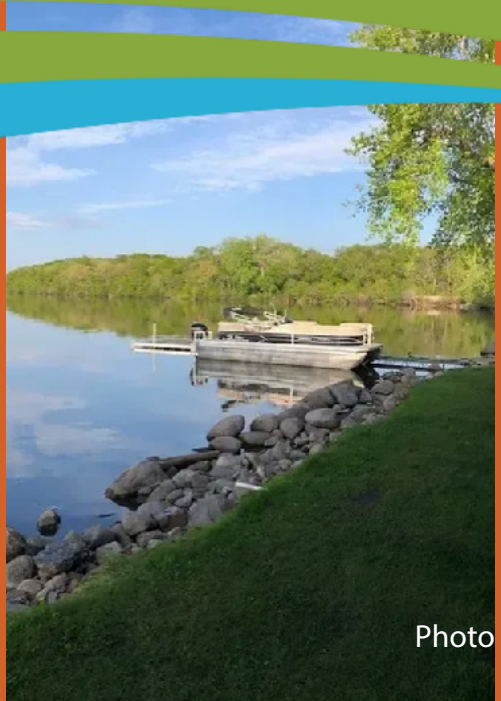


Photo Credits: Minnesota River Valley National Scenic Byway, Lake Benton, and RCRCA

Public Survey Results

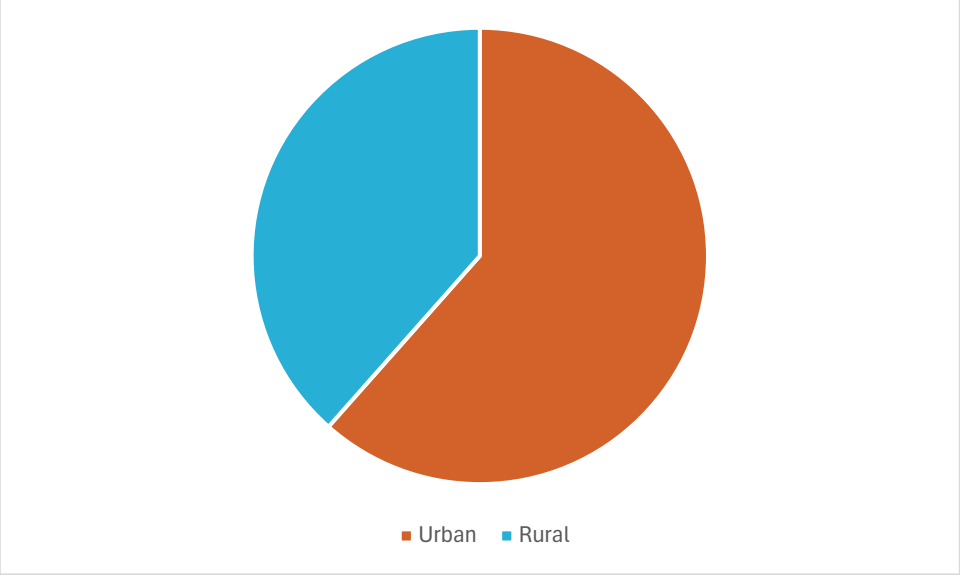
Kickoff Meeting

To get the most public feedback possible at the start of the planning process, three public kick-off events were held over two days. One meeting was held on June 25, 2024, in Lake Benton, and two were held on June 26, 2024, one in Redwood Falls and one in Marshall. Approximately 60 people attended. During the events, community members were informed of the 1W1P program and the planning process, received information about the watershed and its resource conditions, and were given an opportunity to provide direct feedback.

Planning partners also used a survey to get additional feedback. The survey was distributed online as well as in person during the kick-off events. In total, 67 responses were received. Responses are summarized here.

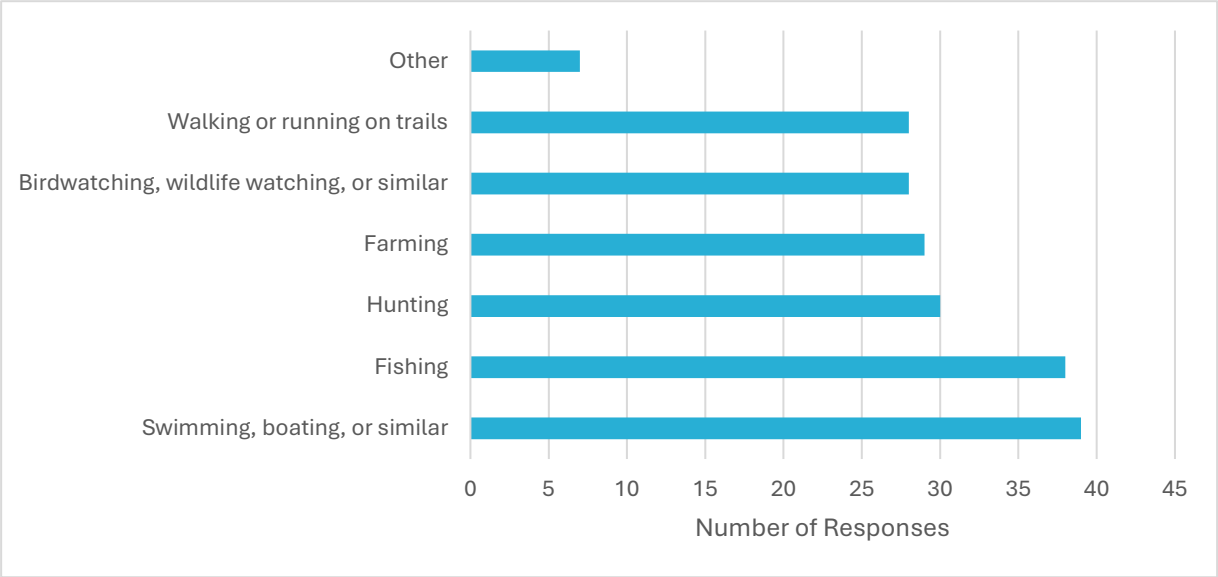
Survey Results

1. Do you live in an urban or rural setting?



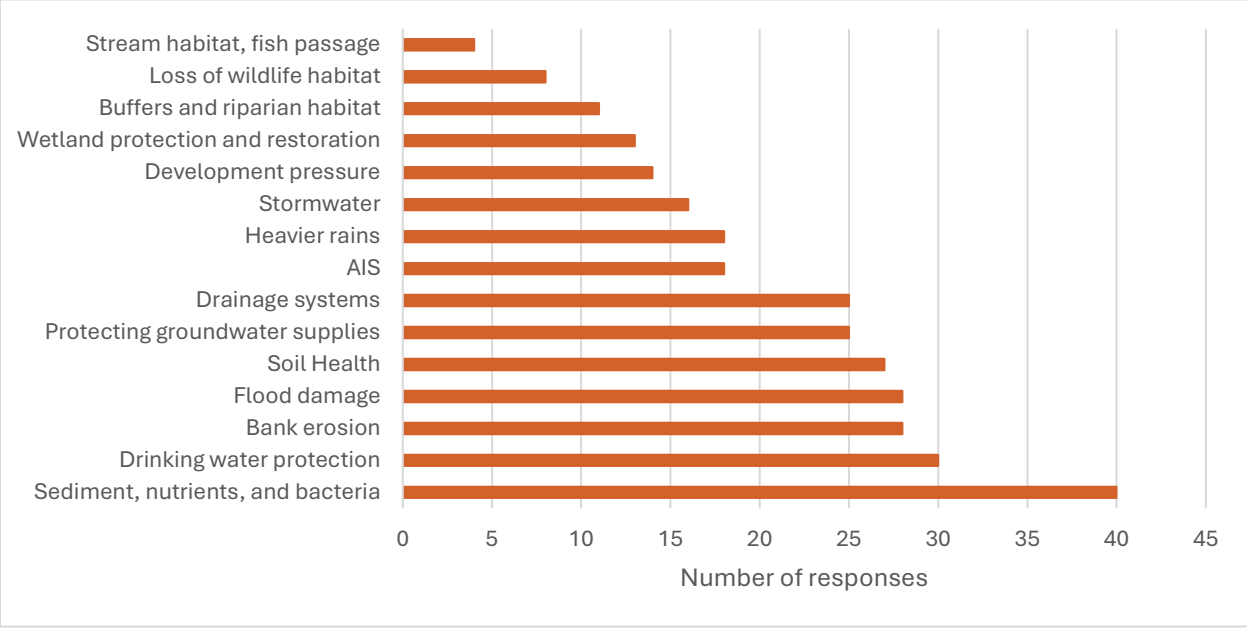
Of survey respondents, more lived in an urban setting than a rural setting.

2. Which of the following activities do you do within the watershed?



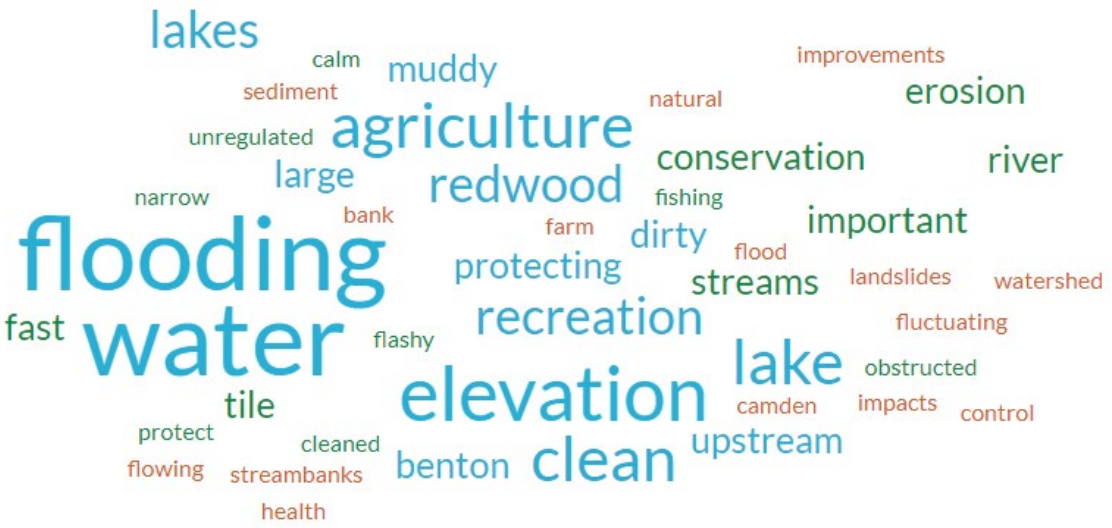
The most common activity was swimming or boating, followed by fishing and hunting. Other responses included consuming water, enjoying the lake, trapping, scenery and historic sites, ATV, and float tubes.

3. What do you see as the most important issues facing natural resources in the area? (pick up to 5)



By a wide margin, survey respondents agreed the most important issue to address was sediments, nutrients, and bacteria. Following that, drinking water protection, bank erosion, and flood damage were important issues.

4. Using 4-5 words, when you think of the Redwood River Watershed, what comes to mind?



This question was displayed using a word cloud.

5. Are there any specific waterbodies or natural areas you are most concerned about?

- Redwood River (17 responses)
- Lake Benton (9 responses)
- Redwood Lake (5 responses)
- Ruthton WMA (3 responses)
- All (2 responses)
- Lyon County Lakes (2 responses
- Three Mile Creek (1 response)
- Dead Coon Lake (1 response)
- Ghent flooding (1 response)
- Lake Shakotan (1 response)
- Norwegian Creek Inlet (1 response)
- Ramsey Creek (1 response)
- Impaired waters (1 response)
- Flooding of roads (1 response)
- Morton (1 response)
- Riverbanks (1 response)

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

- Agency cooperation
- Amount of field tile adding to all systems downstream
- Can anything be done about the algae?
- DNR needs to do their share in doing water storage on DNR property
- Dredging our small lakes to 20 ft ideal by the measurement of a football field in 3 places. Lake Benton would like to be a pilot lake
- Effects of record climate events- more rain or drought
- Field runoff - the need for no till planting/harvesting
- Funding
- Highly agricultural, more soil health needed to keep nutrients in soil.
- How do we slow the upstream water before it plains out by Marshall
- Mostly flooding
- Need to slow movement of water off the landscape of identify storage
- Plan implementation - how will funding work? Project priorities?
- Ruthton WMA
- Soil biome recovery/regeneration to reduce reliance on pesticides/herbicides/fertilizers, Lake Benton water quality (algae blooms, fish kills, nitrates), improving Lake Benton area
- Streambank stabilization is needed in the watershed along with floodwater retention.
- That most of areas looking at are BWSR driven
- The weeds on DNR land and lack of maintenance on county ditch systems
- There is a lot of basin restoration potential in this watershed area
- Very good kickoff meeting
- Water use

Appendix D

Geospatial Subwatershed Prioritization

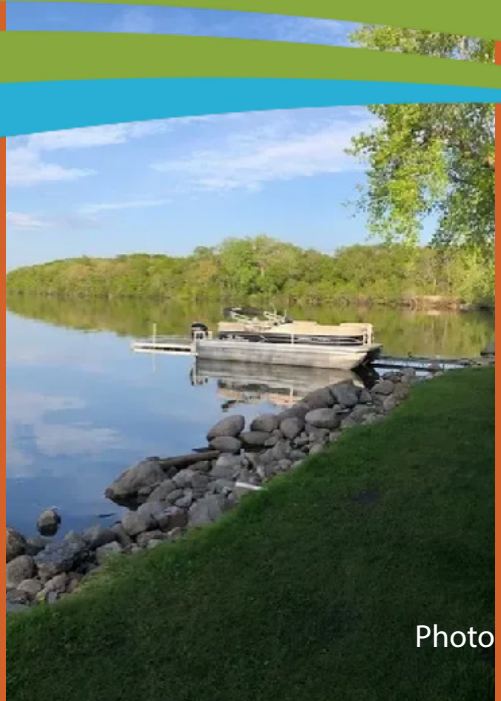


Photo Credits: Minnesota River Valley National Scenic Byway, Lake Benton, and RCRCA

Geospatial Subwatershed Prioritization

Resource	Issue	Issue Statement	Geospatial Ranking Layers
Surface Water Quality	**Soil Health and Working Lands**	There is a need for conservation practices on working lands such as cover crops, perennial cover, reduced tillage, and pasture management, which would improve soil health, decrease upland sediment loss, and increase water storage.	▪ PTMApp sediment loading ▪ Local priorities
	Nutrients and Bacteria	Excess nutrients (phosphorus and nitrogen) delivery to surface waters leads to eutrophication which is a primary stressor to aquatic life.	▪ PTMApp total phosphorous loading ▪ PTMApp total nitrogen loading ▪ Local priorities
	Protection and Restoration	Protection and restoration of high-recreational use waters and waters that are nearly or barely impaired to benefit aquatic life and recreational	▪ Priority resources
	Bank Erosion	Bank erosion is widespread in streams, ravines and rivers from unstable streambanks and high or altered flows, acting as the source of sediment in the	▪ WHAF steep slopes ▪ Local priorities
	Riparian and Shoreline Management	There is a lack of protection along shoreline, ditches, streams, and rivers, causing an excess of erosion and degrading aquatic habitat.	▪ Impaired waters with aquatic habitat as stressor ▪ Priority resources
Groundwater/Drinking Water	**Contamination**	Anthropogenic (i.e. nitrate, pesticides) and geogenic (i.e. arsenic, manganese) groundwater contaminants have been detected in some groundwater, posing a	▪ Pollution sensitivity of near surface materials ▪ Vulnerable DWSMAs

Resource	Issue	Issue Statement	Geospatial Ranking Layers
		health threat through their potential presence in drinking water.	
	Groundwater Quantity	Groundwater recharge is impacted by land use changes that have decreased infiltration, threatening future groundwater supplies.	▪ Groundwater recharge raster
Water Quantity and Hydrology	Water Storage/Flooding	The watershed has lost capacity for water storage in the landscape due to land use change and extensive public (103E) drainage, which decreases infiltration, increases stream flow, and causes excessive flood events. Excess flow can also be a source of increased sediment and nutrients loading.	▪ Local priority ▪ Location relative to Corps of Engineers Diversion Project
	Barriers to Fish Passage	Barriers such as dams, impoundments, and improperly sized culverts occur throughout the watershed, impeding fish passage.	▪ Inventory of bridges and culverts
Land Use and Urban Areas	Stormwater	Stormwater runoff occurs in urban areas, acting as a source of pollutants such as sediment, nutrients, chloride, metals, and debris to receiving surface waters.	▪ Cities

Appendix E

Carbon Benefits

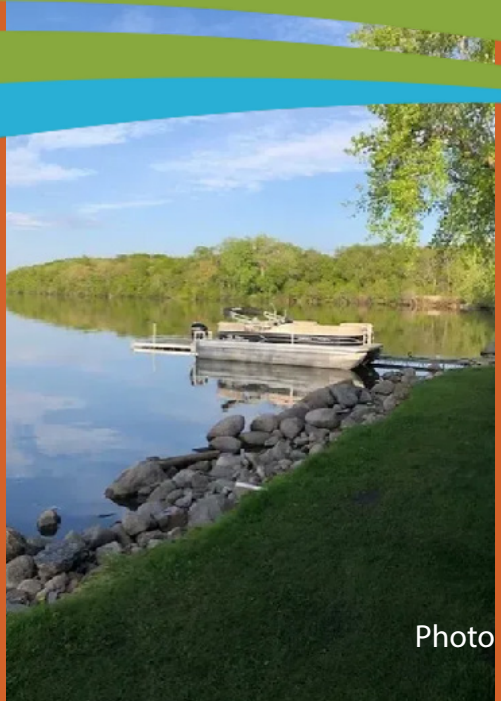


Photo Credits: Minnesota River Valley National Scenic Byway, Lake Benton, and RCRCA

Carbon Benefits

In addition to the water quality benefits described in Section 5- Target Implementation, implementation actions can increase carbon sequestration (the process of capturing and storing carbon from the atmosphere) and reduce carbon emissions. In particular, agricultural best management practices (BMPs) described in the Redwood CWMP can both improve water quality and provide these carbon benefits.

