Washington County, Minnesota

Groundwater Plan

2025-2035

Washington County

Acknowledgments

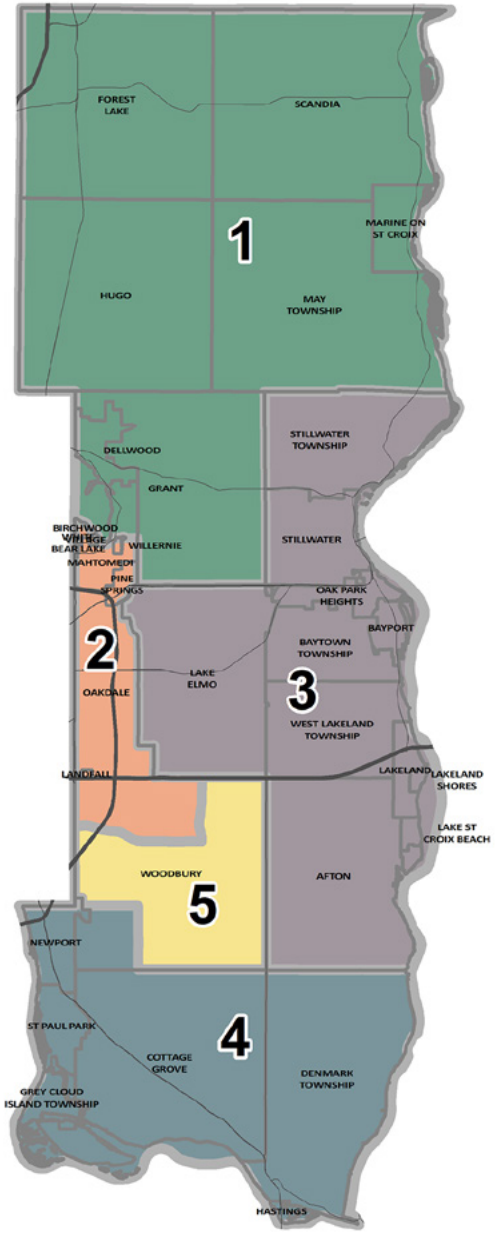

Figure 1. Washington County Commissioner Districts Map

2023 and 2024 Washington County Board of Commissioners

Washington County, MN

District 1 – Fran Miron

District 2 – Stan Karwoski

District 3 – Gary Kriesel

District 4 – Karla Bigham

District 5 – Michelle Clasen

Design: Washington County Staff – Georgia Eilertson, Jacqueline Johnson

Photography: Brain Kaufenberg

Written by: Washington County Department of Public Health & Environment with input from the Groundwater Advisory and Technical Advisory Committees and the Washington County Board of Commissioners.

The Washington County Groundwater Plan 2025 – 2035 was approved by the Minnesota Board of Water and Soil Resources on **XXXXX** and adopted by the Washington County Board of Commissioners on **XXXXX**.

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Groundwater Plan
Table of Contents

Groundwater Plan

Table of Contents: Figures

Groundwater Plan

Table of Contents: Tables

* Tables marked with as asterisk represent ‘Table Groups.’ Table groups are multiple tables under the same title & heading and are located across multiple pages.

Groundwater
Advisory Committee

Amanda Meyer, Municipal- Cottage Grove
Bob Fossum, Citizen
Brian Johnson, Watershed- South Washington WD
Brian Krafthefer, Citizen
Brian Zeller, Watershed- Middle St. Croix WMO
Chris Peltier, Construction
Dan Belka, Citizen
Dave Schulenberg, Well Drilling †
Elden Lamprecht, Agriculture
Erik Nimlos, Hydrogeologist
Fran Miron, Commissioner District 1
Howard Markus, Citizen
Jeff Thron, Well Drilling †
Jim Westerman, Municipal- Woodbury
Kristin Tuenge, Watershed- Carnelian-Marine-St. Croix WD
Liz Finnegan, Municipal- Hugo
Wendy Ward, Municipal- Marine on St. Croix

† Part way through the planning process the well drilling representative changed

Technical
Advisory Committee

Abby Shea, Minnesota Department of Health	John Hanson, Valley Branch Watershed District
Adriana Atcheson, Washington County Public Health and Environment	John Loomis, South Washington Watershed District
Angela Defenbaugh, Washington Conservation District	Karen Kill, Brown's Creek Watershed District
Angie Hong, East Metro Water Resources Education Program	Kim Kaiser, Minnesota Department of Agriculture
Ann White Eagle, Ramsey County	Matt Downing, Middle St. Croix Water Management Organization
Anneka Munsell, Minnesota Department of Health	Matt Moore, South Washington Watershed District
Caleb Johnson, Washington County Public Health and Environment	Michelle Jordan, Board of Water and Soil Resources
Dan MacSwain, Washington County Parks	Mike Isensee, Carnelian-Marine-St. Croix Watershed District
Daniel Elder, Washington County Public Works	Mike Kinney, Comfort Lake-Forest Lake Watershed District
David Brummel, Washington County Public Health and Environment	Nick Tomczik, Rice Creek Watershed District
Emily Berquist, Minnesota Department of Health	Nicole Maras, Ramsey Washington Metro Watershed District
Eric Alms, Minnesota Pollution Control Agency	Patrick Sarafolean, Minnesota Department of Health
Gary Bruns, Washington County Public Health and Environment	Rebecca Higgins, Minnesota Pollution Control Agency
Georgia Eilertson, Washington County Public Health and Environment	Serena Raths, Washington County Administration
James Noyola, Washington County Public Health and Environment	Sharon Kroening, Minnesota Pollution Control Agency
Jay Riggs, Washington Conservation District	Smita Rakshit, Washington County Public Health and Environment
Jen Kader, Metropolitan Council	Stephanie Souter, Washington County Public Health and Environment
Jessica Collin-Pilarski, Washington County Public Health and Environment	Susanna Wilson Witkowski, Chisago County
Joe Richter, Minnesota Department of Natural Resources	Valerie Neppl, Dakota County

Key to Acronyms

BMP	Best Management Practice
BWSR	Board of Water & Soil Resources
DNR	Minnesota Department of Natural Resources
DWAMP	Drinking Water Ambient Monitoring Program
EAW	Environmental Assessment Worksheet
EIS	Environmental Impact Statement
GIS	Geographic Information Systems
GWAC	Groundwater Advisory Committee
HBV	Health Based Value
HHW	Household Hazardous Waste
IBP	Industrial By-Product
IWMZ	Inner Wellhead Management Zone
LGU	Local Government Unit
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MGS	Minnesota Geological Survey
MPCA	Minnesota Pollution Control Agency
MSW	Mixed Municipal Soild Waste
MUSA	Metropolitan Urban Service Area
NRCS	Natural Resource Conservation Service
NPEAP	Non-Point Engineering Assistance Program
PFAS	Per- and Polyfluoroalkyl Substances
PHE	Washington County Public Health and Environment
PWS	Public Water Suppliers
RCRA	Resource Conservation & Recovery Act
RO	Reverse Osmosis
SCWRS	St. Croix Watershed Research Station
SSTS	Subsurface Sewage Treatment System
STATE	State Government (unspecified)
SWCD	Soil & Water Conservation District
TAC	Technical Advisory Committee
TCE	Trichloroethylene
TMDL	Total Maximum Daily Load
U of M	University of Minnesota
VOC	Volatile Organic Compounds
WCA	Wetland Conservation Act
WCD	Washington Conservation District
WHPP	Wellhead Protection Plan
WMO	Watershed Management Organization

Executive Summary

Washington County (county) prioritizes water as one of its most valuable resources. The county relies solely on groundwater for drinking water and is home to many high-quality lakes and streams that depend on clean and plentiful groundwater. It also shares the border of the federally designated 'Wild and Scenic River' and the state designated 'Outstanding Resource Water' - the St. Croix River- with Wisconsin.

Having a county adopted Groundwater Plan (plan), is one way the county works to protect groundwater. Minnesota Statute §103B.255, Metropolitan Groundwater Management, enables a metro county government to prepare and adopt a groundwater plan. Washington County wrote its first groundwater plan in 1992; however, the County Board first formally adopted a Plan in 2003. A second-generation plan was adopted in 2014. This plan serves as the county's third generation plan. The Plan spans a ten-year period from the date of approval by the Board of Water and Soil Resources (BWSR), on behalf of the State of Minnesota.

The purpose of preparing, adopting, and implementing a Plan is to provide a county-wide structure for the protection and conservation of groundwater resources. The Plan is a comprehensive document that lays out the vision, goals, strategies, and actions to address existing and future groundwater related problems. Throughout the development of this plan the county strived to integrate Diversity, Equity, and Inclusion (DEI), and climate and environmental justice into its actions.

The quantity and quality of groundwater in the county is threatened by climate and human impacts. Quality issues include groundwater contamination, such as Per- and polyfluoroalkyl substances (PFAS) and Volatile Organic Compounds (VOCs) from industry practices, and nitrates, pesticides, and chlorides from various land use practices. Quantity of groundwater is affected by how much is pumped out of the ground for human use and climate impacts.

The county's vision over the next ten years is:

"We envision a future where there is plenty of clean water in Washington County to support human health, community growth, and a thriving natural environment."

With the following goals:

- **Groundwater Quality:** Groundwater is safe to drink.
- **Groundwater Quantity:** Groundwater is plentiful to support human needs and a thriving natural environment.
- **Groundwater Education:** People who live and work in Washington County understand the importance of groundwater and adopt practices and behaviors that conserve and protect groundwater.
- **Groundwater Governance:** Groundwater management is coordinated, efficient, and effective.

The county developed an implementation framework to guide groundwater work for the next ten years. The framework consists of many strategies and actions the county and its partners will implement to achieve the above goals and work toward the plan vision. The framework is designed to be prioritized, targeted, and measurable.