Carbon sequestration/reductions were estimated for the following actions outlined in Section 5- Targeted Implementation of the CWMP:

- **Agricultural Conservation and Multi-Benefit Storage Practices** (e.g. grassed waterways, grade stabilizations, groundwater recharge conservation practices, wetland creation, side water inlets, WASCOBs, etc.)
- **Soil Health and Non-Structural Management Practices** (e.g. cover crops, conservation tillage, perennial cover, nutrient management)
- **Land Protection** (e.g. RIM, CRP, CREP)

Calculations of the potential benefits of agricultural BMP implementation were completed using the USDA's COMET-Planner tool. Outputs are reported as metric tons of CO_2e, the carbon dioxide equivalent of all greenhouse gases sequestered or reduced by implementing agricultural BMPs. Values from COMET-Planner are estimates and actual benefits can vary based on field and climatic conditions.

For calculations, cropland was assumed to be non-irrigated. Grassed waterways, cover crops, and CRP were used as the default practice for their respective actions. In addition, a 50% cover crops and 50% conservation tillage scenario (conversion from intensive to reduced tillage) was also included, as the number of each soil health practice implemented will likely vary in actual implementation. Note that values will also vary depending on the exact type of BMP implementation (e.g. conversion from intensive to no-till will have an even greater amount of sequestration than conversion to reduced tillage).

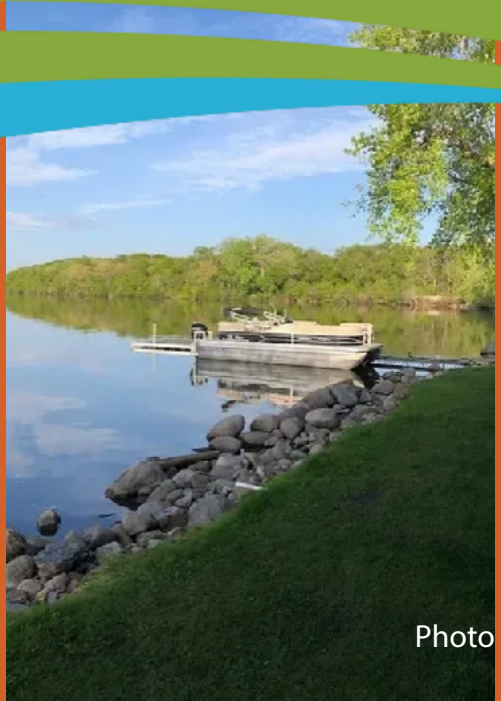
Action	Practice	Metric tons CO_2e/year	Equivalent to emissions from X cars driven for 1 year*
Agricultural Conservation	Grassed waterways (46,200 acres)	51,430	12,000 cars
Soil Health Scenario 1	Cover crops (22,500 acres)	2,430	570 cars
Land Protection	CRP (18,000 acres)	20,040	4,670 cars
Soil Health Scenario 2	Cover crops/Conservation Tillage (22,500 acres)	3,800	890 cars

*From the EPA Greenhouse Gas Equivalencies Calculator

Manure management is also included in the Section 5 action table. However, there is no acreage associated with the goal, so an estimate for carbon benefits from implementation cannot be conducted. However, for every 100 acres of manure management BMPs (e.g. rotational or prescribed grazing), an estimated 15.01 metric tons CO_2e/year is reduced or sequestered.

Appendix F

Total Maximum Daily Load Summary



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Total Maximum Daily Load (TMDL) Summary

Table 1 Total Suspended Solids (TSS) TMDL Summary (Redwood River Watershed TMDL, 2023).

Name	AUID (07020009-)	TSS % reduction
Redwood River	07020006- 502	55%
	07020006- 503*	56%
	07020006- 509	57%
	07020006- 510	37%
Three Mile Creek	07020006- 564, 565 & 566	22%
Clear Creek	07020006- 567 & 568	5%

*No TSS data was collected at reach -503. Therefore the load reduction was selected as between the reduction for the upstream -502 and downstream -509.

Table 2 Fecal Coliform TMDL (MPCA, 2013)

Name	Description (AUID)	Monthly TMDL by Flow Condition				
		High	Moist	Mid	Dry	Low
Redwood River	07020006-501	5165.8	1149.9	355.9	109.5	17.5
	07020006-509	4615.7	1027.5	318.0	97.9	15.7
	07020006-502A	875.9	175.2	44.9	14.4	1.8
	07020006-502B	783.7	156.7	40.2	12.9	1.6
	07020006-505	694.7	138.9	35.6	11.4	1.5
Clear Creek	07020006-506	611.0	136.0	42.1	13.0	2.1
Three-mile Creek	07020006-504	893.1	198.8	61.5	18.9	3.0
Tyler Creek	07020006-512	775.4	155.1	39.8	12.7	1.6
Coon Creek	07020006-511	291.1	58.2	14.9	4.8	0.6

Table 3 E. Coli TMDL Summary (Redwood River TMDL, 2023)

Name	Description (AUID)	Maximum monthly geometric mean	% reduction
Redwood River	07020006- 510	764 organisms/100 mL	73%
Ramsey Creek	07020006- 521	318 organisms/100 mL	55%

Table 4 Phosphorus TMDL Summary (Redwood River Watershed TMDL, 2023)

Name	AUID	Existing TP Load (lbs/yr)	TMDL (lbs/yr)	% reduction*
Redwood River	07020006-501	606.4 lbs/day TP		50%
Lake Benton	41-0043-00	18,903 lbs TP/year	9,212 lbs TP/year	43%
Dead Coon	41-0021-01	14,212 lbs TP/year	8,286 lbs TP/year	54%
Goose Lake	42-0093-00	1,677 lbs TP/year	807 lbs TP/year	42%
School Grove Lake	42-0002-00	1,638 lbs TP/year	377 lbs TP/year	14%
Clear Lake	42-0055-00	502.2 lbs TP/year	227.3 lbs TP/year	39%
Island Lake	42-0096-00	675 lbs TP/year	265 lbs TP/year	33%

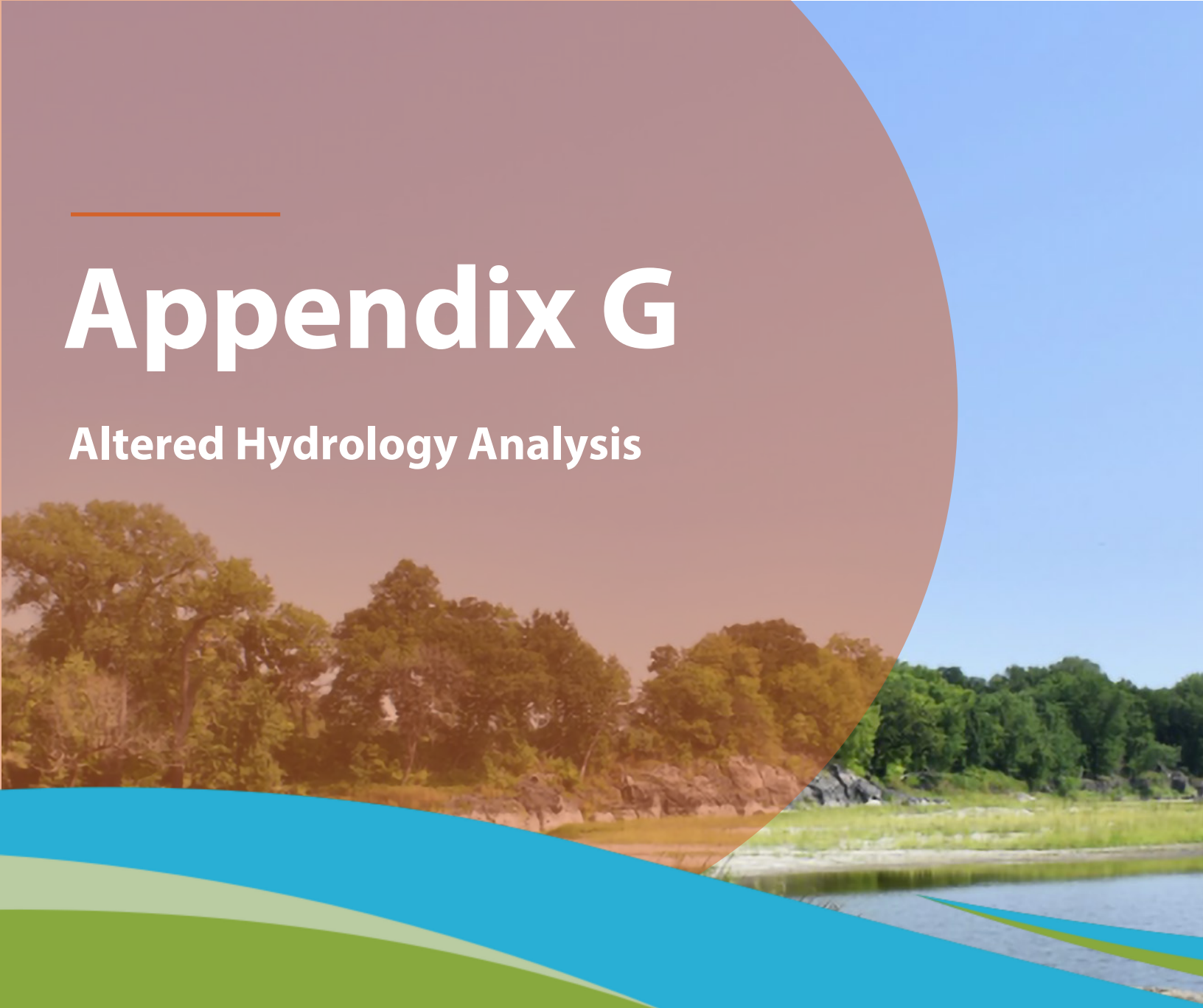
*Percent reduction is greater than the difference between the existing load and TMDL to account for the margin of safety

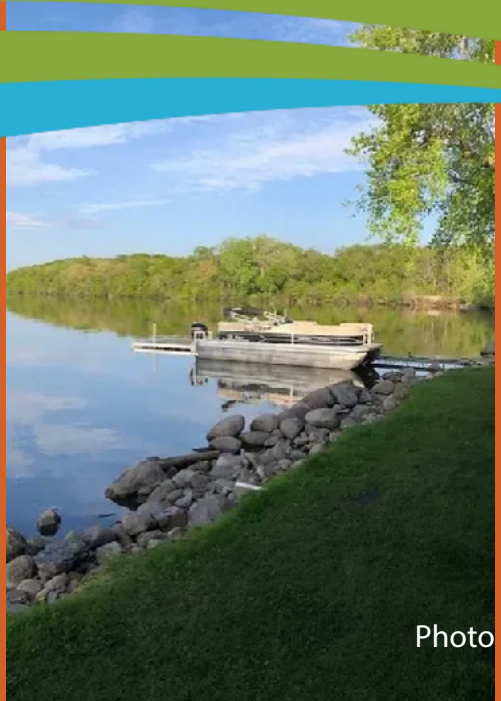
Table 5 Chloride TMDL Summary (Redwood River Watershed TMDL, 2023)

Name	ID	Maximum concentration	% reduction
Redwood River	07020006- 502	463 mg/L chloride	50% reduction

Appendix G

Altered Hydrology Analysis





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Technical Memorandum

To: Kerry Netzke, RCRCA
Redwood River Watershed Planning Partnership

From: Timothy Erickson PE
Houston Engineering, Inc.

Subject: Redwood River Altered Hydrology Analysis

Date: May 2, 2025

Project: 9257-0006

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 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.

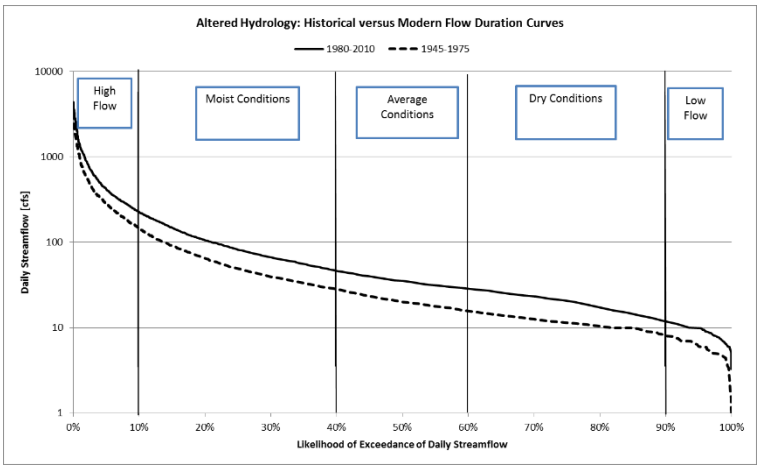


Figure 1. Flow duration curve for the Sand Hill River at Climax, Minnesota. The solid black line shows an increase in daily mean discharge for the 1980 – 2010 period, compared to the early 1945 – 1975 period.

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 to 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.

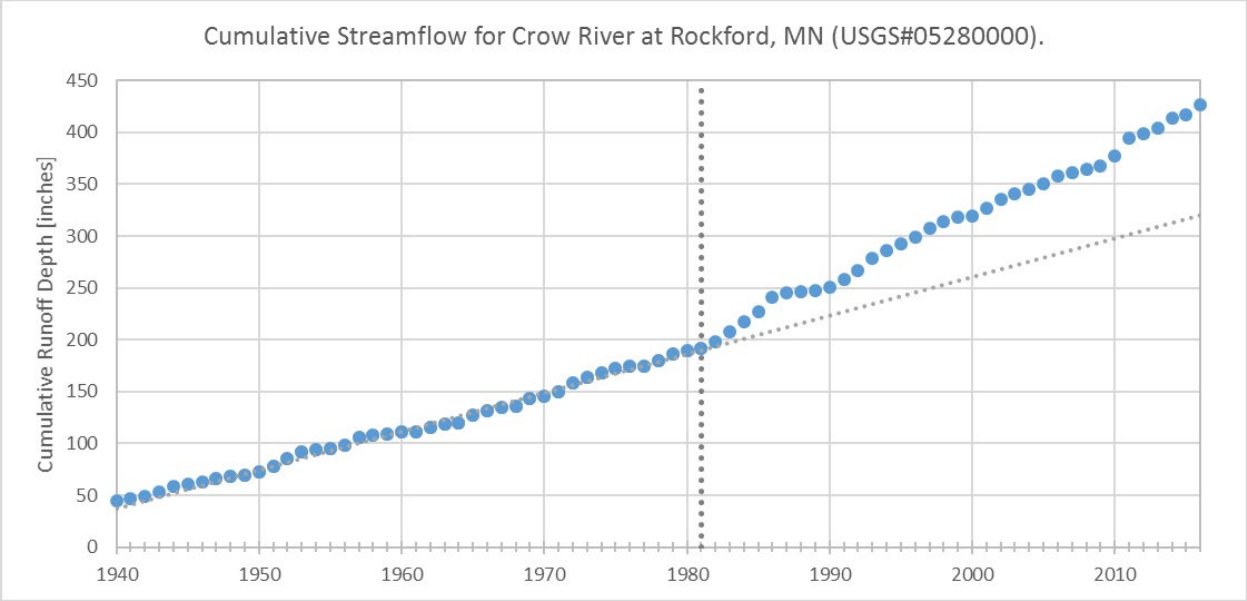


Figure 2. Cumulative streamflow for the Crow River at Rockford, MN (USGS Station 05280000).

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 indictors 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 REDWOOD RIVER

The following are summaries of results from the altered hydrology analysis conducted on long-term gaging stations.

3.1 REDWOOD RIVER

3.1.1 Redwood River near Marshall, MN (USGS# 05315000)

The USGS long-term, continuous flow gaging station in the Redwood River near Marshall, MN (USGS# 05315000) and drains approximately 259 square miles. The data record starts in 1940 and runs to the 2025 (present day). The flow record was downloaded on May 2, 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**).