Chapter 1. Introduction and Plan Overview

1.1 Vision

Groundwater is one of Washington County's (county) most valuable resources. Clean and abundant groundwater is necessary to sustain a healthy population, protect natural resources, and continue economic growth. The county's vision for this Groundwater Plan (Plan) is:

"We envision a future where there is plenty of clean water in Washington County to support human health, community growth, and a thriving natural environment."

1.2 Diversity, Equity, and Inclusion Statement

Diversity, equity, and inclusion (DEI) and climate and environmental justice are issues that were reflected throughout the Public Health and Environment (PHE) strategic planning process, as well as the countywide strategic plan.

We carry the county's commitment to a vibrant workplace and community that practices engagement, representation, and service to all members inclusively and equitably. This includes providing targeted services and advocacy for vulnerable populations who have and continue to face environmental justice issues in Washington County. We acknowledge that stressors related to global climate change will not fall proportionally amongst our community members.

PHE recognizes the impact these topics have across all programs and services, and we are committed to integrating them into all aspects of our work, including the areas impacted by and intersecting with the Groundwater Plan.

1.3 Context

There are many competing interests for the use of groundwater. The two main uses are for humans and natural ecosystems, including streams, lakes, and wetlands. Currently, groundwater provides 100% of the water supply in the county.

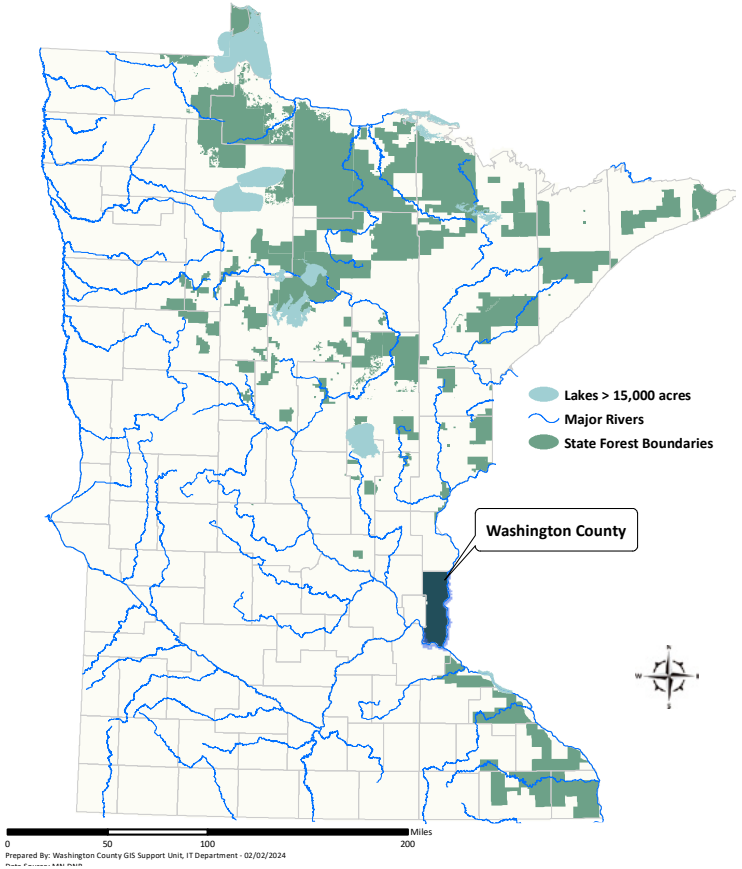


Figure 2. Location of Washington County, Minnesota Map

Human use affects how much, or the quantity, of groundwater that is available for natural resources. Contamination, or groundwater quality, is another factor that affects the amount of groundwater that is available for both human use and natural resources.

Population growth affects groundwater quantity. The current estimated population in the county is 278,936. In the last 10 years the county has added about 32,300 residents, a 13% increase. This growth, along with population projections of 335,272 by 2050, will continue the increased demand on groundwater. (See population and land use chapter for more information).

The county is impacted by known groundwater contamination from Per- and polyfluoroalkyl substances (PFAS), Volatile Organic Compounds (VOCs), nitrates, and other substances. The presence of these contaminants decreases the amount of clean drinking water available without costly treatment.

The purpose of preparing, adopting, and implementing a Plan is to provide a county-wide structure for the protection and conservation of groundwater resources. The Plan is a comprehensive document that lays out the vision, goals, strategies, and actions to address existing and future groundwater related problems.

1.4 Authority

Minnesota Statute §103B.255, Metropolitan Groundwater Management, enables a metro county government to prepare and adopt a groundwater

Table 1. Minnesota Statute §103B.255, Subd. 7 Contents and Locations in Washington County Groundwater Plan

§103B.255, Subd. 7	Content Requirement	Plan Chapter
(1)	cover the entire area within the county;	Chapter 1: Introduction and Plan Overview
(2)	describe existing and expected changes to the physical environment, land use, and development in the county;	Chapter 4: Resource Overview
(3)	summarize available information about the groundwater and related resources in the county, including existing and potential distribution, availability, quality, and use;	Chapter 4: Resource Overview Chapter 6: Quality Chapter 7: Quantity
(4)	state the goals, objectives, scope, and priorities of groundwater protection in the county;	Chapter 1: Introduction and Plan Overview Chapter 2: Plan Implementation
(5)	contain standards, criteria, and guidelines for the protection of groundwater from pollution and for various types of land uses in environmentally sensitive areas, critical areas, or previously contaminated areas;	Chapter 2: Plan Implementation Chapter 6: Quality
(6)	describe relationships and possible conflicts between the groundwater plan and the plans of other counties, local government units, and watershed management organizations in the affected groundwater system;	Chapter 1: Introduction and Plan Overview Chapter 3: Governance, Roles, Responsibilities
(7)	set forth standards, guidelines, and official controls for implementation of the plan by watershed management organizations and local units of government; and	Chapter 2: Plan Implementation Chapter 3: Governance, Roles, Responsibilities
(8)	include procedures and timelines for amending the groundwater plan.	Chapter 1: Introduction and Plan Overview

plan. The county wrote its first groundwater plan in 1992; however, the County Board first formally adopted a Plan in 2003. A second-generation plan was adopted in 2014. The requirements listed in statute and their location in the Plan are listed in Table 1.

The Groundwater Plan is also guided by a number of Minnesota Statutes, such as §103H, Groundwater Protection; §103G, Waters of the State; §103I, Wells, Borings, and Underground Uses; and §115.55, Subsurface Sewage Treatment Systems. The Groundwater Plan will support the goals of the State expressed in these statutes: that groundwater be maintained in its natural condition, free from any degradation caused by human activities, to the extent practicable (MN Statute §103H.001); and to protect health and general welfare by providing a means for the development and protection of the natural resource of groundwater in an orderly, healthful, and reasonable manner (MN Statute §103I.001). Groundwater use is sustainable if it will supply the needs of future generations and will not harm ecosystems, degrade water, or reduce water levels beyond the reach of public water supply and private domestic wells (MN Statute §103G.287).

1.5 Alignment with Other Plans

The Groundwater Plan is aligned with other county Plans such as the Strategic Plan 2024-2029, County Comprehensive Plan 2040, and Solid Waste Management Plan 2024-2030. See Chapter 3 for a description of plans developed by other jurisdictions that align with the Groundwater Plan.

Washington County Strategic Plan 2024-2029

In August 2024, the County Board adopted the Strategic Plan with four strategic priorities. Each priority has a goal and several objectives to achieve that goal. The following strategic priority and associated objectives align with the Groundwater Plan.

Strategic Priority: Strong and Sustainable Environment

Goal: Enhance and maintain investments in the built and natural environment to encourage growth, accessibility, and resilient communities.

Objective E: Develop and implement climate change strategies and policies to improve community resiliency and sustainability of natural resources.

Objective F: Partner with state and local agencies to lead or support efforts to provide clean surface and groundwater of adequate supply to support human health, community growth, and a thriving natural environment.

Washington County Comprehensive Plan 2040

Goals, policies, and strategies around groundwater protection are also recognized in the Washington County Comprehensive Plan 2040. The county recognized that groundwater and surface water are one of its most valuable natural resources. High quality drinking water, healthy streams and lakes, fish habitat, rare plants, and economic vitality all depend on protecting and conserving water resources.

To guide future decision making and county actions, goals, policies, and strategies have been developed specific to the water resources element. Two water resources goals were identified in the Comprehensive Plan 2040, with corresponding policies and strategies. The goals are as follows:

Water Resources Goal 1: Manage the quality and quantity of water resources to protect human health and ensure sufficient supplies of clean water to support human uses and natural ecosystems for current and future generations.

Water Resources Goal 2: Protect groundwater and surface water resources through coordination and collaboration with state and local water resource organizations.

A 2050 Comprehensive Plan update will occur during the 10-year cycle of this Plan.

Solid Waste Management Plan 2024-2042

PHE is also in the process of updating the Solid Waste Management Plan in 2024. The Groundwater Plan supports the work of the Solid Waste Management Plan to implement activities for an integrated solid waste management system that are protective of groundwater. This includes, but is not limited to:

1. Provide technical assistance and education on proper storage and disposal of hazardous waste. Provide information on less toxic/hazardous alternatives and best practices to minimize or eliminate toxic materials used.
2. Evaluate and prioritize compliance activities for hazardous waste generators located in sensitive geologic or wellhead protection areas.
3. Evaluate the need for a solid waste and household hazardous waste/ agricultural chemical management assistance program.
4. Explore options to identify when and where movement of contaminated soil is occurring and evaluate a process to monitor this activity under existing solid and hazardous waste regulations.

1.6 Scope and Plan Period

The Groundwater Plan addresses groundwater conditions throughout the entirety of the county. The Plan spans a ten-year period from the date of approval by the Board of Water and Soil Resources (BWSR), on behalf of the State of Minnesota.

1.7 Planning Process

The Washington County Board of Commissioners sets policy direction for the county and has responsibility for adopting the plan. The process began in June 2023 with a board workshop to review the current plan, seek direction on development of a new plan, and identify high level issues. Partner and public engagement, detailed in the next section, followed the initial board workshop. The strategies identified in this Groundwater Plan draft were presented at a County Board workshop in August 2024. After incorporating their feedback, the draft was sent to Groundwater Advisory Committee (GWAC) and Technical Advisory Committee (TAC) for review.

The county followed the appropriate review process of the draft Groundwater Plan identified in State Statute §103.255, Subd.8. The county submitted the draft Plan for a 60-day review and comment period to the adjoining counties, the Metropolitan Council, the State review agencies, BWSR, the Washington Conservation District (WCD), the cities, townships, tribal nations, and watershed management organizations within the county. The county held a public hearing on the draft Groundwater Plan after the 60-day public review period, which was no sooner than 30 days and no later than 45 days. After completion of the review and revisions, the draft Groundwater Plan, all written comments received on the Groundwater Plan, a record of the public hearing, and a summary of changes incorporated as part of the review process were

submitted to the Metropolitan Council, the state review agencies, and BWSR for final review and approval.

1.8 Partner and Public Engagement

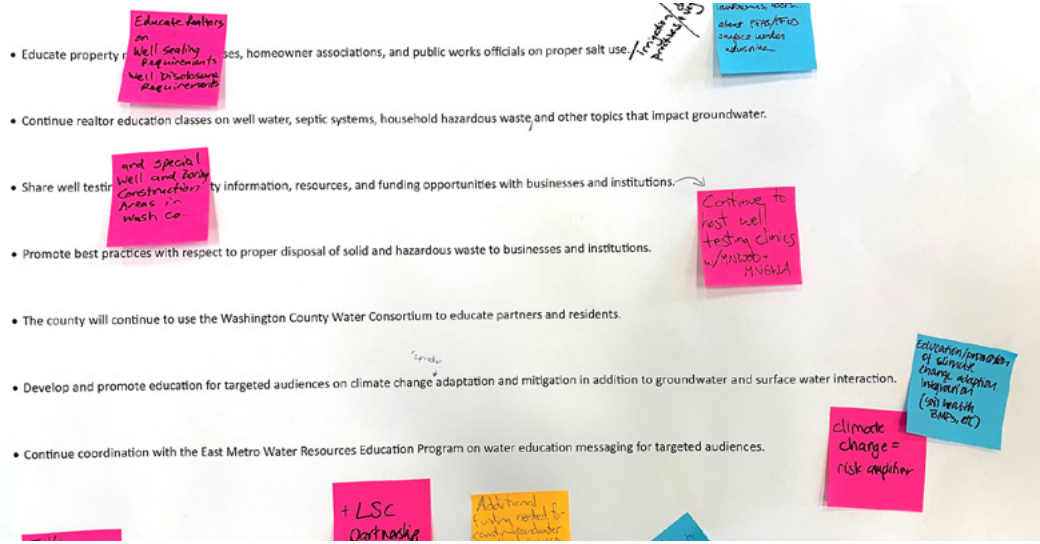
Partner Engagement

To develop the plan the County Commissioners appoints and maintains a GWAC, as required in Minnesota Statute 103B.255. The statute defines representatives of various interests.

The GWAC members represent the perspectives of citizens, rural and urban Local Government Units (LGUs), Watershed Management Organizations (WMOs), construction, well drilling, agriculture, and hydrology professionals. The GWAC consists of 15 members to represent all the required interests identified in the statute. The list of members can be found on page v.

In addition, a Technical Advisory Committee (TAC) was convened to represent the additional groundwater partner interests. The TAC included a representative from BWSR, one representative from each of the 8 WMOs in the county, Chisago County, Dakota County, East Metro Water Resources Education Program (EMWREP), Metropolitan Council, Minnesota Department of Agriculture (MDA), Minnesota Department of Health (MDH), Minnesota Department of Natural Resources (DNR), Minnesota Pollution Control Agency (MPCA), Ramsey County, WCD, Washington County Administration, Washington County PHE, and Washington County Public Works. The GWAC and the TAC helped create the foundation for the Plan.

Staff convened three meetings to bring together the members of the GWAC and TAC on September 28th, 2023, December 18th, 2023, and April 3rd, 2024. The first meeting focused on strategies and actions around groundwater quality and the second meeting focused on strategies and actions around groundwater quantity. In the third meeting, the members of the GWAC and



TAC had the opportunity to review the summary of strategies and actions developed during the first two meetings, as well as strategies and actions around education and governance. The Metropolitan Council was conducting a parallel planning process for their Metro Area Water Supply Plan, and Water Policy Plan, which engaged many of the same partners, over a similar period. County staff worked with the Metropolitan Council staff to obtain the feedback and ideas generated at those meetings and used those to also inform the development of Groundwater Plan actions.

The Plan's partner engagement approach brought together multiple viewpoints and varied opinions that were used to inform decisions and identify key strategies and actions. The process has helped connect county staff with new collaborators and foster relationships with existing partners. The county's engagement process emphasized visibility, transparency of the process, and appreciation of different points-of-view.

Public Engagement

Resident Survey 2022

The county conducts a regular, periodic survey of residents' opinions to understand their needs- with trends going back to 2001. Through this survey, county residents have an opportunity to provide feedback about what is working well and what is not, and to share their priorities for community planning and resource allocation. The most recent iteration of the survey occurred in 2022. The survey was mailed to 3,000 randomly selected households, distributed equally among the five County Commissioner Districts.

With a 22% response rate, 648 surveys were completed. To make the survey results comparable to other years and other jurisdictions, the ratings were converted to average scores on a 100-point scale, where zero is the worst possible rating and 100 is the best possible rating.

Similar to past Resident Surveys, the 2022 survey asked about potential environmental issues and asked how much of a concern, if at all, each was in the county. The quality of drinking water and the quality of water in lakes and streams were rated of highest concern to residents. Results of the survey showed that residents are moderately concerned with these issues, with average scores between 57 and 59.

Table 2. Average Ratings of Environmental Concerns by Year, Resident Survey

Please rate to what degree, if at all, each of the following is an environmental concern in Washington County. Average rating (0=not at all a concern, 100=major concern

Environmental concern	2022	2019	2016	2013	2008	2006	2001
Quality of drinking water	59	57	41	46	54	47	NA
Quality of water in lakes and streams	57	57	48	55	55	53	NA
Energy use	51	48	NA	NA	NA	NA	NA
Climate change	50	51	NA	NA	NA	NA	NA
Quantity of useable water supply	50	50	40	NA	NA	NA	NA
Exposure to radon	38	40	NA	NA	NA	NA	NA
Lack of recycling	35	40	NA	NA	NA	NA	NA
Yard waste disposal	33	NA	NA	NA	NA	NA	NA
Quality of outdoor air	31	32	28	30	37	37	NA
Proper disposal of garbage	31	31	23	29	38	40	NA
Safety of food in public establishments	28	27	28	34	37	36	NA

Environmental Planning Survey 2023

PHE administered an Environmental Planning Survey in 2023, to inform planning for the groundwater and solid waste programs. The survey was open from August to October of 2023. The survey consisted of 16 questions focused on environmental planning. The survey was distributed in the August edition of 'Staying in Touch'- the quarterly, printed newsletter mailed to all residential properties in the county. Residents could scan a QR code with their mobile devices and take the survey online. The survey was available in English, Spanish, Hmong, and Somali languages. Paper copies of the survey were also shared with partner agencies such as the Washington County Community Development Agency, Recycling Coordinators, the Washington Conservation District to distribute at their workshops, at the Washington County fair booths, and at the Well Water Screening Clinic in September 2023. A total of 569 residents responded to the survey. Among them, 560 were in English and 9 in Spanish.

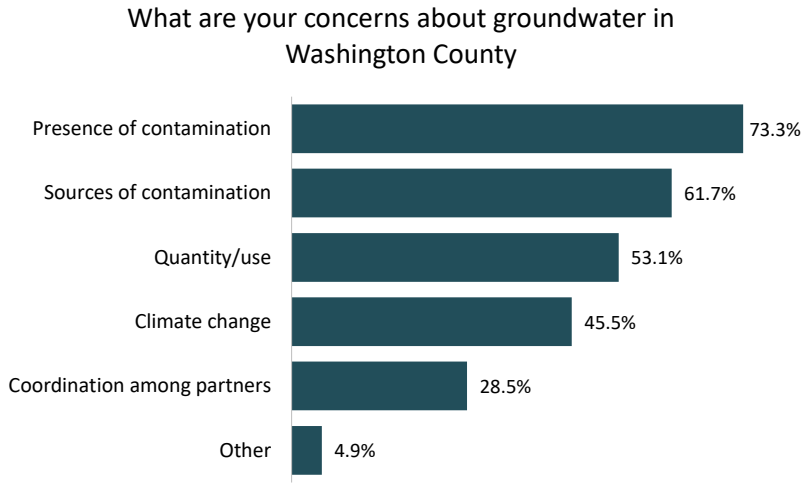


Figure 3. Groundwater Concerns Bar Chart

The survey included 3 questions around groundwater:

- Do you know where your drinking water comes from?
- What are your concerns about groundwater in Washington County?
- How can Washington County, and our state and local partners, help address groundwater concerns?

Most of the respondents (62%) knew that their drinking water comes from groundwater. The two largest concerns were the presence of contamination and sources of contamination, followed by quantity/use, climate change, and coordination among partners.