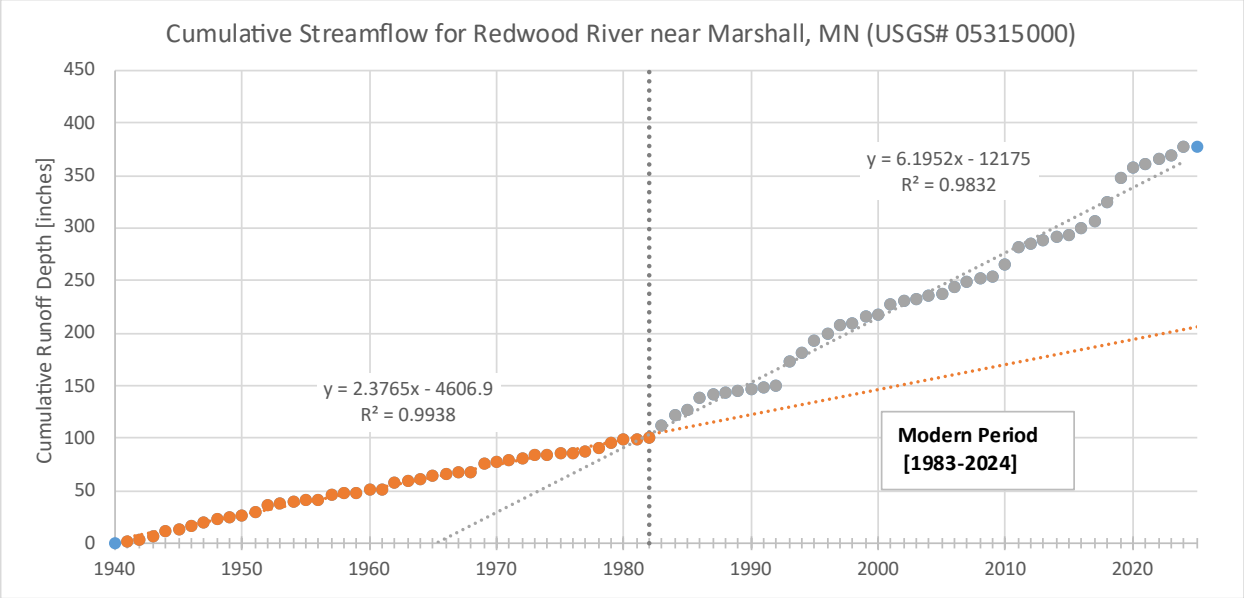


Figure 3. Cumulative streamflow for Redwood River near Marshall, MN (USGS# 05315000).

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 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 Redwood River near Marshall, MN (USGS# 05315000).

Group	Metric	% Difference	Altered Hydrology Metric	Evidence of Altered Hydrology for Group
Aquatic Habitat	10-year, Annual Minimum 30-day Mean Daily Discharge	>1,000%	+	Yes, Increasing
	10-year, Annual Minimum 7-day Mean Daily Discharge	>1,000%	+	
	Median November (Winter Base) Flow	267.7%	+	
Aquatic Organism Life Cycle	Magnitude of Monthly Runoff Volumes	74.2%-to-676%	+	Yes, Increasing
	Distribution of Monthly Runoff Volumes	-36.9%-to-181%	o	
	Timing of Annual Peak Discharge	7.3%	o	
	Timing of Annual Minimum Discharge	-9.9%	o	
Riparian Floodplain (Lateral) Connectivity	10-year Peak Discharge Rate	37.2%	+	Yes, Increasing
	50-year Peak Discharge Rate	36.6%	+	
	100-year Peak Discharge Rate	39.8%	+	
	Average Cumulative Volume above the Historic 10-year Peak Discharge	-17.0%	-	
	Average Cumulative Volume above the Historic 50-year Peak Discharge	8.0%	o	
	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	107.8%	+	Yes, Increasing
	2-year Peak Discharge Rate	77.1%	+	
	Average Cumulative Volume above the Historic 1.5-year Peak Discharge	195.6%	+	
	Average Cumulative Volume above the Historic 2-year Peak Discharge	180.4%	+	
	Duration above the Historic 1.5-year Peak Discharge	200.9%	+	
	Duration above the Historic 2-year Peak Discharge	189.8%	+	
	Flow Duration Curve	52.6%-to-393%	+	

3.1.1 Redwood River near Redwood Falls, MN (USGS# 05313500)

The USGS long-term, continuous flow gaging station in the Redwood River near Redwood Falls, MN (USGS# 05316500) and drains approximately 629 square miles. The data record starts in 1909 and runs to the 2025 (present day) with some missing data form 1914 to 1929. The flow record was downloaded on May 2, 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**).

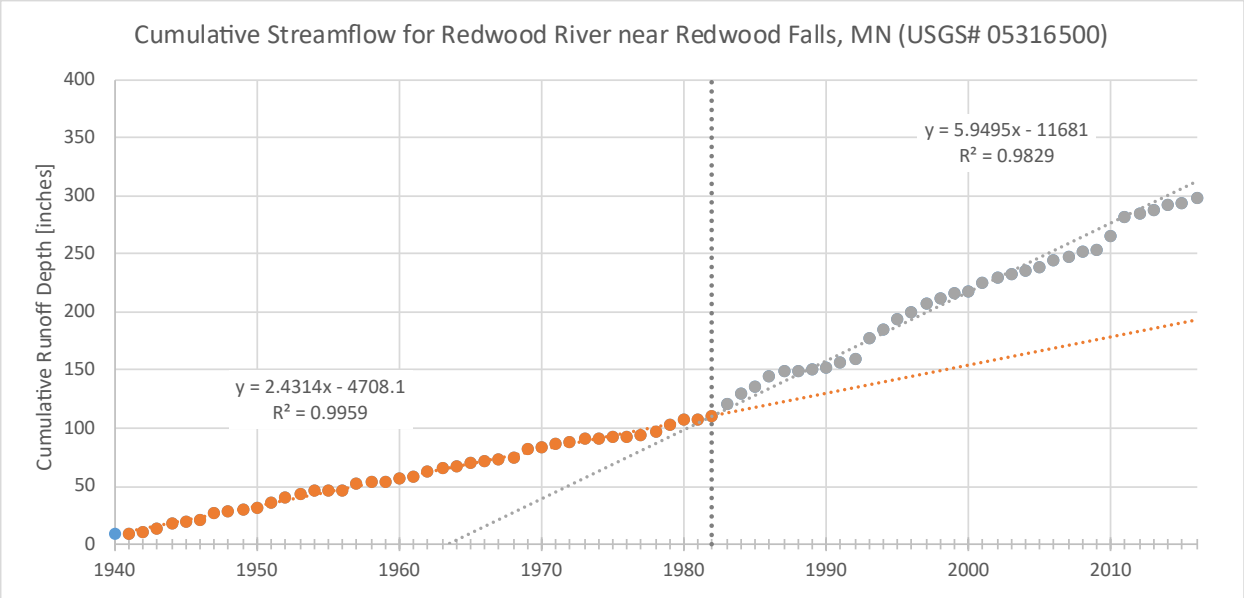


Figure 3. Cumulative streamflow for Redwood River near Marshall, MN (USGS# 05315000).

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 Redwood River near Marshall, MN (USGS# 05315000).

Group	Metric	% Difference	Altered Hydrology Metric	Evidence of Altered Hydrology for Group
Aquatic Habitat	10-year, Annual Minimum 30-day Mean Daily Discharge	689%	+	Yes, Increasing
	10-year, Annual Minimum 7-day Mean Daily Discharge	709%	+	
	Median November (Winter Base) Flow	205%	+	
Aquatic Organism Life Cycle	Magnitude of Monthly Runoff Volumes	61.2%-to-566%	+	Yes, Increasing
	Distribution of Monthly Runoff Volumes	-37.4%-to-159%	o	
	Timing of Annual Peak Discharge	14.5%	+	
	Timing of Annual Minimum Discharge	50.4%	+	
Riparian Floodplain (Lateral) Connectivity	10-year Peak Discharge Rate	34.2%	+	Yes, Increasing
	50-year Peak Discharge Rate	7.4%	o	
	100-year Peak Discharge Rate	-1.2%	o	
	Average Cumulative Volume above the Historic 10-year Peak Discharge	14.2%	+	
	Average Cumulative Volume above the Historic 50-year Peak Discharge	NA	NA	
	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	108.5%	+	Yes, Increasing
	2-year Peak Discharge Rate	88.0%	+	
	Average Cumulative Volume above the Historic 1.5-year Peak Discharge	169.5%	+	
	Average Cumulative Volume above the Historic 2-year Peak Discharge	158.9%	+	
	Duration above the Historic 1.5-year Peak Discharge	142.3%	+	
	Duration above the Historic 2-year Peak Discharge	203.5%	+	
	Flow Duration Curve	35.9%-to->1000%	+	

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 multiples 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** 4 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, realizing that the altered hydrology goals should ideally be established at the 12-digit HUC scale. The average, representative storage goal is **1.32 inches** across the watershed (using results for the most downstream gage (Redwood River near Redwood Falls), or **52,816 acre-feet**. 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 4: Storage goals for rivers in the Redwood River.

Stream	USGS ID	Storage Targets			
		Method 1	Method 2	Method 3	Method 4
Redwood River near Marshall, MN	05315000	1.43 in.	2.73 in.	1.43 in.	0.71 in.
Redwood River near Redwood Falls, MN	05316500	1.25 in.	2.06 in.	1.30 in.	0.68 in.

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

APPENDIX A: METRICS OF ALTERED HYDROLOGY FOR THE REDWOOD RIVER NEAR MARSHALL, MN (USGS# 05315000).

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**.

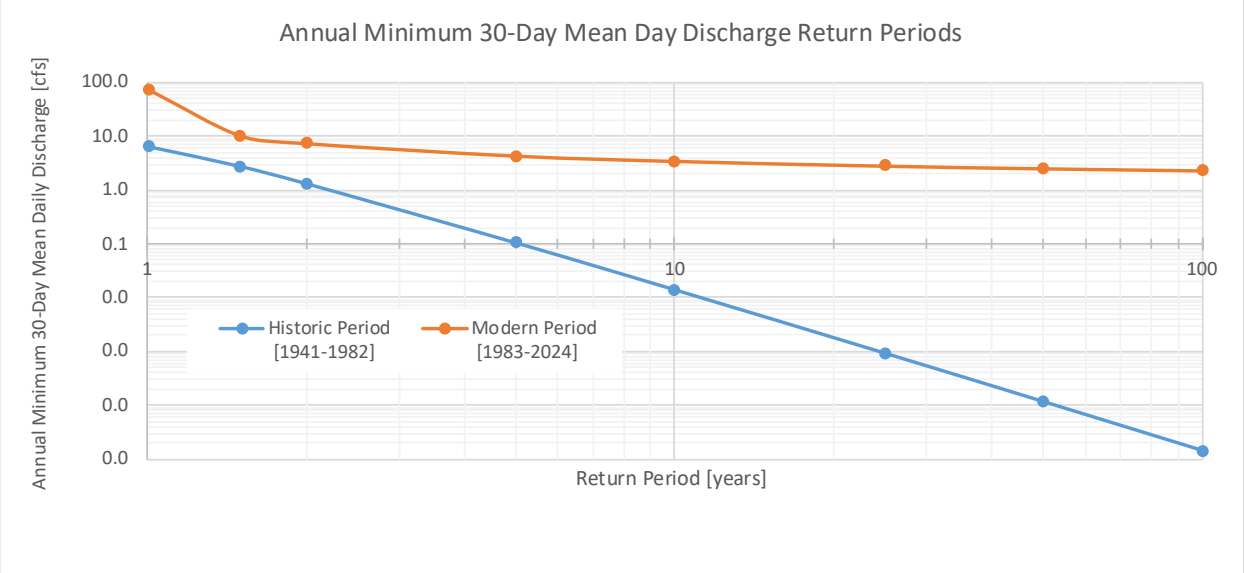


Figure A.1. Historical versus modern annual minimum 30-day mean daily discharge versus return period for Redwood River near Marshall, MN (USGS# 05315000).

Table A.1: Summary of annual minimum 30-day mean daily discharge by return periods for the Redwood River near Marshall, MN (USGS# 05315000).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
1.01	6.4	71.3	1009%	+
1.5	2.8	10.3	271%	+
2	1.3	7.4	459%	+
5	0.104	4.4	4088%	+
10	0.014	3.5	24960%	+
25	0.0009	2.9	309561%	+
50	0.0001	2.6	2217712%	+
100	0.00001	2.3	16499346%	+

+ 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**.

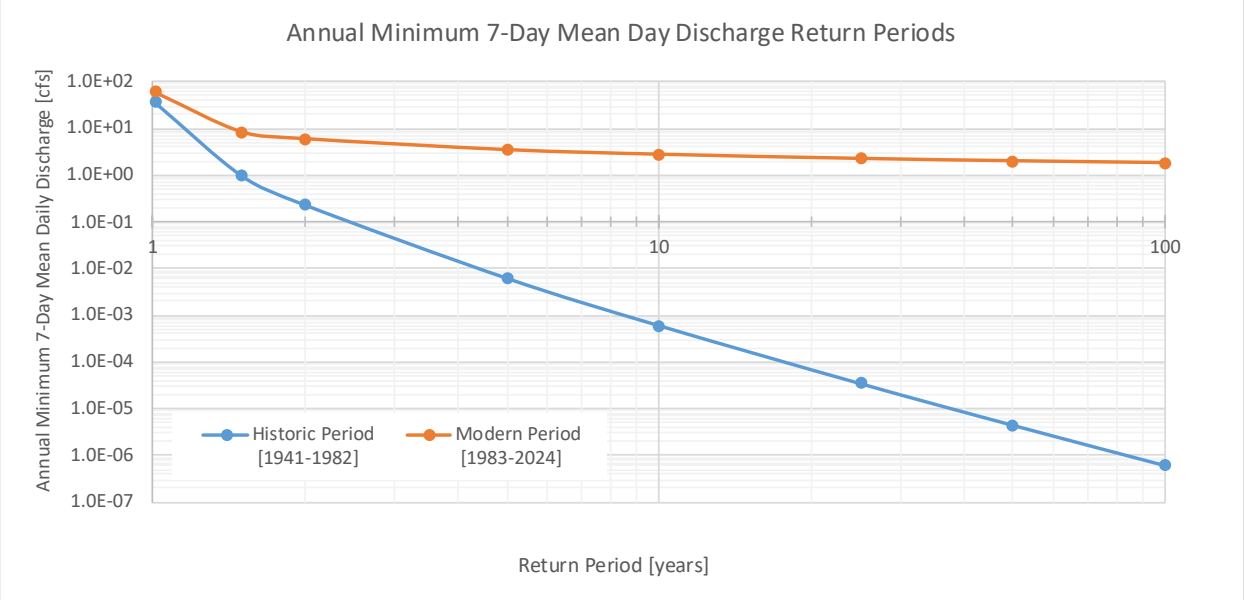


Figure A.2. Historical versus modern annual minimum 7-day mean daily discharge return periods for Redwood River near Marshall, MN (USGS# 05315000).

Table A.2: Summary of annual minimum 7-day mean daily discharge return periods for the Redwood River near Marshall, MN (USGS# 05315000).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
1.0101	36.2	59.8	65%	+
1.5	1.0	8.4	766%	+
2	0.2	6.0	2501%	+
5	0.006	3.5	55430%	+
10	0.001	2.8	457293%	+
25	0.00003	2.3	6478967%	+
50	0.000004	2.0	45011274%	+
100	0.000001	1.8	300184868%	+

+ 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 Redwood River near Marshall, MN (USGS# 05315000).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
Period median November flow [cfs]	6.2	22.8	267.7%	+

+ 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.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**.

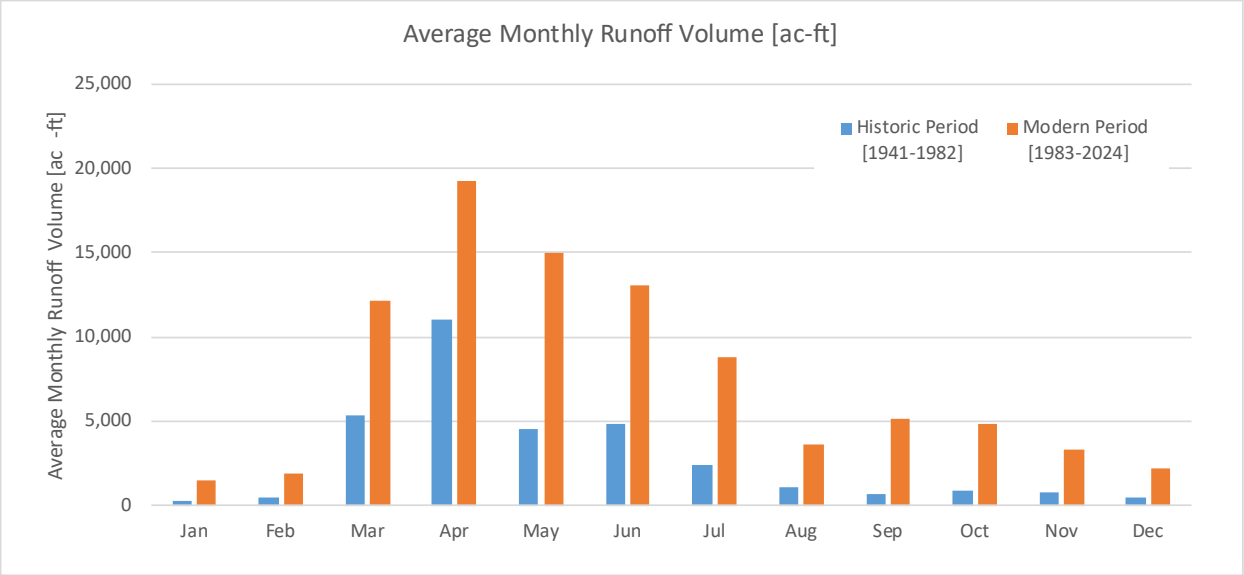


Figure A.3. Average monthly runoff volume [ac-ft] in the Redwood River near Marshall, MN (USGS# 05315000).