Respondents could write in their answer in the 'Other (please specify)' option. Below are the comments we received:

- Reverse Osmosis filters for all, not just those who can afford them, and offer discounts
- Pause and slow down new development
- Chlorides and road salt
- Keep business and agricultural waste out of water and restrict use
- Communicate actions that are being taken to protect residents
- Give residents better guidance on PFAS to protect ourselves and be transparent about what's in the water
- Enforce water restrictions
- Stop treating lawns with chemicals and fertilizers
- Switch to surface water
- Make water testing more convenient and less expensive

For the question on how the county, and the State and local partners can help address groundwater concerns, there were six themes:

- Ensuring frequent monitoring and accessibility of at home testing kits
- Regular, transparent, and honest communication to the public on water analysis
- Enforce/mandate rules, laws, and ordinances on lawn watering and fertilizer use for all residence, business, and agriculture
- Easily accessible education, and intentionally educate community about the concerns, and proper disposal of chemicals
- Free or reduced cost of in-home water filtration (e.g., reverse osmosis)
- Be transparent about PFAS and communicate what can be done so we are drinking safe water

From the survey responses, it is evident that county residents are aware of existing groundwater issues and would like the county to continue efforts to protect it.

1.9 Plan Amendment Process

The Plan is intended to cover a ten-year period beginning with its date of approval by BWSR. The county intends to prepare an annual report to track accomplishments. The county may also review the Plan after any significant State, Regional, or County Plan updates to ensure consistency with guiding documents and address changing circumstances, as needed. The county may prepare proposed amendments to the Plan at any time during this period. Amendments may be a result of changed conditions, completion of other complementary plans that were identified in this Plan, or other possible circumstances.

The county shall prepare proposed amendments updating the Plan and give notice of the proposed Plan amendments before the end of any calendar year. Notice of a public hearing on proposed Plan amendments and a description of the amendments shall be published by the county in at least one legal newspaper in the county. Publication shall occur at least ten days before the hearing. Notice shall also be mailed at least 30 days before the hearing to all the towns, and statutory and home rule charter cities having territory within the county, to the Metropolitan Council, WMOs, DNR, MPCA, MDH, and BWSR.

At the hearing the county shall solicit comments on the proposed Plan amendments. Any person may submit a request to BWSR not later than ten days following the close of the hearing, asking that the proposed Plan amendments be reviewed in accordance with the provisions of section 103B.255, subdivisions 8, 9, and 10.

The county shall not adopt any proposed Plan amendments before BWSR has decided whether the amendment is in accordance with provisions of

section 103B.255, subdivisions 8, 9, and 10. If BWSR has not made a decision within 45 days of the close of the hearing, unless the county agrees to a time extension, review in accordance with the provisions found in section 103B.255, subdivisions 8, 9, and 10 shall not be required.

Chapter 2. Plan Implementation

2.1 Implementation Framework

The county developed an implementation framework to guide groundwater work for the next ten years. The framework is designed to be prioritized, targeted, and measurable. The framework begins with the plan vision and the following goals to support it:

- **Groundwater Quality:** Groundwater is safe to drink.
- **Groundwater Quantity:** Groundwater is plentiful to support human needs and a thriving natural environment.
- **Groundwater Education:** People who live and work in Washington County understand the importance of groundwater and adopt practices and behaviors that conserve and protect groundwater.
- **Groundwater Governance:** Groundwater management is coordinated, efficient, and effective.

To work toward achieving these goals the GWAC and TAC assisted in developing strategies and actions. Each strategy is prioritized as low, medium, or high. Prioritization helps PHE determine what to focus on first and can shift depending on the timeliness of an issue, willingness of partners, and availability of funding. Below are the strategies and their prioritization.

Table Group 3. Groundwater Plan Goal & Strategy Tables

Goal #1: Groundwater Quality: Groundwater is safe to drink.

Strategy A.	Participate in PFAS activities led by state agencies and communicate with residents.	Priority: High
Strategy B.	Assist private well owners in having their drinking water sampled, abandoned wells sealed, and using appropriate water treatments.	Priority: High
Strategy C.	Collaborate with relevant partners (e.g. MDH, DNR, Met Council, etc.) and Water Suppliers to protect their water supply.	Priority: Medium
Strategy D.	Reduce agriculture related groundwater contamination.	Priority: Medium
Strategy E.	Reduce groundwater contamination from chloride.	Priority: Medium
Strategy F.	Prevent pollution by minimizing wastewater impacts on groundwater quality.	Priority: Medium
Strategy G.	Address pollution potential from industrial operations, mining, and historically contaminated sites.	Priority: Low
Strategy H.	Continue a land spreading program that is protective of groundwater.	Priority: Low
Strategy I.	Manage stormwater to prevent groundwater pollution.	Priority: Medium

Goal #2: Groundwater Quantity: Groundwater is plentiful to support human needs and a thriving natural environment.

Strategy A.	Expand understanding of groundwater and surface water connection in the county.	Priority: Medium
Strategy B.	Promote and implement water conservation and efficiency efforts.	Priority: High
Strategy C.	Support stormwater retention, infiltration and opportunities to replenish aquifer storage.	Priority: Low

Strategy D.	Protect, preserve, and restore resources that support groundwater dependent ecosystems.	Priority: Medium
Strategy E.	Support and encourage safe and feasible water reuse.	Priority: Medium
Strategy F.	Regularly update and share water quantity related data.	Priority: Medium

Goal #3: Groundwater Education: People who live and work in Washington County understand the importance of protecting groundwater, how to conserve water and use it efficiently, and prevent contamination.

Strategy A.	Inform and educate targeted audiences (e.g. well and septic owners, business, property managers, etc.), and encourage adoption of practices that are protective of groundwater quality and quantity.	Priority: High
Strategy B.	Inform and educate residents and encourage adoption of practices that are protective of groundwater quality and quantity.	Priority: Medium

Goal #4: Groundwater Governance: Groundwater management is coordinated, efficient, and effective.

Strategy A.	Collaborate with all levels of government.	Priority: Medium
Strategy B.	Support and create regulations and policies that improve and protect groundwater quality and quantity.	Priority: High
Strategy C.	Advocate for more funds to support access to safe drinking water for all residents.	Priority: High
Strategy D.	Support and create county programs which improve and prioritize groundwater protection.	Priority: Medium

For each strategy there are actions to implement. The implementation tables are listed below and organized by goal, then strategy, and actions. For each action the following is identified:

- ***Action No.*** – Is a reference number for each action
- ***Action*** – The activity to take place
- ***Activity*** – Identifies if the activity is something to continue, new, or does it need to be expanded or modified
- ***Role*** – Identifies if the county's role for the action is to partner, regulate, educate, fund, advocate for, or operate
- ***Target*** – Who is the target audience
- ***Timeframe*** – When will the action be implemented over the ten years
- ***External Partners*** – Who are the partners the county will work with on the action
- ***Measure*** – What is the measure to determine if the action is effective

There are many state and local agencies that are involved in groundwater work (described in Chapter 3). The users of this Plan will include state agencies, regional organizations, the county, LGUs, WMOs, and interested residents. PHE will provide overall leadership, coordination, and annual review for implementing the Plan, but it will take the coordinated efforts of all partners to carry it out.

2.2 Implementation Tables for Groundwater Quality, Quantity, Education, and Governance

Table Group 4. Groundwater Quality Plan Implementation Tables
Goal #1: Groundwater is safe to drink.

A. Strategy: Participate in PFAS activities led by state agencies and communicate with residents. (Priority: High)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
1.A.1	Assist residents in connecting with PFAS information and resources provided by state agencies and public water suppliers, and monitor state response for potential gaps related to PFAS testing and lab access.	Continue	Advocate	Residents	Ongoing	MDH LGUs PWSs	# of residents referred Update website quarterly
1.A.2	Monitor and participate in MPCA PFAS Blueprint activities and communicate activities to the public.	Continue	Advocate	Businesses and residents	Ongoing	MDH LGUs	# of activities participated in
1.A.3	Participate in 3M Settlement activities.	Continue	Partner	Businesses and residents	Ongoing	LGUs State Agencies	# of activities participated in
1.A.4	Partner with the state to provide technical assistance and support for licensed Non-community Transient Public Water Suppliers with PFAS detections.	New	Partner	Licensed Non-community Transient Public Water Suppliers	Ongoing	State Agencies Non-comm. Trans. PWSs	# of Non-community Transient PWSs assisted
1.A.5	Assess role in providing PFAS testing for non-residential wells such as, but not limited to, the county's licensed Non-community Transient Public Water Suppliers.	New	Regulate	Owners of non-residential wells	Ongoing	MDH	Role is assessed
1.A.7	Monitor and advocate for research and studies (e.g. biomonitoring, additional surveillance) on health effects from PFAS and other contaminants	Continue	Partner	Residents	Ongoing	MDH Health systems	# of studies

B. Strategy: Assist private well owners in having their drinking water sampled, abandoned wells sealed, and using appropriate water treatments. (Priority: High)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
1.B.1	Review existing well testing and location information for the following, to inform targeted implementation actions. • Vulnerable populations and their access to safe drinking water, including renters. • Potential hot spots or contamination areas such as nitrates, pesticides, manganese, arsenic, and others in the county. • Flood prone areas.	New	Lead	Private well owners; vulnerable populations	2025-2026; Ongoing	WCD WMOs State Agencies	Existing information is documented and reviewed
1.B.2	Expand testing options for contaminants including but not limited to coliform bacteria, nitrate, arsenic, manganese, lead, and newly identified emerging contaminants. • Continue a fee for service water sampling program. • Explore and implement, as appropriate, options to lessen the cost of sampling such as a free program that rotates throughout the county, lower cost options, and/or identifying opportunities to apply for and offer grants. • Continue to hold one free private water sampling event each year with partners. • Explore and implement options for reminding private well owners to test their well water. • Identify methods for residents to test for pesticides and support MDAs continued work on pesticide identification and treatment.	Expand	Lead	Private well owners; vulnerable populations	2025; Ongoing	MDH MDA	# of new testing options for residents # of tests provided annually
1.B.3	Explore options for financial assistance for private well water treatment and implement as appropriate. • In collaboration with state and local partners, identify options and funding for low or no cost grants for private well treatment. • Promote existing loan program for private well repair and replacement in accordance with county policy.	Continue and New	Lead	Private well owners; vulnerable populations	2025; Ongoing	LWCD WMOs State Agencies	Low cost or no cost options exist # of treatment systems installed

1.B.4	Continue to work with state agencies and LGUs impacted by TCE on appropriate mitigation strategies.	Continue	Partner	PWSs and private well owners	Ongoing	LGUs State Agencies PWSs	# of meetings attended
1.B.5	Continue existing abandoned well sealing grant program and expand by identifying and applying for grant opportunities. Collaborate with local units of government to find and seal abandoned wells.	Continue and Expand	Lead	Businesses and residents	Ongoing	LGUs State Agencies PWSs	# of abandoned wells sealed
1.B.6	Explore options for a coordinated private well data information system among agencies that collect well data. If a data information system is created ensure it is easily accessible to the public.	New	Partner	Partners and the public	2026-2028	WMOs WCD Met Council State Agencies	Data information system is available and accessibly by the public

C. Strategy: Collaborate with relevant partners (e.g. MDH, DNR, Met Council, etc.) and Water Suppliers to protect their water supply. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
1.C.1	Monitor and review wellhead protection (WHP) and water supply planning activities led by MDH, assess county role, and provide comments on both plans.	Continue and New	Partner	PWSs	Ongoing	LGUs PWSs MDH	County role defined and documented # of WHPs reviewed
1.C.2	Continue to maintain awareness of drinking water standards as they evolve and new information becomes available, and inform partners and residents of PWS actions.	Continue	Partner	Partners and residents	Ongoing	MDH	# of standards changed or newly created # of outreach efforts made to this strategy

1.C.3	Continue water supply testing, sanitary surveys, and inner wellhead management zone (IWMZ) inventory for the Department of Public Health and Environment's licensed Noncommunity Transient Public Water Suppliers.	Continue	Lead	Non-community Transient PWSs	Ongoing	MDH Non-Community Transient PWSs	# of non-community transient PWS tested # of sanitary surveys completed

D. Strategy: Reduce agriculture related groundwater contamination. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
1.D.1	Continue to support the MDA Nitrate Local Advisory Team activities in Washington County and implementation of the MDAs Nitrogen Fertilizer Management Plan.	Continue	Partner	Agricultural community	Ongoing	WCD MDA LGUs	# of meetings attended
1.D.2	Continue to partner with the Washington Conservation District, MDA, NRCS, and other organizations, to support whole farm planning that includes promotion of water quality best management practices (BMPs) and soil health practices. ‡ Examples include: • Promote Minnesota Agriculture Water Quality Certification Program and AgBMP loans. • Promote peer to peer farmer programs. • Animal waste management.	Continue	Partner	Agricultural community	Ongoing	WCD MDA NRCS WMOs LGUs	# of practices installed
1.D.3	Explore and implement, if feasible, cost share funding for agricultural water quality BMPs through the Washington Conservation District, Watershed Management Organizations, Lower St. Croix One Watershed One Plan, and any BWSR funding that becomes available.	New	Partner	Agricultural community	Ongoing	WMOs WCD LSC Partnership BWSR State Agencies	Cost share funding programs established

‡ *Signifies Actions that include both a positive water quality and water quantity benefit.*

E. Strategy: Reduce groundwater contamination from chloride. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
1.E.1	Continue to fund one Smart Salt training in the county each year.	Continue	Partner Fund	Public works departments and contractors	Annual	EMWREP MPCA	# of attendees
1.E.2	Promote chloride reduction by advocating and incentivizing the replacement of outdated water softeners with new, efficient on-demand water softeners.	New	Lead	Residents	2026	LGUs WMOs WCD Met Council State Agencies	# of replaced water softeners
1.E.3	Investigate testing a sample of some collector and/or community septic systems for the concentration of chlorides.	New	Lead	Collector and community septic systems	2026	Internal	Samples are taken from systems
1.E.4	Work with County departments to minimize salt use on County roads, sidewalks, and parking lots while protecting public safety.	New	Partner	Building services and Public Works	Ongoing	Internal	Lbs. of salt saved
1.E.5	Encourage cities and townships to develop and implement chloride reduction policies and practices.	New	Partner	LGUs	2025; Ongoing	LGUs	# of LGUs with chloride reduction policies and practices in place

F. Strategy: Prevent pollution by minimizing wastewater impacts on groundwater quality. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
1.F.1	Ensure that subsurface sewage treatment systems (SSTS) in Washington County will be constructed, operated, and maintained in conformance with Minnesota statutes and rules and County Development Code Chapter 4.	Continue	Regulate	Businesses and residents	Ongoing	Internal	# of SSTS permitted

1.F.2	Continue to offer SSTS loans and low-income grants and explore additional funding for non-compliant SSTS, including city sewer connection where available.	Continue	Lead	LGUs, businesses, and residents	Ongoing	Internal	# of loans and grants administered
1.F.3	Identifying failing SSTSs through the required compliance inspection process at the time of property transfer and requiring their replacement to protect groundwater.	Continue	Regulate	LGUs, businesses, and residents	Ongoing	Internal	# of SSTS inspected at time of property transfer
1.F.4	Periodically review and update the SSTS Risk Assessment database and promote it as a tool for land-use planning, including identified opportunities to expand municipal sewers.	Continue	Lead	Developers, LGUs	Ongoing	Internal	# of updates
1.F.5	The county will define its role regarding community sewers and their effect on groundwater.	New	Lead	Community sewer systems	2025	State Agencies	Role defined
1.F.6	Continue administering county SSTS operating permits program.	Continue	Lead	Businesses and residents	Ongoing	Internal	# of operating permits
1.F.7	Utilize approved nutrient and bacterial total maximum daily loads (TMDLs) and other studies as a tool to work with partners (e.g. watershed, cities) to identify areas for focused septic system maintenance and management.	Continue	Partner	Partners and residents	Ongoing	WMOs	# of focused SSTS maintenance and management

G. Strategy: Address pollution potential from industrial operations, mining, and historically contaminated sites. (Priority: Low)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
1.G.1	Continue to track, review, and comment on Environmental Impact Statements, Environmental Assessment Worksheets, and Alternative Urban Areawide Reviews.	Continue	Partner	Developers and LGUs	Ongoing	Internal	# of studies reviewed
1.G.2	Evaluate the need for a solid waste and household hazardous waste/ agricultural chemical management assistance program.	New	Lead	Residents	2030	WCD	Evaluation complete

1.G.3	Continue the county's hazardous waste licensing role by: • Continuing to enforce Washington County Ordinances that regulate the proper collection, storage, and disposal of hazardous waste. • Identifying and evaluating businesses and other non-residential entities served by SSTSs that generate or potentially generate hazardous waste and ensure that hazardous waste is not disposed of in an onsite well or SSTS. • Provide tailored assistance to licensed establishments with SSTS or a non-community water supply.	Continue and New	Lead	Licensed generators	Ongoing	MPCA	# of licenses
1.G.4	Work with Public Works, Administration, and the WCD to develop a process to review and provide comments on mining permits that includes professional engineering as well as hydrological review and analysis.	Continue and New	Partner	Mining operations	2025	WCD	Process is developed Engineer is on contract # of mining permits
1.G.5	The county will explore options to identify when and where movement of contaminated soil is occurring and evaluate a process to monitor this activity under existing solid and hazardous waste regulations.	New	Lead	Developers and LGUs	2026; Ongoing	Internal	Process is developed
1.G.6	The county will continue the following with respect to landfills: • The county supports Minnesota Rule 7001.3111 "Additional Siting Requirements for Certain Landfills that have not Received a Permit before January 1, 2011." • The county will continue to review and provide comments on any proposed landfill operations within the county to protect groundwater. • The county will review and comment on any proposed statute or rule changes from the state with regards to landfill operations to protect groundwater.	Continue	Lead	State agencies	Ongoing	State Agencies	Zero new landfills
1.G.7	The Washington County Groundwater Plan supports the work of the Washington County Solid Waste Management Plan to implement activities for an integrated solid waste management system that is protective of groundwater.	Continue	Lead	Residents Businesses LGUs	Ongoing	Internal	Both plans implemented

H. Strategy: Continue a land spreading program that is protective of groundwater. (Priority: Low)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
1.H.1	Explore collaboration and partnerships with local WMOs, WCD, Met Council, researchers and/or other potential partners on review of land spreading permitting by the county for the beneficial use of byproducts that are land-spread as soil amendments.	New	Lead	Partners	2026 or later	IWMOs WCD Met Council State Agencies	Collaborative process is developed
1.H.2	Establish a sharable data management and mapping system to track proposed sites for land application to reduce the risk of direct human exposure to waste or contamination of groundwater.	New	Lead	Partners	2027 or later	Internal	Sharable data management system is developed
1.H.3	Advocate that the MPCA evaluate and effectively regulate land spreading of septage to avoid adversely affecting public health. • Don't allow spreading in karst areas or vulnerable Drinking Water Source Management Areas, or areas of high pollution sensitivity. • Require sample analyses to include emerging contaminants including PFAS. • Monitor permitted applications beyond annual self-reporting including monitoring adjacent surface and groundwater to check for emerging contaminants after land spreading activity.	Continue and New	Partner	MPCA	2025; Ongoing	MPCA MDH	MPCA regulates land spreading of septage to protect groundwater
1.H.4	Develop and implement educational resources for residents regarding land spreading of septage.	New	Lead	Residents	Ongoing	EMWREP WCD WMOs LGUs MPCA	# of social media views # reached with ed. materials

I. Strategy: Manage stormwater to prevent groundwater pollution. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
1.I.1	Continue to implement Washington County MS4 to prevent pollution to surface and groundwater.	Continue	Lead (Public Works)	Residents Municipalities	Ongoing	Municipal-ities WCD	MS4 reporting complete
1.I.2	Follow the MPCA Stormwater Manual and any guidance from MDH for safe placement of infiltration practices, working with state agencies to address barriers to implementation.	Continue	Lead (Public Works)	Residents Municipalities Watersheds	Ongoing	Municipal-ities WCD WMOs MDH MPCA	Infiltration practices are safely placed
1.I.3	Encourage partners to implement stormwater best management practices that are protective of groundwater, including safe and feasible water reuse. ‡	Continue	Support	Municipalities Watersheds	Ongoing	WCD WMOs LGUs	Stormwater BMPs are safely placed

Table Group 5. Groundwater Quantity Plan Implementation Tables

Goal #2: Groundwater is plentiful to support human needs and a thriving natural environment.