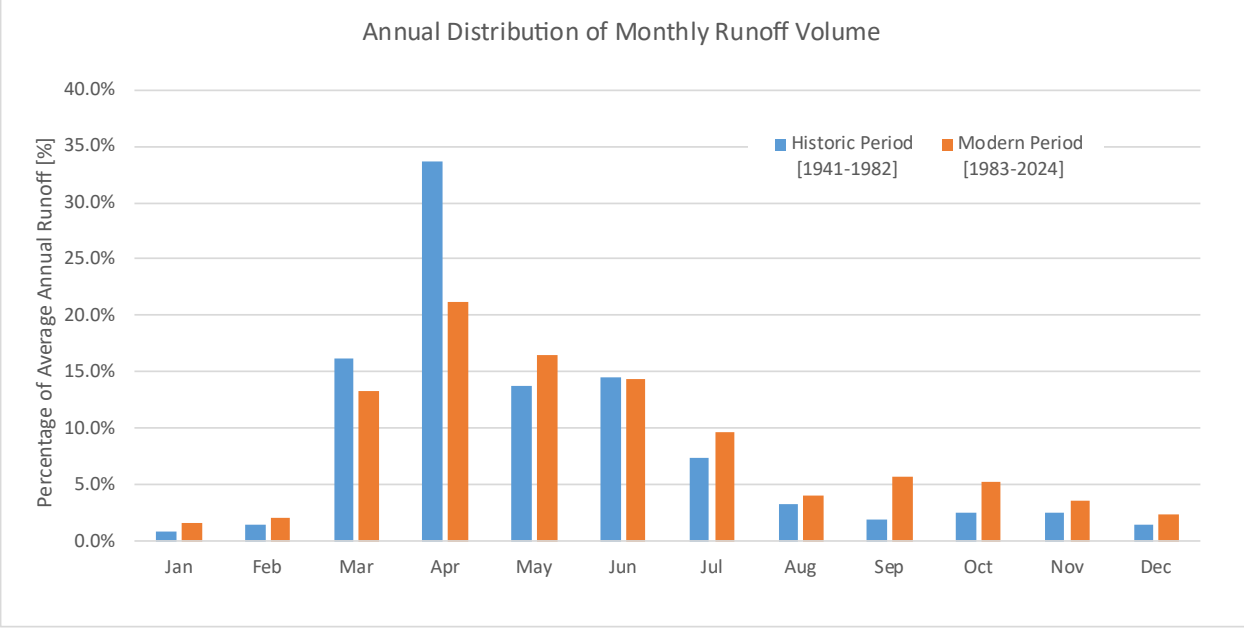


Figure A.4. Annual distribution of average monthly runoff volume as a percentage of annual total volume in the Redwood River near Marshall, MN (USGS# 05315000).

Table A.4. Average monthly runoff volume and annual distribution of monthly runoff volumes in Redwood River near Marshall, MN (USGS# 05315000).

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	284	1,513	431.9%	+	0.9%	1.7%	92.6%	+
Feb	505	1,859	268.3%	+	1.5%	2.0%	33.4%	+
Mar	5,347	12,151	127.3%	+	16.3%	13.4%	-17.7%	-
Apr	11,071	19,285	74.2%	+	33.7%	21.2%	-36.9%	-
May	4,543	14,997	230.1%	+	13.8%	16.5%	19.5%	+
Jun	4,802	13,061	172.0%	+	14.6%	14.4%	-1.5%	o
Jul	2,431	8,838	263.6%	+	7.4%	9.7%	31.7%	+
Aug	1,099	3,631	230.2%	+	3.3%	4.0%	19.6%	+
Sep	663	5,145	676.1%	+	2.0%	5.7%	181.0%	+
Oct	830	4,842	483.6%	+	2.5%	5.3%	111.3%	+
Nov	826	3,274	296.3%	+	2.5%	3.6%	43.5%	+
Dec	469	2,173	363.9%	+	1.4%	2.4%	68.0%	+

+ 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 typical 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 Redwood River near Marshall, MN (USGS# 05315000).

Statistic	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Average	2-May	10-May	7.28%	o
Median	8-Apr	30-Apr	22.34%	+
Standard Deviation	59 days	49 days	-16.62%	-

[1]Based 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 Redwood River near Marshall, MN (USGS# 05315000).

Statistic	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Average	18-Aug	26-Jul	-9.92%	o
Median	10-Sep	10-Sep	0.20%	o
Standard Deviation	82 days	108 days	30.91%	+

[1]Based 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**.

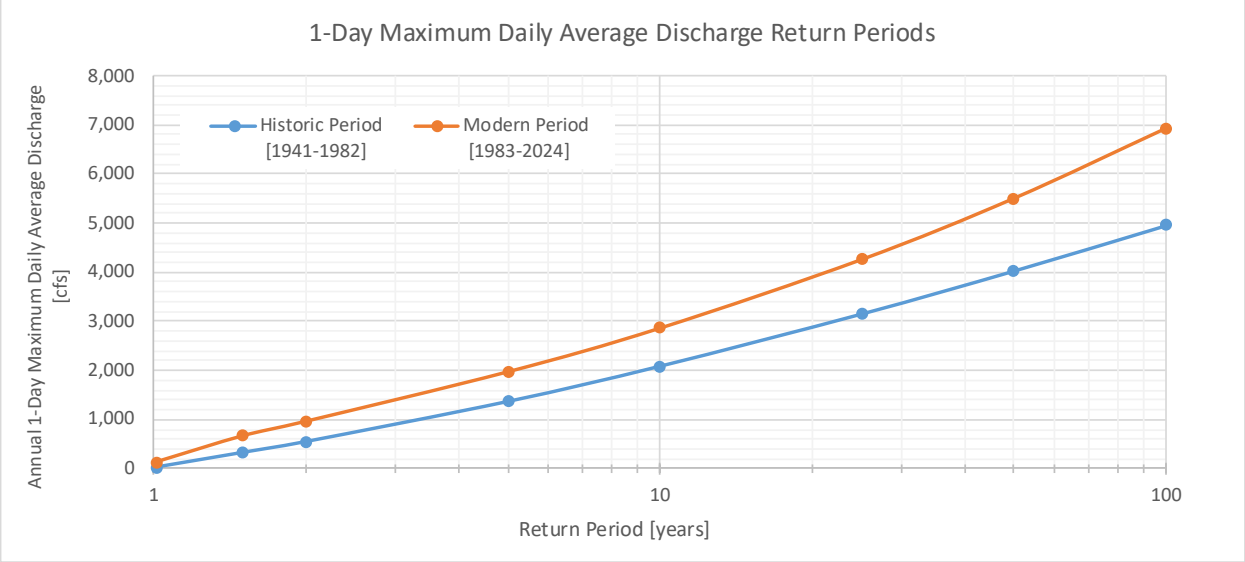


Figure A.5. Historical (1940-1975) versus modern (1980-2015) peak discharge return periods for Redwood River near Marshall, MN (USGS# 05315000).

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 Redwood River near Marshall, MN (USGS# 05315000).

Flow Metric	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.[1]	Altered Hydrology
5-Year Peak Discharge, Q(5) [cfs]	1,362	1,968	44.5%	+
Number of years with Discharge (Q) > Q_H (5)	8	16	100.0%	+
Average number of days per year Q > Q_H (5)	4	8	90.0%	+
Average annual cumulative volume > Q_H (5) [ac-ft]	6,134	10,624	73.2%	+
10-Year Peak Discharge, Q(10) [cfs]	2,084	2,859	37.2%	+
Number of years with Discharge (Q) > Q_H (10)	3	9	200.0%	+
Average number of days per year Q > Q_H (10)	3	5	43.3%	+
Average annual cumulative volume > Q_H (10) [ac-ft]	7,781	6,462	-17.0%	-
25-Year Peak Discharge, Q(25) [cfs]	3,152	4,258	35.1%	+
Number of years with Discharge (Q) > Q_H (25)	2	3	50.0%	+
Average number of days per year Q > Q_H (25)	2	2	16.7%	+
Average annual cumulative volume > Q_H (25) [ac-ft]	4,564	3,799	-16.8%	-
50-Year Peak Discharge, Q(50) [cfs]	4,032	5,506	36.6%	+
Number of years with Discharge (Q) > Q_H (50)	2	2	0.0%	o
Average number of days per year Q > Q_H (50)	2	2	0.0%	o
Average annual cumulative volume > Q_H (50) [ac-ft]	1,621	1,750	8.0%	o
100-Year Peak Discharge, Q(100) [cfs]	4,963	6,938	39.8%	+
Number of years with Discharge (Q) > Q_H (100)	0	1	NA	o
Average number of days per year Q > Q_H (100)	0	1	NA	o
Average annual cumulative volume > Q_H (100) [ac-ft]	0	668	NA	o

[1]No 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.

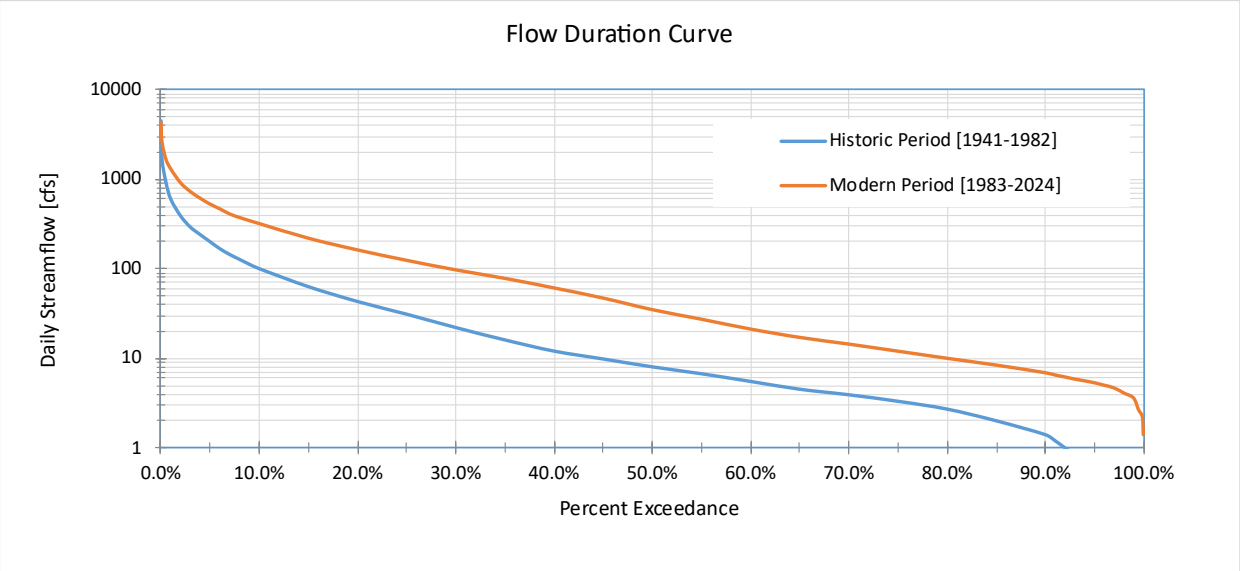


Figure A.6. Historical (1940-1975) versus modern (1980-2015) flow duration for Redwood River near Marshall, MN (USGS# 05315000).

Table A.8. Select summary of the flow duration curves for the Redwood River near Marshall, MN (USGS# 05315000).

Percent Exceedance	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology
0.10%	1,730	2,640	52.6%	+
1.0%	600	1,300	116.8%	+
10.0%	100	319	219.0%	+
25.0%	31	124	300.0%	+
50.0%	8	35	336.3%	+
75.0%	4	14	269.2%	+
90.0%	1	7	392.9%	+
99.0%	0	4	NA	+
99.9%	0	2	NA	+

+ 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 Redwood River near Marshall, MN (USGS# 05315000).

Flow Metric	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology
1.5-Year Peak Discharge, Q(1.5) [cfs]	321	667	107.8%	+
Number of years with Discharge (Q) > Q_H (1.5)	30	39	30.0%	+
Average number of days per year Q > Q_H (1.5)	13	39	200.9%	+
Average annual cumulative volume > Q_H (1.5) [ac-ft]	10,108	29,880	195.6%	+
2-Year Peak Discharge, Q(2) [cfs]	543	962	77.1%	+
Number of years with Discharge (Q) > Q_H (2)	22	30	36.4%	+
Average number of days per year Q > Q_H (2)	8	25	189.8%	+
Average annual cumulative volume > Q_H (2) [ac-ft]	8,380	23,498	180.4%	+

+ 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.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 **19,722 AF or 1.43 inches** across the watershed.

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 Redwood River near Marshall, MN (USGS# 05315000) using method 2.

Return Period	Historic Period Discharges (cfs)	Modern Period Discharges (cfs)	Difference (cfs)	Probability of Occurrence	Difference*Probability (cfs)
1.5	321	667	346	0.67	230.7

2	543	962	419	0.50	209.5
5	1,362	1,968	606	0.20	121.1
10	2,084	2,859	775	0.10	77.5
25	3,152	4,258	1106	0.04	44.2
50	4,032	5,506	1474	0.02	29.5
100	4,963	6,938	1975	0.01	19.7
				Sum (cfs):	732
				Sum (ac-ft/day):	1,453
		Number of days:	26	Total Volume Goal:	37,658 AF (2.73 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 multiples 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 Redwood River near Marshall, MN (USGS# 05315000) 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	346	0.67	457.7	26	11,864
2	419	0.50	415.6	16	6,668
5	606	0.20	240.3	4	946
10	775	0.10	153.8	1	222
25	1,106	0.04	87.7	0	29
50	1,474	0.02	58.5	0	0
100	1,975	0.01	39.2	1	39
				Total Volume Goal:	19,769 AF (1.43 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 **9,793 AF, or 0.71 inches,** across the watershed.

APPENDIX B: METRICS OF ALTERED HYDROLOGY FOR THE REDWOOD RIVER NEAR REDWOOD FALLS, MN (USGS# 05316500).

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

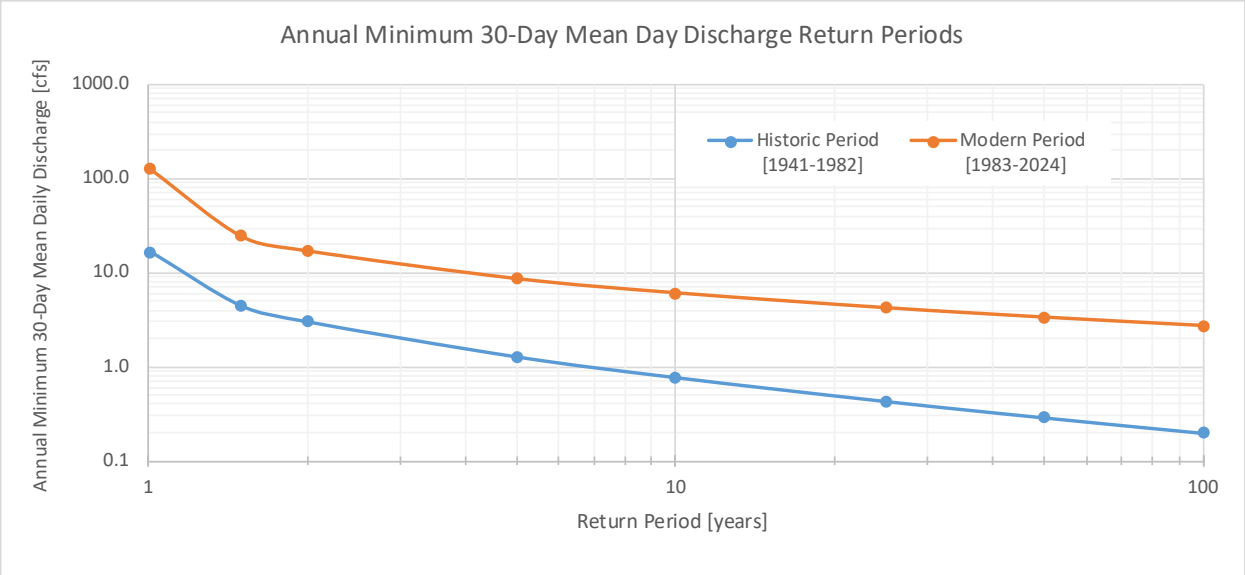


Figure A.1. Historical versus modern annual minimum 30-day mean daily discharge versus return period for Redwood River near Redwood Falls, MN (USGS# 05316500).

Table A.1: Summary of annual minimum 30-day mean daily discharge by return periods for the Redwood River near Redwood Falls, MN (USGS# 05316500).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
1.01	16.7	126.4	658.8%	+
1.5	4.4	24.4	449.4%	+
2	3.0	17.1	465.9%	+
5	1.3	8.6	574.8%	+
10	0.8	6.1	689.1%	+
25	0.4	4.2	880.4%	+
50	0.3	3.3	1060.1%	+
100	0.2	2.7	1275.7%	+

+ 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.1.2 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**.