A. Strategy: Expand understanding of groundwater and surface water connection in the county. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
2.A.1	Support research and modeling to increase understanding of the surface and groundwater connection and how it impacts groundwater availability and contaminant flow.	Continue	Advocate	County-wide	Ongoing	Met Council State Agencies WCD WMOs	# of research projects supported.
2.A.2	Partner with the WCD and watersheds to support efforts for soil health. ‡	Continue	Partner	Landowners	Ongoing	WMOs WCD State Agencies	# of soil health projects

‡ *Signifies Actions that include both a positive water quality and water quantity benefit.*

B. Strategy: Promote and implement water conservation and efficiency efforts. (Priority: High)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
2.B.1	Explore funding opportunities for water conservation and efficiency, and work with partners to create, promote, and/or expand programs (including but not limited to, moisture sensors for irrigation systems, smart controls, water efficient appliances, and water leak detection projects).	Expand	Lead Partner	PWSs Property and Building managers HOAs	Ongoing	WCD WMOs Met Council State Agencies LGUs PWSs	# of water efficiency and conservation practices implemented
2.B.2	Identify opportunities for water use audits and implementation of water conservation and efficiency projects on county-owned property.	New	Lead	County property	Ongoing	WCD EMWREP	# of water efficiency and conservation practices implemented
2.B.3	Continue supporting rain barrel sales offered through the Department of Public Health and Environment.	Continue	Lead	Residents	Ongoing	Recycling Association of Minnesota.	# of rain barrels sold

C. Strategy: Support stormwater retention, infiltration and opportunities to replenish aquifer storage. (Priority: Low)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
2.C.1	Support partner efforts to maximize stormwater retention and infiltration where it can be done safely.	New	Advocate	County-wide	Ongoing	State Agencies Met Council LGUs	# of actions taken
2.C.2	Support research by partners to establish feasibility and safety of direct injection of aquifers and infiltration, including shallow injection from dewatering construction projects.	New	Advocate	County-wide	Ongoing	State Agencies Met Council LGUs	# of actions taken

D. Strategy: Protect, preserve, and restore resources that support groundwater dependent ecosystems. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
2.D.1	Continue to fund WCD's administration of the Wetland Conservation Act through the BWSR Natural Resource Block Grant.	Continue	Lead Partner	Partner Fund	Ongoing	BWSR WCD	Acres of wetland managed
2.D.2	Encourage projects and activities that will improve groundwater quality, temperature and quantity for groundwater dependent resources. ‡ Examples include but are not limited to: • Land protection • Soil health practices • Minimum Impact Design Standards	Continue	Lead	Partner	Ongoing	WCD LGUs	# of practices implemented Acres protected

E. Strategy: Support and encourage safe and feasible water reuse. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
2.E.1	Support efforts to determine water reuse options, including use of treated and commercial containment water, which are safe for public health and their implementation. ‡	New	Advocate	Partners	Ongoing	Met Council State Agencies	# of interactions
2.E.2	Support increased landscape storage and retention of water for reuse, for both quantity and quality. ‡	New	Advocate	Partners, developers, businesses, residents	Ongoing	WMOs WCD LGUs Met Council State Agencies	# of initiatives conducted in support
2.E.3	Support agencies exploring development of diversified grades of water (non-potable for non-drinking uses).	Ongoing	Advocate	Partners	Ongoing	Met Council State Agencies	# of initiatives conducted in support

‡ *Signifies Actions that include both a positive water quality and water quantity benefit.*

2.E.4	Promote projects in the county to encourage more reuse in development & redevelopment.	New	Advocate	Developers	Ongoing	WMOs WCD LGUs Met Council	# of initiatives conducted to promote

F. Strategy: Regularly update and share water quantity related data. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
2.F.1	Support and encourage agency water supply modeling and a groundwater database that can be used to identify areas at risk for depletion, areas for storage for future use, predict aquifer levels and trends and other water management issues.	Continue	Advocate	Partners	Ongoing	Met Council State Agencies	# of initiatives conducted in support
2.F.2	The county will compile water usage data and publish annually to water suppliers.	New	Lead	PWSs	Annually	Met Council DNR LGUs PWSs	Published annually
2.F.3	Encourage regular and consistent data updates to Atlas 14.	New	Advocate	NOAA	Ongoing	WCD WMOs LGUs Met Council State Agencies NOAA	% of updates made

Table Group 6. Groundwater Education Plan Implementation Tables

Goal #3: People who live and work in Washington County understand the importance of protecting groundwater, how to conserve water and use it efficiently, and prevent contamination.

A. Strategy: Inform and educate targeted audiences (e.g. well and septic owners, business, property managers, etc.), and encourage adoption of practices that are protective of groundwater quality and quantity. (Priority: High)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
3.A.1	Support elected official education through Workshop on the Water, MPCA's Smart Salting For Community Leaders workshops, and other opportunities.	Continue	Partner Fund Educate	Elected Officials	Annual	EMWREP WCD MN/WI DNRs Adjoining Counties LSC Partnership MPCA	# of attendees
3.A.2	Educate targeted audiences (e.g. property managers, businesses, homeowner associations, and public works officials) on adoption of practices regarding proper salt use, use of irrigation and drought tolerant practices, and other topics.	Continue	Partner Fund Educate	Property managers and owners	Ongoing	EMWREP WCD LSC Partnership	# of social media views # of training attendees # reached with educational materials
3.A.3	Host realtor education classes on well water, SSTS, household hazardous waste, and other topics that impact groundwater. Include well sealing requirements and well disclosure agreements.	Continue	Partner Educate	Realtors	Annual	SPAAR	# of realtors who attended training
3.A.4	Provide relevant information to targeted audiences on: • Well testing and water quality information, resources, and funding opportunities. • Best practices with respect to proper disposal of solid and hazardous waste.	Continue	Partner Educate	Targeted audiences	Ongoing	MDH MPCA	# of social media views # reached with educational materials

3.A.5	Develop and promote education for targeted audiences on climate change impacts, adaptation, and mitigation in addition to groundwater and surface water interaction.	New	Partner Educate	Targeted audiences	Ongoing	EMWREP Met Council DNR MPCA BWSR	# of social media views # reached with educational materials
3.A.6	Support education efforts from EMWREP, the Lower St Croix Partnership, and other partners to work with rural and agricultural landowners.	Continue	Partner Educate	Landowners	Ongoing	EMWREP LSC Partner-ship Adjacdent Counties	# of social media views # reached with educational materials
3.A.7	Develop tailored messages for private well and/or septic system owners on maintenance, testing and other practices that protect public health. • Coordinate dissemination of existing guidance and brochures already available from state agencies. • Coordinate opportunity to test well when SSTS is serviced. • Proper disposal of treatment filters as appropriate	Expand	Partner Operate Educate	Owners of wells and SSTS	Ongoing	EMWREP MPCA MDH	# of social media views # reached with educational materials

B. Strategy: Inform and educate residents and encourage adoption of practices that are protective of groundwater quality and quantity. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
3.B.1	Continue to fund WCD's administration of the Wetland Conservation Act through the BWSR Natural Resource Block Grant.	Continue	Lead Partner	Partner Fund	Ongoing	BWSR WCD	Acres of wetland managed
3.B.2	Encourage projects and activities that will improve groundwater quality, temperature and quantity for groundwater dependent resources. ‡ Examples include but are not limited to: • Land protection • Soil health practices • Minimum Impact Design Standards	Continue	Partner Educate	Partner	Ongoing	PWS LGUs State Agencies Met Council	# of social media views # reached with educational materials
3.B.3	Educate residents on proper disposal of pharmaceuticals (County Drop Boxes), household hazardous waste and promote the use of the County Environmental Center(s) and satellite HHW events.	Continue	Lead Educate	Residents	Ongoing	EMWREP	# of pharmaceuticals/ HHW dropped off

‡ *Signifies Actions that include both a positive water quality and water quantity benefit.*

3.B.4	Educate residents on the importance of properly sealing abandoned wells and promote the County Abandoned Well Sealing Grant and Cost Share Programs.	Continue	Lead Educate	Residents	Ongoing	MDH WCD	# of wells sealed
3.B.5	Develop and promote education for residents on climate change impacts, adaptation, and mitigation in addition to groundwater and surface water interaction.	New	Partner Educate	Residents	Ongoing	EMWREP WCD WMOs MDH U of MN Met Council LGUs	# of social media views # reached with educational materials
3.B.6	Work with partners to coordinate education of residents on fish consumption concerns related to PFAS and other contaminants.	Continue	Partner Educate	Residents	Ongoing	EMWREP WCD WMOs LGUs MDH	# of social media views # reached with educational materials
3.B.7	Educate residents on how to use best management practices to minimize contamination of groundwater caused by the use and storage of fertilizers, pesticides, and salt (including softeners).	Continue	Partner Educate	Residents	Ongoing	EMWREP WCD State Agencies LGUs	# of social media views # reached with educational materials
3.B.8	Plan and support the Metro Children's Water Festival.	Continue	Partner Educate	Students	Ongoing	Metro Counties Met Council WMOs	# of students who attend the CWF each year

Table Group 7. Groundwater Governance Plan Implementation Tables

Goal #4: Groundwater management is coordinated, efficient, and effective.