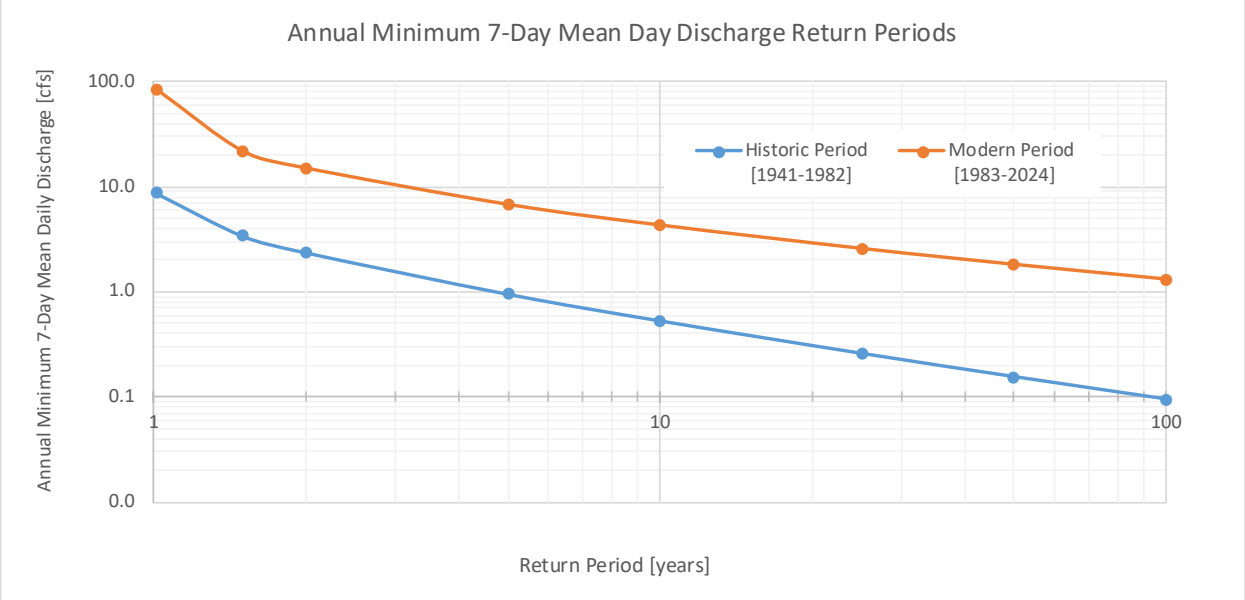


Figure A.2. Historical versus modern annual minimum 7-day mean daily discharge return periods for Redwood River near Redwood Falls, MN (USGS# 05316500).

Table A.2: Summary of annual minimum 7-day mean daily discharge return periods for the Redwood River near Redwood Falls, MN (USGS# 05316500).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
1.0101	8.8	84.8	866.5%	+
1.5	3.4	21.7	536.3%	+
2	2.4	14.9	532.4%	+
5	1.0	6.7	608.5%	+
10	0.5	4.3	708.5%	+
25	0.3	2.6	887.5%	+
50	0.2	1.8	1062.3%	+
100	0.1	1.3	1277.4%	+

+ 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.1.3 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 Redwood River near Redwood Falls, MN (USGS# 05316500).

Return Period	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology Criterion
Period median November flow [cfs]	19.0	58.0	205.3%	+

+ 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**.

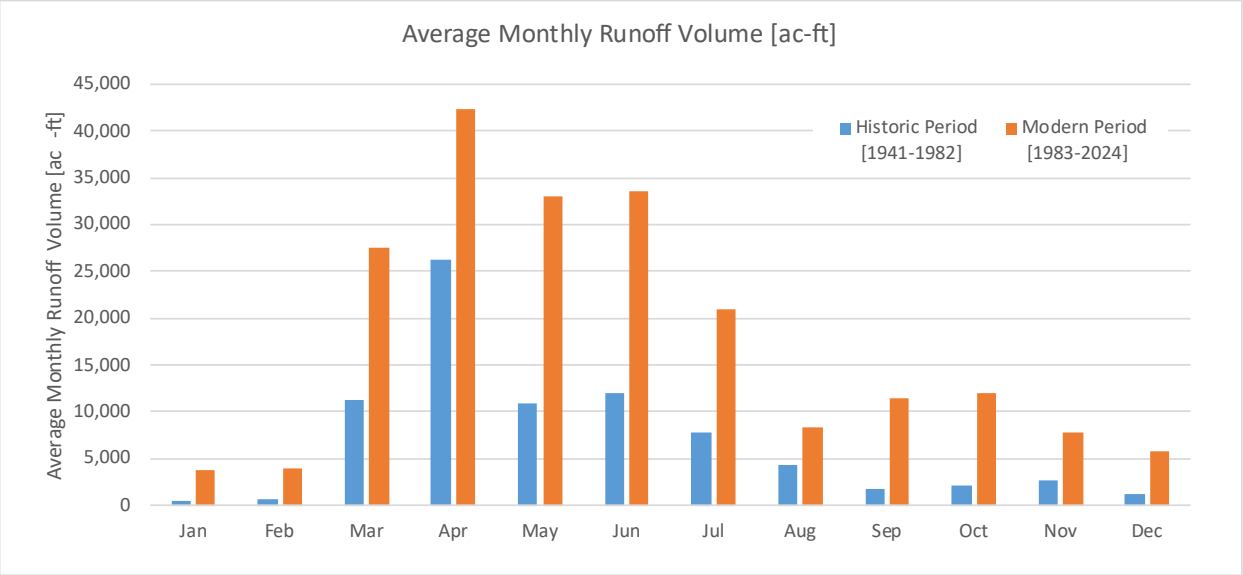


Figure A.3. Average monthly runoff volume [ac-ft] in the Redwood River near Redwood Falls, MN (USGS# 05316500).

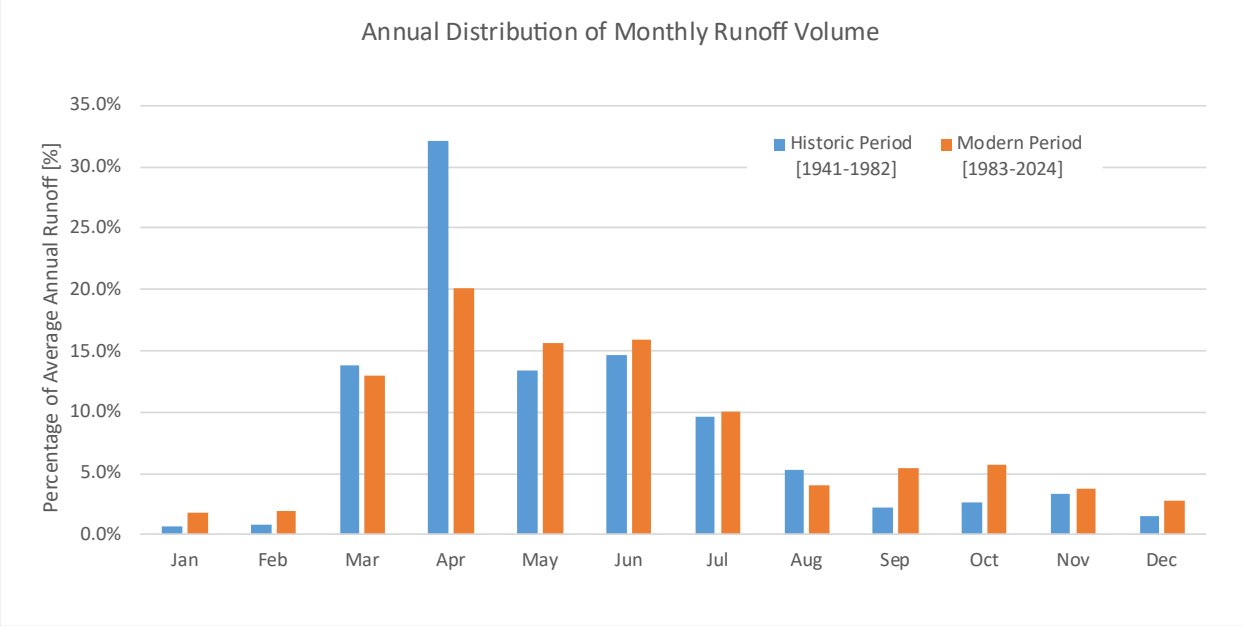


Figure A.4. Annual distribution of average monthly runoff volume as a percentage of annual total volume in the Redwood River near Redwood Falls, MN (USGS# 05316500).

Table A.4. Average monthly runoff volume and annual distribution of monthly runoff volumes in Redwood River near Redwood Falls, MN (USGS# 05316500).

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	569	3,791	566.3%	+	0.7%	1.8%	158.9%	+
Feb	710	3,952	456.2%	+	0.9%	1.9%	116.1%	+
Mar	11,288	27,439	143.1%	+	13.8%	13.0%	-5.6%	o
Apr	26,261	42,325	61.2%	+	32.1%	20.1%	-37.4%	-
May	10,947	33,020	201.6%	+	13.4%	15.7%	17.2%	+
Jun	11,933	33,597	181.5%	+	14.6%	16.0%	9.4%	o
Jul	7,880	21,034	166.9%	+	9.6%	10.0%	3.7%	o
Aug	4,295	8,375	95.0%	+	5.3%	4.0%	-24.2%	-
Sep	1,843	11,369	516.9%	+	2.3%	5.4%	139.7%	+
Oct	2,105	12,022	471.1%	+	2.6%	5.7%	121.9%	+
Nov	2,701	7,877	191.6%	+	3.3%	3.7%	13.3%	+
Dec	1,262	5,724	353.7%	+	1.5%	2.7%	76.3%	+

+ 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 typical 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 Redwood River near Redwood Falls, MN (USGS# 05316500).

Statistic	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Average	29-Apr	16-May	14.54%	+
Median	7-Apr	11-May	35.57%	+
Standard Deviation	54 days	50 days	-8.18%	o

[1]Based 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 Redwood River near Redwood Falls, MN (USGS# 05316500).

Statistic	Historic Period [1941-1982]	Modern Period [1983-2024]	% diff.	AH
Average	13-May	19-Jul	50.44%	+
Median	12-Feb	11-Sep	485.06%	+
Standard Deviation	118 days	106 days	-10.32%	-

[1]Based 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**.

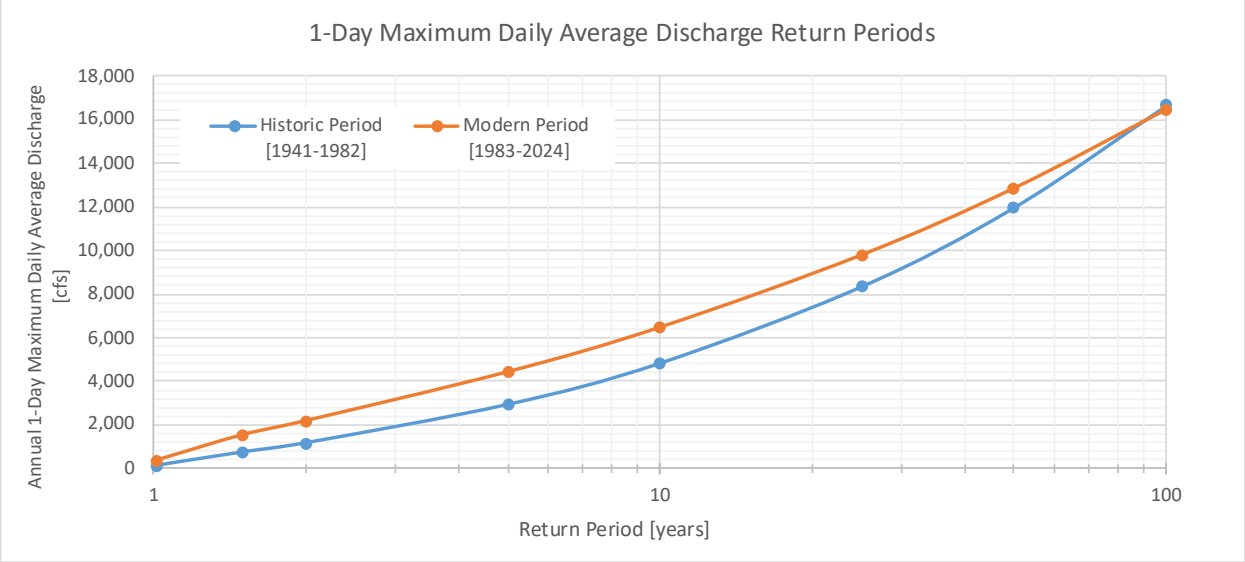


Figure A.5. Historical (1940-1975) versus modern (1980-2015) peak discharge return periods for Redwood River near Redwood Falls, MN (USGS# 05316500).

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 Redwood River near Redwood Falls, MN (USGS# 05316500).

Flow Metric	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.[1]	Altered Hydrology
5-Year Peak Discharge, Q(5) [cfs]	2,919	4,420	51.4%	+
Number of years with Discharge (Q) > Q_H (5)	7	17	142.9%	+
Average number of days per year Q > Q_H (5)	6	8	41.5%	+
Average annual cumulative volume > Q_H (5) [ac-ft]	25,614	24,896	-2.8%	o
10-Year Peak Discharge, Q(10) [cfs]	4,816	6,466	34.2%	+
Number of years with Discharge (Q) > Q_H (10)	5	8	60.0%	+
Average number of days per year Q > Q_H (10)	3	5	60.2%	+
Average annual cumulative volume > Q_H (10) [ac-ft]	15,319	17,493	14.2%	+
25-Year Peak Discharge, Q(25) [cfs]	8,334	9,786	17.4%	+
Number of years with Discharge (Q) > Q_H (25)	2	2	0.0%	o
Average number of days per year Q > Q_H (25)	2	2	-25.0%	-
Average annual cumulative volume > Q_H (25) [ac-ft]	11,091	4,024	-63.7%	-
50-Year Peak Discharge, Q(50) [cfs]	11,970	12,851	7.4%	o
Number of years with Discharge (Q) > Q_H (50)	1	0	NA	o
Average number of days per year Q > Q_H (50)	1	0	NA	o
Average annual cumulative volume > Q_H (50) [ac-ft]	2,440	0	NA	o
100-Year Peak Discharge, Q(100) [cfs]	16,666	16,472	-1.2%	o
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

[1]No 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.

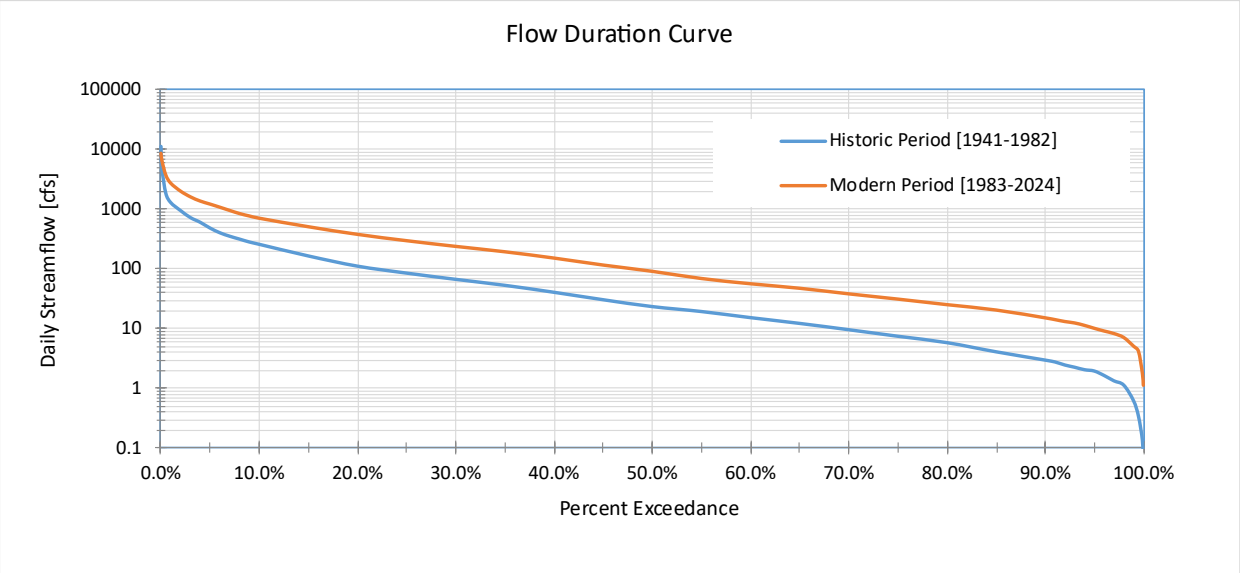


Figure A.6. Historical (1940-1975) versus modern (1980-2015) flow duration for Redwood River near Redwood Falls, MN (USGS# 05316500).

Table A.8. Select summary of the flow duration curves for the Redwood River near Redwood Falls, MN (USGS# 05316500).

Percent Exceedance	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology
0.10%	4,906	6,666	35.9%	+
1.0%	1,286	2,766	115.1%	+
10.0%	256	712	178.0%	+
25.0%	84	298	254.8%	+
50.0%	23	91	295.7%	+
75.0%	9	38	304.3%	+
90.0%	3	15	417.2%	+
99.0%	1	5	733.3%	+
99.9%	0.1	2	1233.8%	+

+ 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 Redwood River near Redwood Falls, MN (USGS# 05316500).

Flow Metric	Historic Period [1941-1982]	Modern Period [1983-2024]	% Diff.	Altered Hydrology
1.5-Year Peak Discharge, Q(1.5) [cfs]	736	1,536	108.5%	+
Number of years with Discharge (Q) > Q_H (1.5)	29	39	34.5%	+
Average number of days per year Q > Q_H (1.5)	15	38	142.3%	+
Average annual cumulative volume > Q_H (1.5) [ac-ft]	24,645	66,412	169.5%	+
2-Year Peak Discharge, Q(2) [cfs]	1,160	2,181	88.0%	+
Number of years with Discharge (Q) > Q_H (2)	22	31	40.9%	+
Average number of days per year Q > Q_H (2)	9	27	203.5%	+
Average annual cumulative volume > Q_H (2) [ac-ft]	20,642	53,439	158.9%	+

+ 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 **41,767 AF or 1.25 inches** across the watershed.

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 Redwood River near Redwood Falls, MN (USGS# 05316500) using method 2.