A. Strategy: Collaborate with all levels of government. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
4.A.1	Continue the Washington County Water Consortium and explore additional options for collaboration with partners.	Continue	Lead	Water resource professionals Elected Officials Residents Agencies	Ongoing	WCD EMWREP	Average # of attendees per meeting # of consortium meetings held
4.A.2	Monitor and participate with White Bear Lake court order and its effects.	Continue	Monitor	Maintain awareness	Ongoing	Met Council State Agencies LGUs	# of meetings attended
4.A.3	Participate in the DNR's North and East Metro Groundwater Management Area work group, monitor activities, and ensure the county's needs are represented.	Continue	Monitor Advocate	Maintain awareness and advocate for county needs	Ongoing	State Agencies Met Council LGUs WCD WMOs	# of meetings attended
4.A.4	Support any needed updates to the County Geologic Atlas Part A and the Hydrogeologic Atlas Part B.	Continue	Advocate	Water Resource Professionals County-wide	Ongoing	MGS DNR	# of needed updates completed
4.A.5	Participate and track coordinated wellhead protection efforts with MDH and Public Water Suppliers.	Expand	Partner	PWSs	Ongoing	PWSs MDH LGUs	# of wellhead protection plans reviewed
4.A.6	Continue membership in the Lower St Croix One Watershed One Plan Partnership	Continue	Partner	1W1P Partners	Ongoing	1W1P Partners	Joint Powers membership

B. Strategy: Support and create regulations and policies that improve and protect groundwater quality and quantity. (Priority: High)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
4.B.1	To maximize local public health protection and support private well owners, work toward becoming a delegated well authority under MN Statute 103I.111. In the event a delegated program is created, require well testing at time of property transfer.	New	Lead	Private well owners	2025	MDH LGUs	County makes decision on if it will become a delegated well authority If the county becomes a delegated well authority, measure is % of wells sampled at time of property transfer
4.B.2	Support limited liability legislation for salt applicators and support best practices to reduce chloride contamination from road salt and water softeners.	New	Advocate	Salt applicators	Ongoing	LGUs WMOs	# of initiatives conducted in support
4.B.3	Work with interagency task force and partners to clarify regulatory and guidance framework and updates to state code that support safe water reuse.	New	Advocate Partner	Safe water reuse	Ongoing	Met Council State Agencies WMOs LGUs WCD	Guidance document is developed
4.B.4	Support laws that require private well testing and treatment at time of sale for relevant contaminants.	New	Advocate	Private well owners	Ongoing	MMDH LGUs WMOs Realtors	# of initiatives conducted in support

4.B.5	Support legislative changes requested by communities that allow them to charge rates that support reuse and conservation investments.	New	Advocate	PWSs LGUs	Ongoing	PWSs LGUs	# of initiatives conducted in support
4.B.6	Monitor requests for groundwater appropriation and advocate for limiting groundwater exportation.	New	Monitor Advocate	Residents and businesses	Ongoing	Met Council State Agencies LGUs WMOs	100% of groundwater stays in the county

C. Strategy: Advocate for more funds to support access to safe drinking water for all residents. (Priority: High)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
4.C.1	Advocate for renewal of Clean Water Fund.	New	Advocate	Legislature	2030-2034	WMOs WCD	# of initiatives conducted
4.C.2	Support and encourage expanded grant and funding programs by the state that allow for well testing, monitoring, and treatment for private well owners (including PFAS).	New	Advocate	State Agencies Legislature	Ongoing	State Agencies	# of grant programs advocated for
4.C.3	Advocate for funding to become available for private well owners to connect to city water in areas of contamination (including PFAS).	New	Advocate	State Agencies Legislature	Ongoing	State Agencies	# of grant programs advocated for
4.C.4	Advocate for funding for community and public water suppliers to offset costs of supplying water, especially in communities impacted by PFAS and other contaminants.	New	Advocate	State Agencies Legislature	Ongoing	LGUs Water Suppliers State	# of grant dollars awarded
4.C.5	Advocate for additional funding for Best Management Practices that protect groundwater from both a quality and quantity perspective.	Continue	Partner	State Agencies Legislature	Ongoing	WMOs	Monitor legislation and encourage BMP and groundwater funding.

D. Strategy: Support and create county programs which improve and prioritize groundwater protection. (Priority: Medium)

Action No.	Action	Activity	Role	Target	Timeframe	External Partners	Measure
4.D.1	Implement the county's Land and Water Legacy Program, under the direction of the county board, which seeks to protect and improve the quality of rivers, lakes, streams, and groundwater resources through the acquisition of land or interests in land via conservation easement.	Continue	Lead (Admin)	Landowners	Ongoing	Landowner WCD WMOs LGUs State Agencies	Acres protected
4.D.2	Invest in and support the restoration and enhancement of the county's protected lands to promote improved water quality and increased water quantity.	Continue	Partner	Land Preservation	Ongoing	WCD WMOs LGUs	Acres improved

2.3 Funding

Minnesota Statute 103B.255 states: "A metropolitan county may levy amounts necessary to administer and implement an approved and adopted groundwater plan. A county may levy amounts necessary to pay the reasonable increased costs to soil and water conservation districts and watershed management organizations administering and implementing priority programs identified in the county's groundwater plan."

Funding is necessary to coordinate and implement the Plan. These activities include developing an annual groundwater program work plan, implementing Plan strategies and actions, and initiating other related program activities.

The primary source of funding is from the county environmental charge (CEC). The CEC is a service charge for managing waste to avoid contaminating groundwater. It is collected by haulers as a percentage of the garbage bill. The CEC is used for the management of solid waste, hazardous waste, recycling, resource recovery, and groundwater work. The county is mandated by the Waste Management Act to develop and implement a Solid Waste Management Plan. The purpose of a county solid waste plan is to coordinate the implementation of an integrated waste management system to protect public health and the environment. The work of the county's solid waste and groundwater plans complement each other in the protection of groundwater.

Additional supportive funding comes from the county Solid Waste Management special assessment, BWSR Natural Resources Block Grant (NRBG), the county water testing program, the water and sewer portion of the Food, Pools, and Lodging (FPL) licenses, other grants for specific initiatives, and partnerships. Collaborative initiatives such as groundwater related research projects, rule and policy development, education and technical assistance programs, and capital improvement projects will be funded based on the specific goals and benefits of the participating or benefiting partners. To the greatest extent possible, state and federal grants will be sought to fund projects. Efforts will be made to develop cooperative, joint funding of projects from local government and watershed organizations. Annual work planning will help guide this budgeting process. The county will provide overall coordination of grant funding efforts, including cost-sharing. As part of implementation, financial assistance may also be available to individual homeowners through

cost-share grants or low interest loans available from the county, the WCD, or other organizations.

The primary work of groundwater protection for the county is carried out by PHE in the groundwater program, the solid and hazardous waste programs, and the septic programs. In addition, other county departments lend support at varying levels, including Administration, Information Technology (Geographic Information Systems), Public Works, and the County Attorney's Office. The WCD is also an important partner in providing base technical services.

2.4 Measurement

The county encourages a culture of quality improvement and is committed to integrating performance management and quality improvement into its programs and services, including implementation of the Plan. Performance management provides a framework for the regular collection, analysis, and reporting of performance measures that track resources used, work produced, and specific results achieved. The information and knowledge gained from this process informs continuous improvement activities to address gaps and help reach goals. PHE utilizes a Results Based Accountability (RBA) framework for performance management, asking the questions of 1) what did we do? 2) how well did we do it? 3) Is anyone better off?

RBA principles will be considered as Plan actions are implemented, on a project-by-project basis. PHE will also compile and document annual progress and results of the Plan on an annual basis.

Chapter 3. Governance, Roles, and Responsibilities

Water governance in Minnesota is complex, with state and local agencies responsible for different aspects of surface and groundwater management. For some topics, federal agencies like the U.S Environmental Protection Agency (EPA) also play a significant role in setting regulations or guiding work. The county is currently not a delegated well authority; MDH oversees MN well code (e.g. permitting and drilling of wells). The county recognizes that several regulatory aspects and decision-making authorities for groundwater lie with our partner agencies and local governments. However, the county values the importance of groundwater for our communities and residences; and therefore, chooses to act as a convener to ensure and enable coordination with respect to groundwater needs in the county.

3.1 Washington County Roles

This section describes the county's primary responsibilities with respect to groundwater protection. The first four sections describe PHE responsibilities, sections 5 and 6 describe the role of other departments.

1. Groundwater Plan Implementation

The county has maintained a Groundwater Plan since 2003. The plan(s) have evolved over time, as have the roles and responsibilities of various state and local agencies, and the complexity of groundwater management. The county is not a delegated well authority, therefore does not have regulatory controls with respect to the drilling or permitting of wells. PHE implements several voluntary programs to promote and protect groundwater and drinking water for residents. These programs are identified in the strategies and actions identified in this plan.