Return Period	Historic Period Discharges (cfs)	Modern Period Discharges (cfs)	Difference (cfs)	Probability of Occurrence	Difference*Probability (cfs)
1.5	736	1,536	799	0.67	532.8

2	1,160	2,181	1021	0.50	510.3
5	2,919	4,420	1501	0.20	300.1
10	4,816	6,466	1650	0.10	165.0
25	8,334	9,786	1452	0.04	58.1
50	11,970	12,851	881	0.02	17.6
100	16,666	16,472	-194	0.01	0.0
				Sum (cfs):	1,584
				Sum (ac-ft/day):	3,142
		Number of days:	22	Total Volume Goal:	69,229 AF (2.06 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 multiples 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 Redwood River near Redwood Falls, MN (USGS# 05316500) 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	346	799	0.67	1,057.1	22
2	419	1,021	0.50	1,012.4	18
5	606	1,501	0.20	595.5	2
10	775	1,650	0.10	327.3	2
25	1,106	1,452	0.04	115.2	0
50	1,474	881	0.02	35.0	0
100	1,975	-194	0.01	0.0	0
				Total Volume Goal:	43,558 AF (1.30 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 **22,818 AF, or 0.71 inches,** across the watershed.

Appendix H

PTMApp Implementation Scenario

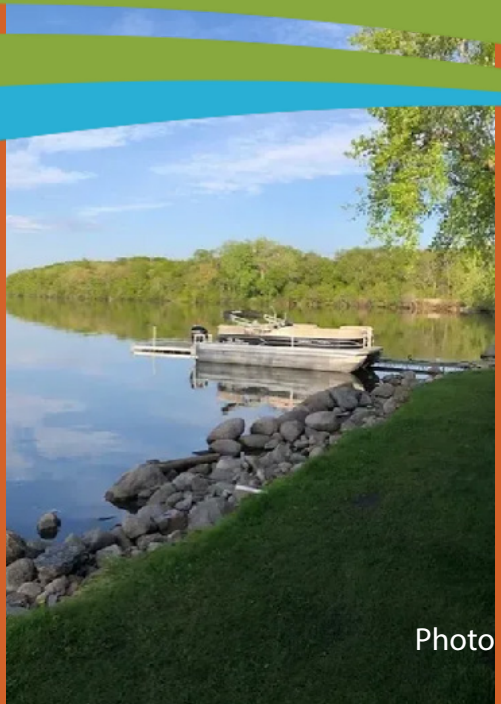


Photo Credits: Minnesota River Valley National Scenic Byway, Lake Benton, and RCRCA

PTMApp Implementation Scenario

Actions in **Section 5. Implementation** of this plan are based on a PTMApp Implementation Scenario developed by the Steering Committee during the RRW 1W1P planning process. For the purpose of planning, this implementation scenario is summarized more broadly in **Section 5** to enable flexibility during implementation. This Appendix details the decisions made and shows the best management practices (BMP) targeting maps that resulted from the implementation scenario.

Actions were developed through a review of goals in the WRAPS report, responses from the 60-day notification of planning, planned actions in neighboring watersheds, and committee input. The action tables include a long list of structural and nonstructural best management practices (BMPs), land protection and restoration, and research and outreach actions that local and state partners will work together to implement. The measurable output of each action, such as the number of acres of a practice or the number of events held, will be tracked by implementation partners.

Introduction

The Prioritize, Target, and Measure Application (PTMApp) is a program that can be used by practitioners as a technical bridge from general descriptions of implementation strategies in a local water plan to the identification of implementable on-the-ground BMPs and conservation practices.

PTMApp can be used by Soil and Water Conservation Districts (SWCD), watershed districts, county and local watershed planners, and agency staff and decision-makers to prioritize resources and the issues impacting them, target specific fields to place practices, and measure water quality improvement by estimating the expected nutrient and sediment load reductions delivered to priority resources.

Prioritize, Target, and Measure Application (PTMApp)

The tool enables practitioners to build prioritized and targeted implementation scenarios, measure the cost-effectiveness of the scenario for improving water quality, and report the results to pursue funds for project implementation.

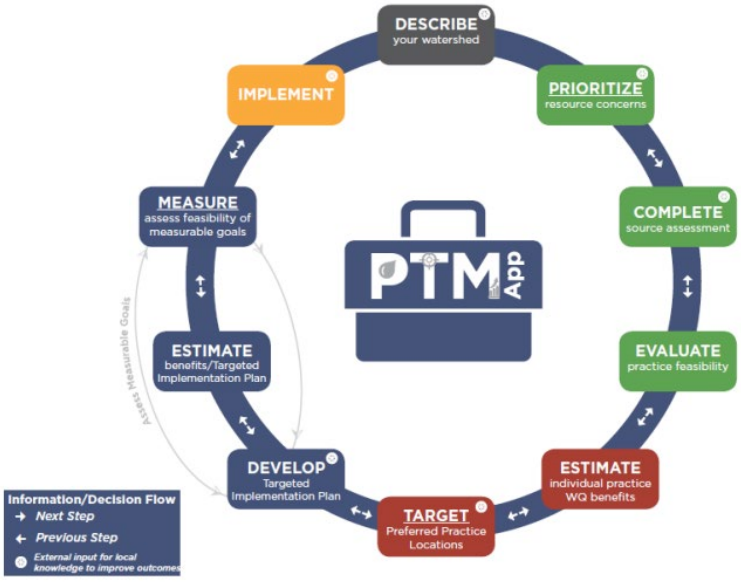


Table 1: PTMApp decisions discussed during the November 13, 2024 Steering Committee meeting.

Decision	Implications	Steering Committee Decision
Criteria used to further screen practices	Criteria are used to further screen practices considered technically feasible for implementation but are not practicable to implement.	See Table 2.
Types of practices to include	Determines types of NRCS practices that are included in the implementation scenario.	See Table 3.
Costs	Costs can represent the "cost" share or total cost. For example, EQIP is the federal government cost share.	Double EQIP Costs (see Table 4) to capture the full cost of the practice + 20% for technical assistance. Include a $4,000 per practice cost for grade stabilization (based off local knowledge and expertise from other watersheds). Soil Health: $150/acre, based off local feedback on a realistic 3-year cost-share.
Spatial Scale	The decision reflects the spatial scale for application of the load reduction goals. For example, will the ability of the proposed BMPs to achieve the sediment, TP, and TN load reduction goal be assessed at the field edge or some other spatial scale. This decision also affects which BMPs are selected as best. The "best" practice locations tend to be near the location where the load reduction is desired. Using the edge of field will tend to spread practices more evenly across the landscape. Use of a planning region outlet will tend to concentrate the practices upstream of that location.	The "best" practices selected based on the highest load reduction at the edge of the field (spreads out practices within the planning region). Practices for the Projects and Support Implementation Program will be capped (initially) at $250,000 (rationale: anything over $250,000 is a Capital Improvement Project).

Decision	Implications	Steering Committee Decision
Parameters and method used to rank the "best" conservation practices.	The "best" conservation practices will differ depending on which parameters are used, and whether they are weighted.	Best conservation practices will be evaluated by sediment cost efficiency.
Process for identifying the number of practices which will be included in the Implementation Scenario.	Decision ultimately affects the "cost(s)" of the Implementation Scenario and ability to achieve the load reduction goals.	Number of practices that can be afforded under the Funding Level 2 (Current Funding + Watershed-Based Implementation Funding).

Using the screening criteria, practices with low potential for water quality benefits are removed from the analysis. Reduction efficiency criteria were set to immediately rule out structural or management practices that would be minimally effective. Two criteria were evaluated- BMPs must reduce loads by at least 10% and treat 50% of a 2-year rain event, and BMPs must reduce a significant amount of load (at least 0.25 tons of sediment/year and 0.25-0.5 lbs nutrients/year). Efficiencies for BMPs with N/A in Table 2 are uniform for all BMPs of a given type and are not screened by that criterion as a result.

Table 2: Recommended PTMApp Screening Criteria

Conservation Practice Name	PTMApp NRCS Practice Code	Remove BMPs with little runoff volume delivery or constituent removal efficiency				Remove BMPs with low removal magnitudes at the edge of field		
		Delivery and Reduction Efficiency Criteria (Value must be greater than)				Reduction Magnitude Selection Criteria (Value must be greater than)		
		Percent of 2-yr, 24-hr event treated	Sediment Reduction (%)	TP Reduction (%)	TN Reduction (%)	Sediment Reduction @ Catchment Outlet	TP Reduction @ Catchment Outlet (lbs/year)	TN Reduction @ Catchment Outlet (lbs/year)
Farm Pond/Wetland	378	50	10	10	10	0.25	0.25	0.5
Drainage Water Management	554	50	10	10	10	0.25	0.25	0.5
Water and Sediment Control Basin	638	50	10	10	10	0.25	0.25	0.5
Regional Wetland/Pond	656_1	50	10	10	10	0.25	0.25	0.5
Large Wetland Restoration	656_2	50	10	10	10	0.25	0.25	0.5
Riparian Buffer	390	50	10	10	10	0.25	0.25	0.5
Filtration Strip	393	50	10	10	10	0.25	0.25	0.5
Saturated Buffer	604	50	10	10	10	0.25	0.25	0.5
Denitrifying Bioreactor	605	50	10	10	10	0.25	0.25	0.5
Infiltration Trench/Small Infiltration Basin	350	50	10	10	10	0.25	0.25	0.5
Multi-stage Ditch (open channel)	582	50	10	10	10	0.25	0.25	0.5
Critical Area Planting	342	N/A				0.25	0.25	0.5
Grade Stabilization	410	N/A				0.25	0.25	0.5
Grassed Waterway	412	N/A				0.25	0.25	0.5
Lake and Wetland Shoreline Restoration	580	N/A				0.25	0.25	0.5
Perennial Crops	327	N/A				0.25	0.25	1
No till	329	N/A				0.25	0.25	1
Cover Crops	340	N/A				0.25	0.25	1
Reduced till	345	N/A				0.25	0.25	1
Forage / Biomass Planting	512	N/A				0.25	0.25	1

Conservation Practice Name	PTMApp NRCS Practice Code	Remove BMPs with little runoff volume delivery or constituent removal efficiency				Remove BMPs with low removal magnitudes at the edge of field		
		Delivery and Reduction Efficiency Criteria (Value must be greater than)				Reduction Magnitude Selection Criteria (Value must be greater than)		
		Percent of 2-yr, 24-hr event treated	Sediment Reduction (%)	TP Reduction (%)	TN Reduction (%)	Sediment Reduction @ Catchment Outlet	TP Reduction @ Catchment Outlet (lbs/year)	TN Reduction @ Catchment Outlet (lbs/year)
Prescribed Grazing	528	N/A				0.25	0.25	1
Nutrient Management Plan of Groundwater	590_1	N/A				0.25	0.25	1
Nutrient Management Plan for Phosphorus	590_2	N/A				0.25	0.25	
Nutrient Management Plan for Nitrogen	590_3	N/A				0.25		1

After practices were screened, the remainder were ranked by their sediment cost efficiency at the catchment outlet from highest to lowest. Each NRCS conservation practice was allotted a certain amount of funding based on scenario estimates by the Steering Committee, as shown in Table 3. Targeted practices were selected from the highest position on the ranked list until each practice funding limit was reached.

Table 3: NRCS Conservation Practices and associated priority for funding (high, medium, or low)

Conservation Practice Name	NRCS Practice Code	Priority
Farm Pond/Wetland	378	M
Drainage Water Management	554	M
Water and Sediment Control Basin	638	H
Large Wetland Restoration	656_1†	M
Regional Wetland/Pond	656_2†	M
Riparian Buffer	390	M
Filtration Strip	393	M
Saturated Buffer	604	M
Denitrifying Bioreactor	605	L
Infiltration Trench/Small Infiltration Basin	350	L
Multi-stage Ditch (open channel)	582	L
Critical Area Planting	342	M
Grade Stabilization	410	H
Grassed Waterway	412	H
Lake and Wetland Shoreline Restoration	580	None (outside PTMApp)
Forage / Biomass Planting	512	None (part of soil health)

Table 4: Unit costs based on 2020 EQIP payment rates

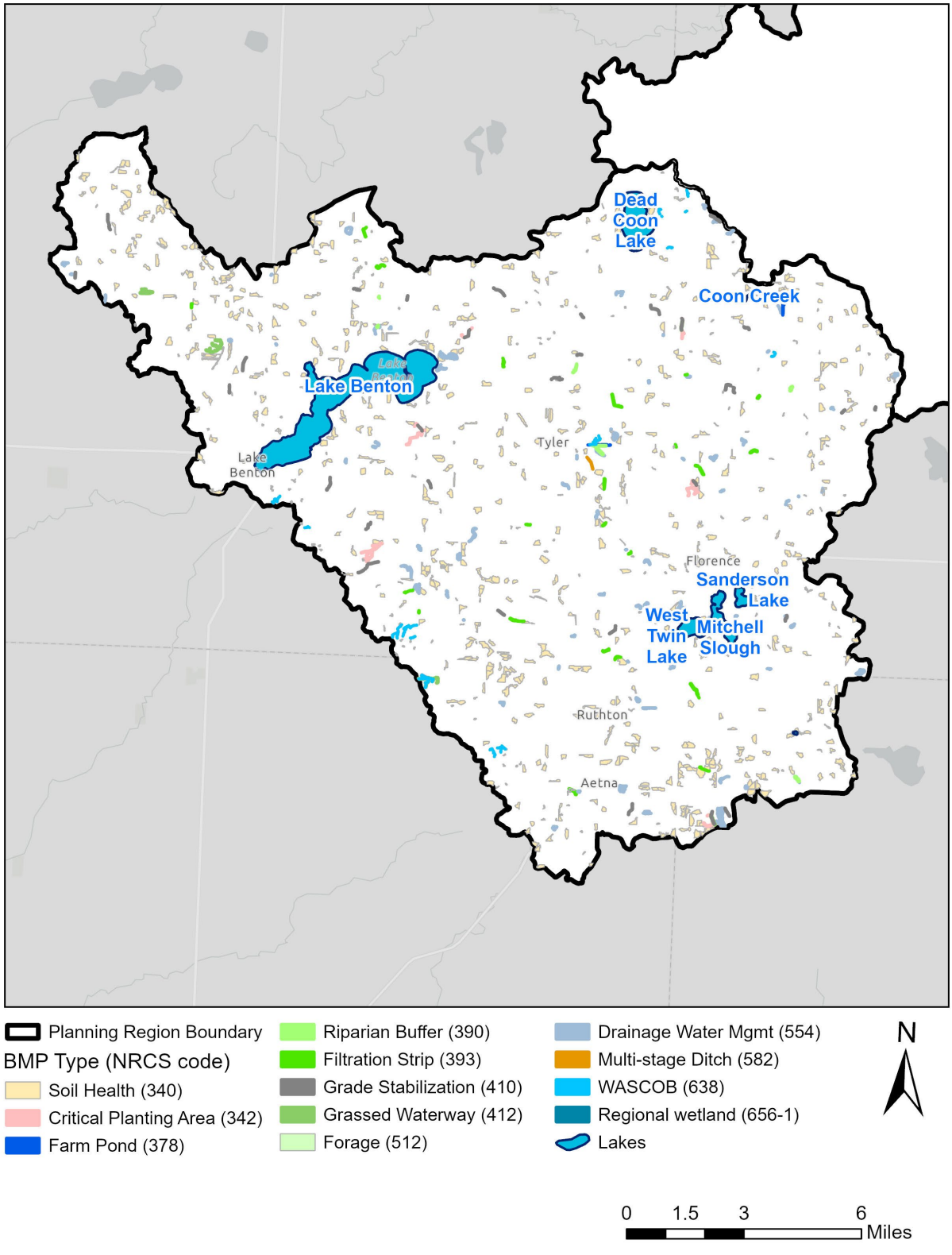
PTMApp Conservation Practice Name	NRCS Practice Name	PTMApp Treatment Group Code	Treatment Group	NRCS Codes	Previous Values		Updated Values				
					Cost per unit	Units	Cost per unit	Units	Typical Units Installed	Typical Cost	Suggested PTMApp Minimum Cost
bmp_pond	Farm Pond/Wetland	1	Storage	378	$ 2.70	cubic yard	$ 812.05	acre	1	$ 812.05	$ 203.01
bmp_drain	Drainage Water Management	1	Storage	554	$ 2.70	cubic yard	$ 5.54	acre	50	$ 277.00	$ 277.00
bmp_wascob	Water and Sediment Control Basin	1	Storage	638	$ 2.70	cubic yard	$ 4,500.00	each	1	$ 4,500.00	$ 4,500.00
bmp_reg_wet	Regional Wetland/Pond	1	Storage	656_1	$ 2.70	cubic yard	$ 20,439.57	acre	0.25	$ 5,109.89	$ 1,277.47
bmp_nut_wet	Large Wetland Restoration	1	Storage	656_2	$ 2.70	cubic yard	$ 20,439.57	acre	0.25	$ 5,109.89	$ 1,277.47
bmp_riparian*	Riparian Buffer	2	Filtration	390	NA	NA	$ 1,065.87	acre	3.00	$ 3,197.61	$ 799.40
bmp_filtst	Filtration Strip	2	Filtration	393	$ 474.07	acre	$ 496.08	acre	1	$ 496.08	$ 124.02
bmp_satbuff	Saturated Buffer	3	Biofiltration	604	$ 44.92	cubic yard	$ 1,367.78	acre†	0.92	$ 1,258.36	$ 1,258.36
bmp_denit	Denitrifying Bioreactor	3	Biofiltration	605	$ 44.92	cubic yard	$ 38.02	cu. yd‡	200	$ 7,604.00	$ 1,896.25
bmp_inftrech	Infiltration Trench/Small Infiltration Basin	4	Infiltration	350	$ 27,199.29	acre	$ 36.45	sq. yd'	111	$ 4,045.95	$ 1,011.49
bmp_ditch2s	Multi-stage Ditch (open channel)	4	Infiltration	582	$ 27,199.29	acre	$ 4,036.56	acre†	1.25	$ 5,045.70	$ 1,261.43
bmp_crit_plant	Critical Area Planting	5	Protection	342	$ 2,133.35	acre	$ 293.77	acre	1	$ 293.77	$ 73.44
bmp_protect	Grade Stabilization	5	Protection	410	$ 2,133.35	acre	$ 53.10	sq. yd	80	$ 4,248.00	$ 1,062.00
bmp_gwater	Grassed Waterway	5	Protection	412	$ 2,133.35	acre	$ 1,062.86	acre†	2.5	$ 2,657.16	$ 664.29
bmp_shore	Lake and Wetland Shoreline Restoration	5	Protection	580	$ 2,133.35	acre	$ 37.98	sq. yd	111	$ 4,215.78	$ 1,053.95
bmp_peren	Perennial Crops	6	Source Reduction	327	$ 30.87	acre	$ 480.80	acre	1	$ 480.80	$ 120.20
bmp_no_till	No Tillage	6	Source Reduction	329	NA	NA	$ 11.03	acre	100	$ 1,103.00	$ 275.75
bmp_covcrop	Cover Crops	6	Source Reduction	340	$ 30.87	acre	$ 33.52	acre	40	$ 1,340.80	$ 335.20
bmp_red_till	Reduced Tillage	6	Source Reduction	345	NA	NA	$ 11.03	acre	100	$ 1,103.00	$ 275.75
bmp_forage*	Forage / Biomass Planting	6	Source Reduction	512	NA	NA	$ 44.84	acre	40	$ 1,793.60	$ 448.40
bmp_grazing*	Prescribed Grazing	6	Source Reduction	528	NA	NA	$ 6.34	acre	40	$ 253.60	$ 63.40
bmp_no3	Nutrient Management of Groundwater	6	Source Reduction	590_1	$ 30.87	acre	$ 6.84	acre	40	$ 273.60	$ 68.40
bmp_p_mgmt	Nutrient Management for Phosphorus	6	Source Reduction	590_2	NA	NA	$ 6.84	acre	40	$ 273.60	$ 68.40
bmp_n_mgmt	Nutrient Management for Nitrogen	6	Source Reduction	590_3	NA	NA	$ 6.84	acre	40	$ 273.60	$ 68.40

* Costs are based on 2020 EQIP payment rates
† EQIP payment rate based on linear feet. An assumed practice width was applied to bmp_satbuff, bmp_ditch2s, and bmp_gwater (50ft, 60ft, and 100ft, respectively).
‡ Volume was calculated based on an assumed 1/8" runoff across the drainage area of the BMP
' EQIP payment rate based on cubic yards. A practice depth of 1.5 yd was assumed.

PTMApp Implementation Scenarios

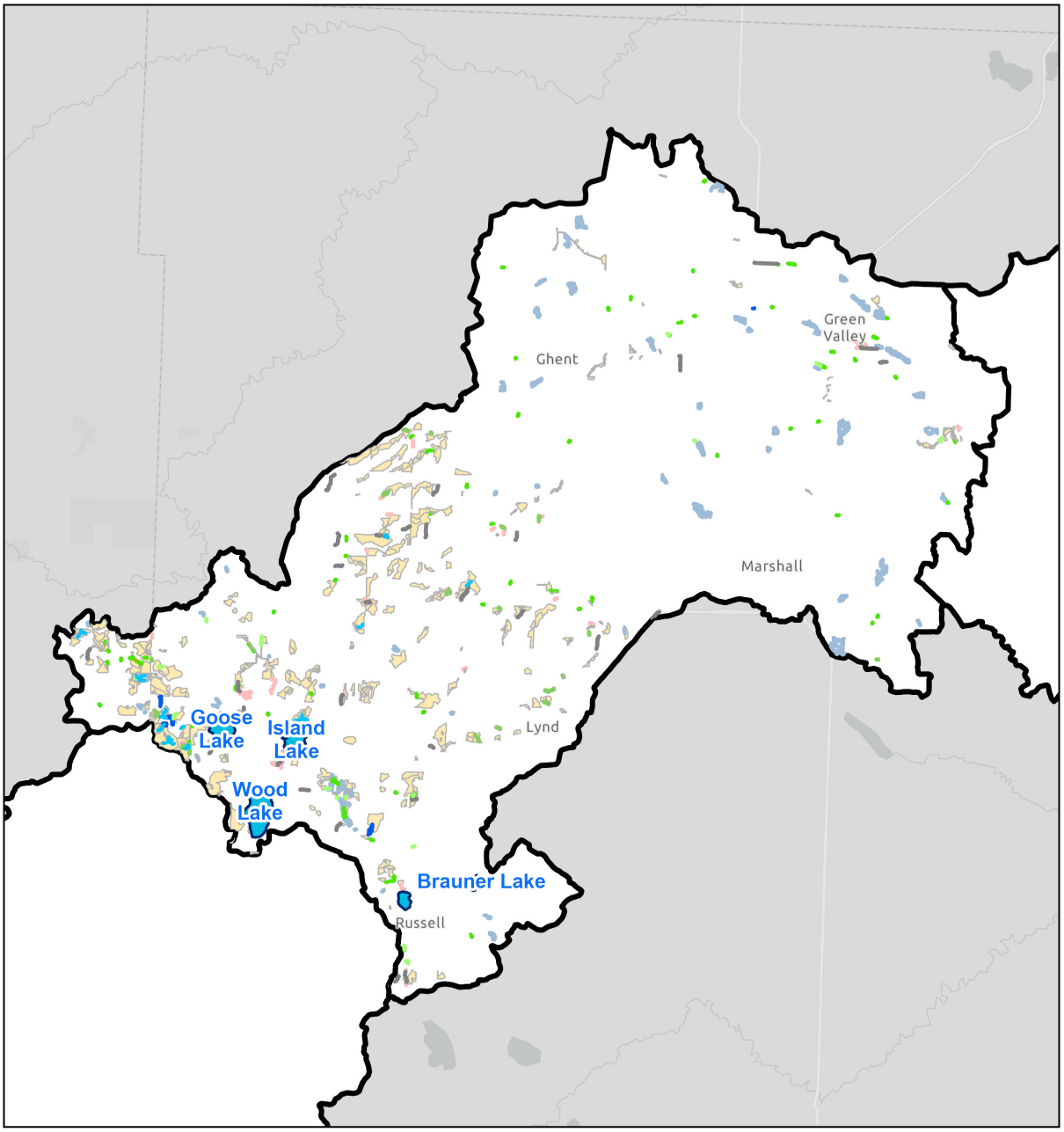
Upper Redwood Planning Region

BMP Treatment Group	Number of Practices	Total Cost ($)	Values at Catchment Outlet			Additional Water Storage (ac-ft)	BMP Surface Area (acres)
			Sediment Reduction (tons/yr.)	TP Reduction (lbs./yr.)	TN Reduction (lbs./yr.)		
378 - Farm pond/wetland	3	$53,093	1,541	205	4,274	136	833
554 - Drainage water management	91	$55,455	5,189	842	14,490	484	4,646
638 - WASCOB	14	$138,600	1,787	129	1,900	78	496
390 - Riparian Buffer	6	$53,178	429	45	940	0	260
393 - Filtration Strip	23	$53,359	141	18	356	0	94
582 - Multi-stage Ditch	1	$20,737	101	2	125	1	45
342 - Critical Area Planting	8	$50,936	356	27	545	0	79
410 - Grade Stabilization	31	$124,000	570	22	432	0	63
412 - Grassed Waterway	5	$116,335	244	18	339	0	50
340 - Cover Crops	619	$836,454	4,345	1,263	25,538	0	5,576
512 - Forage / Biomass Planting	167	$34,755	1,555	66	531	0	232
Total:	968	$1,536,901	16,257	2,636	49,471	699	12,374


Dead Coon Lake
Coon Creek
Lake Benton
Lake Benton
Tyler
Florence
Sanderson Lake
West Twin Lake
Mitchell Slough
Ruthton
Aetna
Planning Region Boundary
BMP Type (NRCS code)
Soil Health (340)
Critical Planting Area (342)
Farm Pond (378)
Riparian Buffer (390)
Filtration Strip (393)
Grade Stabilization (410)
Grassed Waterway (412)
Forage (512)
Drainage Water Mgmt (554)
Multi-stage Ditch (582)
WASCOB (638)
Regional wetland (656-1)
Lakes
N
0 1.5 3 6
Miles

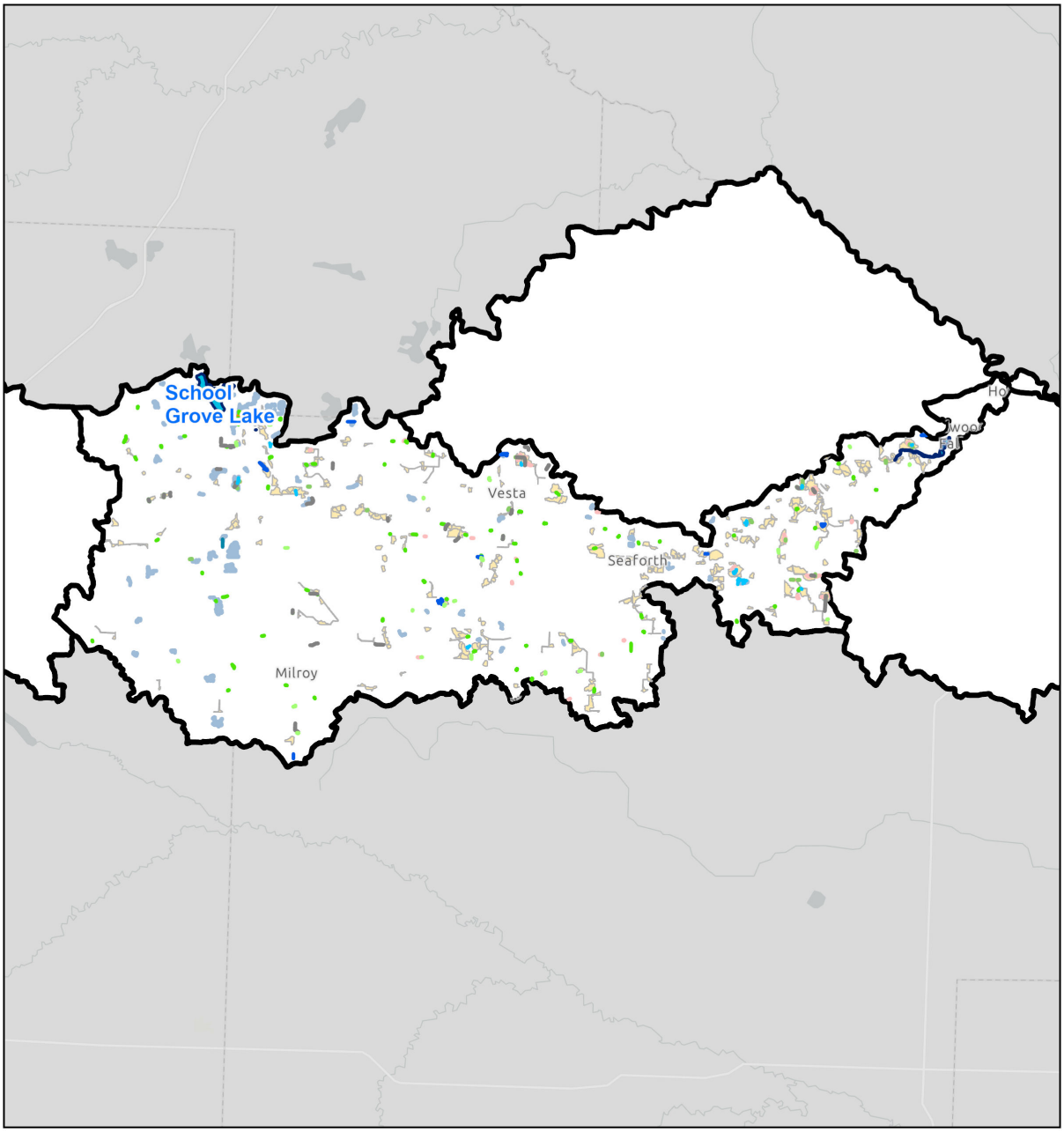
Middle Redwood River Planning Region

BMP Treatment Group	Number of Practices	Total Cost ($)	Values at Catchment Outlet			Additional Water Storage (ac-ft)	BMP Surface Area (acres)
			Sediment Reduction (tons/yr.)	TP Reduction (lbs./yr.)	TN Reduction (lbs./yr.)		
378 - Farm pond/wetland	6	$31,270	1,478	178	3,771	35	705
554 - Drainage water management	83	$50,580	10,011	2,511	40,406	1,018	15,313
638 - WASCOB	12	$118,800	1,540	106	1,563	40	408
390 - Riparian Buffer	17	$40,422	511	59	1,135	0	343
393 - Filtration Strip	76	$50,638	298	84	1,643	0	455
582 - Multi-stage Ditch	2	$15,582	80	2	114	1	38
342 - Critical Area Planting	34	$50,597	576	28	528	0	78
410 - Grade Stabilization	29	$116,000	549	19	389	0	57
412 - Grassed Waterway	28	$110,438	420	17	315	0	47
340 - Cover Crops	219	$736,044	13,134	1,112	22,487	0	4,907
512 - Forage / Biomass Planting	104	$38,971	2,917	74	596	0	260
Total:	610	$1,359,342	31,513	4,189	72,946	1,094	22,610


Ghent
Green Valley
Marshall
Lynd
Goose Lake
Island Lake
Wood Lake
Braun̓er Lake
Russell
Planning Region Boundary
BMP Type (NRCS code)
Soil Health (340)
Critical Planting Area (342)
Farm Pond (378)
Riparian Buffer (390)
Filtration Strip (393)
Grade Stabilization (410)
Grassed Waterway (412)
Forage (512)
Drainage Water Mgmt (554)
Multi-stage Ditch (582)
WASCOB (638)
Regional wetland (656-1)
Lakes
N
0 1.5 3 6
Miles

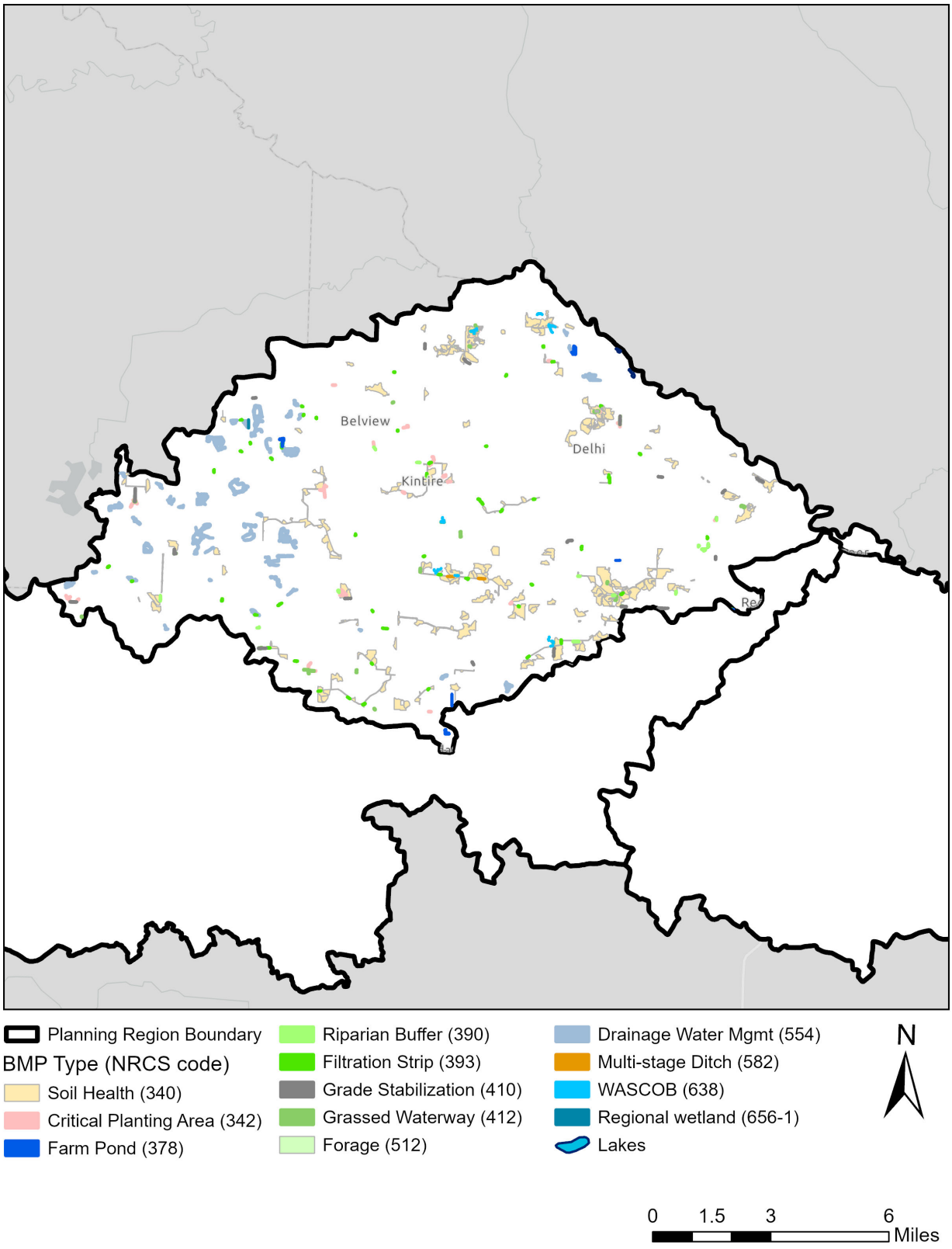
Redwood River Planning Region

BMP Treatment Group	Number of Practices	Total Cost ($)	Values at Catchment Outlet			Additional Water Storage (ac-ft)	BMP Surface Area (acres)
			Sediment Reduction (tons/yr.)	TP Reduction (lbs./yr.)	TN Reduction (lbs./yr.)		
378 - Farm pond/wetland	9	$43,130	649	267	5,744	49	1,054
554 - Drainage water management	78	$47,569	2,698	1,393	24,395	1,091	7,567
638 - WASCOB	12	$118,800	566	117	1,545	36	434
656_1 - Regional wetland	1	$14,001	14	4	107	1	24
390 - Riparian Buffer	22	$46,893	281	82	1,595	0	452
393 - Filtration Strip	74	$47,650	301	114	2,264	0	601
582 - Multi-stage Ditch	1	$8,670	35	2	74	0	19
342 - Critical Area Planting	29	$47,312	500	26	494	0	73
410 - Grade Stabilization	27	$108,000	487	16	306	0	45
412 - Grassed Waterway	26	$109,767	462	17	312	0	47
340 - Cover Crops	247	$774,423	7,866	1,170	23,662	0	5,163
Total:	526	$1,366,216	13,860	3,207	60,497	1,178	15,480


School
Grove Lake
Vesta
Seaforth
Milroy
Planning Region Boundary
BMP Type (NRCS code)
Soil Health (340)
Critical Planting Area (342)
Farm Pond (378)
Riparian Buffer (390)
Filtration Strip (393)
Grade Stabilization (410)
Grassed Waterway (412)
Forage (512)
Drainage Water Mgmt (554)
Multi-stage Ditch (582)
WASCOB (638)
Regional wetland (656-1)
Lakes
N
0 2 4 8
Miles

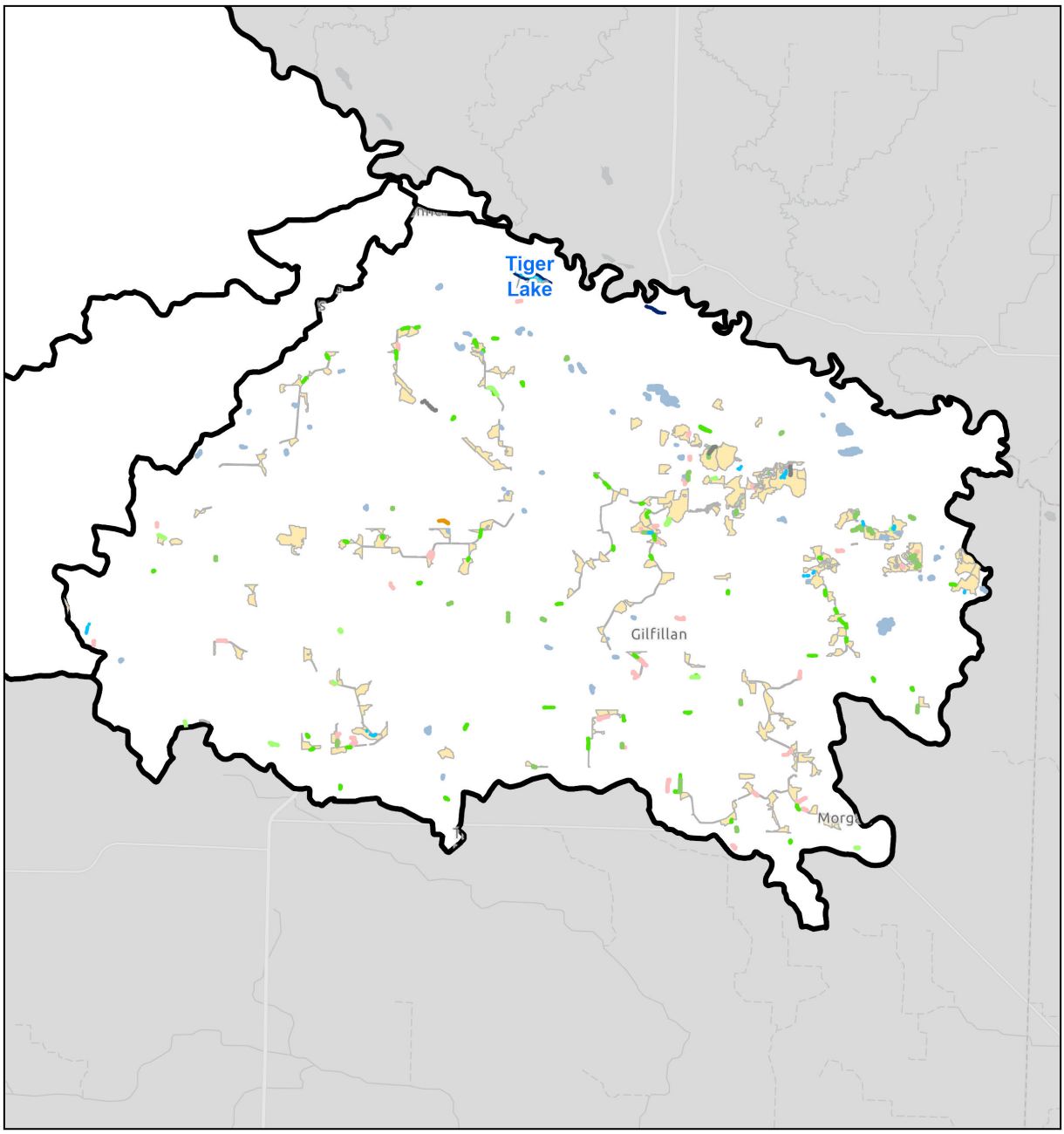
Ramsey Creek Planning Region

BMP Treatment Group	Number of Practices	Total Cost ($)	Values at Catchment Outlet			Additional Water Storage (ac-ft)	BMP Surface Area (acres)
			Sediment Reduction (tons/yr.)	TP Reduction (lbs./yr.)	TN Reduction (lbs./yr.)		
378 - Farm pond/wetland	5	$26,689	308	149	3,240	46	590
554 - Drainage water management	53	$32,298	2,790	1,523	26,123	845	8,461
638 - WASCOB	7	$69,300	331	66	904	21	245
656_1 - Regional wetland	1	$11,200	13	4	131	1	43
390 - Riparian Buffer	13	$30,027	220	50	1,044	0	266
393 - Filtration Strip	52	$31,126	213	70	1,496	0	387
582 - Multi-stage Ditch	2	$11,692	57	2	94	0	27
342 - Critical Area Planting	22	$30,014	195	16	316	0	46
410 - Grade Stabilization	18	$72,000	179	8	139	0	21
412 - Grassed Waterway	23	$73,428	180	12	200	0	31
340 - Cover Crops	141	$495,363	5,056	749	15,139	0	3,302
512 - Forage / Biomass Planting	35	$10,488	725	20	160	0	70
Total:	372	$893,627	10,269	2,668	48,986	913	13,488


Belview
Delhi
Kintire
Planning Region Boundary
BMP Type (NRCS code)
Soil Health (340)
Critical Planting Area (342)
Farm Pond (378)
Riparian Buffer (390)
Filtration Strip (393)
Grade Stabilization (410)
Grassed Waterway (412)
Forage (512)
Drainage Water Mgmt (554)
Multi-stage Ditch (582)
WASCOB (638)
Regional wetland (656-1)
Lakes
N
0
1.5
3
6
Miles

Wabasha Creek Planning Region

BMP Treatment Group	Number of Practices	Total Cost ($)	Values at Catchment Outlet			Additional Water Storage (ac-ft)	BMP Surface Area (acres)
			Sediment Reduction (tons/yr.)	TP Reduction (lbs./yr.)	TN Reduction (lbs./yr.)		
554 - Drainage water management	57	$34,736	493	169	3,004	81	920
638 - WASCOB	9	$89,100	436	78	1,151	30	299
390 - Riparian Buffer	11	$32,943	126	38	748	0	227
393 - Filtration Strip	58	$37,347	216	47	965	0	245
582 - Multi-stage Ditch	2	$11,692	24	2	88	0	26
342 - Critical Area Planting	36	$35,969	235	20	376	0	56
410 - Grade Stabilization	3	$12,000	9	1	21	0	3
412 - Grassed Waterway	24	$79,133	174	13	218	0	34
340 - Cover Crops	97	$423,119	5,322	640	12,935	0	2,821
512 - Forage / Biomass Planting	32	$12,957	811	25	198	0	86
Total:	329	$768,994	7,845	1,033	19,705	112	4,716


Tiger Lake
Gilfillan
Morgan
Planning Region Boundary
BMP Type (NRCS code)
Soil Health (340)
Critical Planting Area (342)
Farm Pond (378)
Riparian Buffer (390)
Filtration Strip (393)
Grade Stabilization (410)
Grassed Waterway (412)
Forage (512)
Drainage Water Mgmt (554)
Multi-stage Ditch (582)
WASCOB (638)
Regional wetland (656-1)
Lakes
N
0 1 2 4
Miles

Appendix I

Local Regulatory Comparison

Photo Credits: Minnesota River Valley National Scenic Byway, Lake Benton, and RCRCA

Local Regulatory Comparison

	Lincoln	Lyon	Murray	Pipestone	Redwood
Aquatic Invasive Species (AIS)	County	County	County	County	County
Buffers	County ordinance; SWCD compliance	County ordinance; SWCD compliance	County ordinance; SWCD compliance	County ordinance; SWCD compliance	County ordinance; SWCD compliance
Feedlots	Delegated County	Delegated County	Delegated County	Delegated County	MPCA
Floodplain management	County ordinance	County ordinance	County ordinance	County ordinance	County ordinance
Hazard Management	Multi-jurisdictional Hazard Mitigation Plan (2024)	County (All Hazard Mitigation Plan)	County (All Hazard Mitigation Plan)	County (All Hazard Mitigation Plan 2019)	County (All Hazard Mitigation Plan)
Shoreland Management	County ordinance	County ordinance	County ordinance	County ordinance	County ordinance
Public Drainage	County Board of Commissioners	County Planning & Zoning	County Board of Commissioners	County Board of Commissioners	County Board of Commissioners
Noxious Weeds	County ag inspector	County ag inspector	County ag inspector	County ag inspector	County ag inspector
Subsurface Sewage Treatment Systems (SSTS)	County ordinance	County ordinance	County ordinance	County ordinance	County ordinance
Solid Waste Management	County	County	County	County	County
Wetland Conservation Act (WCA)	SWCD	SWCD	SWCD	SWCD	SWCD

Appendix J

Local Funding Authorities

Photo Credits: Minnesota River Valley National Scenic Byway, Lake Benton, and RCRCA

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 *(please see details in the full text of each provision)*
§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 *(please see details in the full text of each provision)*
§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 *(please see details in the full text of each provision)*
		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.

Appendix K

Formal Review Comments

Photo Credits: Minnesota River Valley National Scenic Byway, Lake Benton, and RCRCA

Redwood River Comprehensive Watershed Management Plan

Formal Review Comments

#	Commenter	Section	Page	Paragraph	Comment	Editorial	Material	Note	Change Needed	Resolution
1	DNR	3	Page 3-7 –	Invasive Species.	The last two paragraphs on this page address aquatic invasive species, specifically noting that zebra mussels have not been observed in the in RRW. Please note that, as of 2024, zebra mussels have been observed in East Twin Lake. We suggest amending this section of the plan to denote that zebra mussels are present in the RRW.		X		Y	Added new AIS to plan narrative as recommended, with thanks
2	DNR	4	Pages 4-13	Bank Erosion	Landscape and climate changes in the RRW have resulted in significant alterations to runoff duration and peak discharge to local rivers and streams. The plan identifies development of storage areas to reduce impacts from high intensity peak flows, however, while large floods can create significant damage and erosion, changes in flow duration for frequent lower intensity events also represents high erosion potential for destabilization of channel bed and banks. Along these lines, we suggest mentioning changes in flow duration as well as peak flows as a part of conditions impacting channel erosion potential in these sections. The water storage goal described on page 4-11 will have a host of benefits for all events in the watershed hydrologic regime, including reducing peak flow reduction and moderating changes in duration for the moderate more frequently occurring flows, reducing erosion potential across the board. Bank erosion is a factor of flow, bank height, vegetative protection, and floodplain connectivity. Channels that are connected to their adjacent floodplains exhibit less bank erosion than those that contain flows within the channel. The bank erosion-specific goal of 2,000 linear feet of streambank can make sites more resilient to erosion, if properly implemented. While hard armoring (i.e. rip-rap) is a reasonable strategy to protect infrastructure, more natural approaches like toe wood can improve floodplain connectivity and instream habitat - woody debris plays a significant role in providing habitat for aquatic organisms.		X		Y	Added text about change in flow duration as recommended.
3	DNR	5	Page 5-6 –	Land Protection	Solar farms are listed as a consideration for Land Protection. While solar farms are a valuable source of renewable energy, the inclusion at this point in the tables appears to suggest that solar farms that are being placed on the land with temporary or permanent habitat easements, which may not be ideal sites for consideration of these facilities due to habitat considerations for native species and communities. We suggest adding a clarifying statement to ensure clarity that solar farms are not suggested for lands in permanent easement programs.		X		Y	Removed solar farm language in action. Added as an "Emerging Issue" using the Cottonwood-Middle Minnesota as the starting point. Statement added about potential for increased runoff coming form solar farms (cite MPCA) - native grasses are best to manage underneath. Also included language about waste / disposal.
4	DNR	5	Page 5-6 –	Stormwater Management Practices	If these projects are to be partnered with potential stream projects, please include DNR as a partner in the planning process		X		Y	DNR added as a partner for WW-10
5	DNR	5	Page 5-7 –	Watershed Education and Outreach	Please add DNR as a partner in the development of educational and outreach programs within the RRW. DNR staff can assist with these efforts.		X		Y	DNR added as a partner for EO-1
6	MDA	6	Page 6-5,	Table 6-1	Summary of ongoing water quality and quantity monitoring programs. • Under MDA, please add: GW (Groundwater) for Chlorides.		X		Y	Added GW for MDA
7	MDA	7	Page 7-6,	Table 7-3	Example funding sources for the RRW. • For MDA: Nutrient Management Initiative (NMI). Please include an indicator dot under the Education and Outreach column		X		Y	Indicator added

#	Commenter	Section	Page	Paragraph	Comment	Editorial	Material	Note	Change Needed	Resolution
8	MDA	General			The MDA maintains a variety of water quality and financial assistance programs including research, demonstration, as well as ground and surface water monitoring. Our goal is to provide you with information from each program to help address resource concerns and further engage the agricultural community during implementation efforts. Please refer to the MDA's priority concerns letter for more information on programs that may be of assistance in the future.			X	N	Comment noted, with thanks.
9	MDH	General			The Minnesota Department of Health (MDH) Source Water Protection Unit appreciates the opportunity to review the draft Redwood Watershed One Watershed One Plan (1W1P). MDH appreciates the plan partners for including groundwater and drinking water in the plan. Thank you for allowing MDH the opportunity to be part of the steering and advisory committees and for incorporating our ideas and suggestions into the draft plan. The comments and suggestions MDH provided during plan development have been addressed and there are no further comments.			X	N	Comment noted, with thanks.
10	MPCA	General			The Minnesota Pollution Control Agency (MPCA) appreciates the opportunity to participate and provide input throughout the Redwood Middle Minnesota (RWMM) Final Comprehensive Watershed Management (RWMP) Plan (Plan) development process for the RWMM Planning Area. Overall, the Plan is very well written, concise, and thorough. We have no comments as part of the official 30-Day (90-day) Review and Comment Period and recommend it for approval.			X	N	Comment noted, with thanks.
11	BWSR				We appreciate the group's efforts to include BWSR comments and make changes when suggested. Also, the list of appendices in the table of content makes them easy to find.			X	N	Comment noted, with thanks.
12	BWSR	1			Covers all BWSR requirements outlining the process on how the group has gotten to this point of the planning process along with issues, goals, targeted actions, and implementation. Mission statement isn't present but purpose is covered within the executive summary			X	N	Comment noted, with thanks.
13	BWSR	2			Covers BWSR requirements and is clear and concise. Easy to read and follow.			X	N	Comment noted, with thanks.
14	BWSR	3			Covers BWSR requirements, Table 3-1 & 3-2 make this user friendly.			X	N	Comment noted, with thanks.
15	BWSR	4			Covers BWSR requirements, including stacked benefits and focus maps makes this section easy to measure, show, and report successful achievements within the implementation of the plan.			X	N	Comment noted, with thanks.
16	BWSR	5			Covers BWSR requirements, the use of targeted practices both watershed wide and per region, along with the action tables on pages 5-6 through 5-8 make this a working section of the plan that includes targeting and funding sources.			X	N	Comment noted, with thanks.
17	BWSR	6	6-9		Public Drainage Sysyems: Remove LGU and county and add Drainage Authority, also it is the benefited landowners of the system not the entire county.		X		Y	Replaced LGU and County with drainage authority
18	BWSR	7	7-7		climate resiliency, MPCA has climate-planning grants for communities to improve stormwater or wastewater system resilience, reduce flood risk, and adapt community services, ordinances, or spaces. These grants directly connect to Water Storage and Flooding and Stormwater goal and actions.			X	Y	This grant is included as written with language that grants are available at the time plan was written and are subject to change.