This includes:

- Drinking water testing, education, and outreach
    - Regular fee-for-service testing
    - Free clinics with partners
    - Technical assistance to residents and connecting them with MDH and other partners as needed
- Outreach and education for homeowners, realtors, elected officials, and others
- Partnering with the WCD on agricultural outreach and education
- Reviewing and commenting on plans (watershed, wellhead protection, comprehensive, etc.), rules, and environmental review with a groundwater perspective
- Studies and research
    - Groundwater and surface water interaction studies
    - SSTS risk assessment
    - Water reuse assessment

2. Septic System Program

The county is responsible for regulating septic systems, also known as subsurface sewage treatment systems (SSTS) for all but one municipality. While a SSTS can be an efficient means of treating wastewater in rural areas, a failing or poorly maintained SSTS has the potential to contaminate groundwater and surface water with a variety of contaminants, including nitrates, coliform bacteria (E. coli), and phosphorus.

Minnesota Rules Chapter 7080 through 7083, address statewide requirements for SSTS location, design, installation and maintenance, licensing of SSTS professionals, and the county administration and role. Every county must have a SSTS ordinance that is at least as strict as the rules set by the MPCA. The county's septic ordinance, part of the Washington County Development Code, was first adopted in 1972 and was recently revised in 2018.

The county SSTS Ordinance regulates the permitting, inspection, and maintenance of these systems. In addition to the requirements in MN Rules, the county requires replacement when they are non-compliant. Since 2009 the county's ordinance has included the requirement for SSTS inspection prior to property transfer. This is to help ensure that non-compliant SSTS are identified and replaced. The ordinance also requires maintenance of SSTS. There are more than 19,000 SSTS in the county serving both commercial and residential properties. This includes approximately 17,500 systems for households and another 1,500 systems serving commercial and other properties.

Since the last Plan, PHE has developed a robust financial assistance program to aid residents with the costs of replacing their SSTSs. This includes options to secure low-interest loans where payments are assessed on property taxes, as well as "fix up grants" available to low-income residents. The county has partnered with the Washington County Community Development Agency (CDA) to provide these services to residents. Funding for low-interest loans comes from both the MDAs AgBMP loan program, as well as county funds.

3. Solid and Hazardous Waste Programs

The county implements several hazardous and solid waste programs and regulations that all contribute to the protection of groundwater.

Solid Waste Management

Metropolitan counties are required by the Minnesota Waste Management Act, Minnesota Statute 473.803, to prepare and implement solid waste management plans in alignment with the Metropolitan Solid Waste Management Policy Plan. The county's Solid Waste Management Plan describes and guides county waste management activities and funding to achieve state waste objectives. An updated six-year Solid Waste Management Plan will be adopted in 2024.

Under the Solid Waste Management Plan, the county implements different waste management strategies and programs intended to prevent pollution, conserve resources, protect health and the environment, and prevent passing costs onto future generations. Minnesota law includes a hierarchy of preferred methods to manage waste, emphasizing prevention of environmental problems and protection of public health.

Some of these services include:

- Ramsey/Washington Recycling and Energy Center
- Food Waste Prevention
- Waste Reduction and Reuse
- Recycling for businesses, schools, and residents
- Yard Waste

Additionally, the county regulates solid waste facilities including transfer stations, recycling center facilities, waste storage, processing and disposal sites, and operations, through licensing and inspection. The county derives its regulatory authority for solid waste management and protection of public health, safety, and the environment from Minnesota Statutes §115A, §145A, §375, §400 and §473. The solid waste management regulations encourage the cooperation of local units of government in enforcing the rules (Minnesota Rules Chap. 7035.0400). The Minnesota Solid Waste Rules have been adopted by reference in the Washington County Solid Waste Management Ordinances.

Hazardous Waste Regulations

The county is mandated by Minn. Statute §473.811 subd.5b to regulate and enforce state and local hazardous waste and has administered its program since 1985. Washington County Ordinance #195, adopted in 2014, describes the county regulations related to hazardous waste management. Any business or non-household entity that generates hazardous waste must comply with these regulations that are designed to protect public health and the environment and focus on preventing hazardous waste releases to the environment or exposure to people.

The county also regulates, through a licensing and inspection process, facilities that treat, store, or dispose of hazardous waste. These facilities are subject to additional regulations beyond those for generators based on the types of waste handled and the size and nature of their operation. Hazardous waste facilities are also required to have a permit from the MPCA and the EPA.

Toxicity Reduction/Household Hazardous Waste

Reduction in the toxic/hazardous character of waste refers to efforts with the ultimate goal of reducing potential impacts to public health and the environment. The county encourages residents to use fewer toxic products and safely dispose of hazardous items through the various county programs designed to protect people and the environment. The county provides safe disposal options for automotive products, batteries, pesticides and other hazardous items for free through its household hazardous waste (HHW) collection program. Electronics are also accepted through this program. The county has operated an HHW facility since 1994, starting with a small facility located in Oakdale and expanding to the current Environmental Center located in Woodbury in the fall of 2009. The Woodbury Environmental Center operates year-round, and a second year-round site is scheduled to open in 2025 in Forest Lake. The county also hosts one-day collection events at various locations, operating from April through October. The county participates in a reciprocal use agreement with seven other metropolitan counties. This allows residents to use HHW services in any other metro county for free and, residents of those counties can use Washington County's services for free.

In addition, a partnership between the Washington County Sheriff's Office and PHE provides residents in the county with free collection drop boxes to safely dispose of unwanted, expired, and unused medications. Safely disposing of medicine helps prevent crime, drug abuse, and accidental poisoning, while protecting our environment. In 2023, 12,240 pounds of pharmaceutical waste were collected and properly managed.

4. Noncommunity Transient Public Water System Delegation

The county operates a noncommunity transient public water supply program that oversees well water systems used for drinking water that do not serve the same individuals on a day-to-day basis but do provide water to at least 25 people for 60 days or more per year. These systems are commonly found in places like campgrounds and restaurants. The program ensures that these water supplies meet drinking water health and safety standards by conducting water testing and system surveys. This responsibility is delegated to the county by MDH.

5. Public Works

The county's Public Works Department has a role in groundwater protection in several areas.

Land Use

The Mining Ordinance, last updated in 2018, is detailed in Chapter 7 of the Washington County Development Code. The county mining ordinance has provisions to protect groundwater that include requirements for borings to show the depth to groundwater, water quality monitoring, a mandatory Environmental Assessment Worksheet (EAW) for any mine proposed below the groundwater level or that will excavate 40 or more acres to a mean depth of 10 feet, a mandatory Environmental Impact Worksheet (EIS) for any mine proposed to excavate 160 or more acres to a mean depth of 10 feet, the submittal of grading plans and phased rehabilitation plans to the WCD and the appropriate watershed for their approval, and any abandoned wells must be sealed.

The ordinance requires the county issue formal permits that include annual inspections, and when required, submittal of surface and groundwater monitoring reports. Each operation must also undergo a review process with a public hearing every five years, so that the full permit can be reviewed and any changes to the process can be incorporated. For reclamation, all permits must include a reclamation plan and an inspection is conducted at the time a site is considered fully reclaimed, to ensure the conditions of the plan and permit have been met.

Public Works also oversees shoreland regulations in certain areas of the county. In the development code this is covered in Chapter 5 that includes rules for the Lower St. Croix River Bluffland and Shoreland, and Chapter 6 that includes all other shoreland areas in unincorporated townships. These chapters regulate the subdivision, use, and development of shorelands of public waters to preserve and enhance the quality of surface waters, conserve the economic and natural environmental values of the shorelands, and provide for wise use of waters and related land resources.

Transportation

Public Works plans, builds, and maintains a transportation network to move people and goods to their destinations. This network includes highways, public transit facilities, and trails, and contributes to the safety and quality of life of residents and visitors. With respect to groundwater, the primary impacts from roadways include new and reconstruction of county roads, and road maintenance practices including winter salt application.

Parks

The county parks system plays a key role in providing opportunities for visitors to recreate outdoors and interact with nature. Two Natural Resource Coordinators oversee and implement land stewardship activities throughout the over 5,000-acre park system. Surface and groundwater protection and improvement are actively considered in the management of the park system. Parks has partnered with watershed districts, non-profit organizations, and the WCD to implement several projects over the years.

County Facilities

In addition to the park and highway system, the county's Building Services Division, within Public Works, is responsible for the maintenance and operation of county buildings and grounds. Altogether, the county maintains 11 buildings over approximately 112 acres (minus parks). There is opportunity for groundwater protection with respect to onsite water management and use, irrigation, and salt application on county property.

6. Land and Water Legacy Program

The county partners with landowners and organizations to purchase land or interests in land to keep it in its natural condition. County land protection efforts were strengthened in 2006 after the passage of a $20 million voter-approved bond referendum for the preservation of water quality, woodlands, and other natural areas. The program became known as the Washington County Land and Water Legacy Program.

The program funds are used for the following purposes:

- Improve water quality of rivers, lakes, and streams
- Protect drinking water sources
- Purchase parkland, including trail corridors and greenways
- Preserve wetlands and woodlands
- Protect land along water bodies from development
- Increase public access to natural areas

The county and its partners have completed 40 land protection projects on more than 1,300 acres in the last 17 years increasing public access to natural areas. More information can be found at Land and Water Legacy Program.

3.2 State and Regional Roles

At the state level and regional level, there are several agencies with responsibilities in surface and groundwater management.

State Agencies

In 2023, the state released the Minnesota Water Management Framework that outlines responsibilities for 5 areas:

- Ongoing Implementation,
- Monitoring Assessment, and Characterization,
- Problem Investigation and Applied Research,
- Restoration and Protection strategy Development, and
- Comprehensive Watershed Management Plan

The state agencies involved in the framework include BWSR, MDH, MPCA, DNR, MDA, and the Public Facilities Authority (PFA).

Some high-level responsibilities of these agencies include (but are not limited to):

- BWSR oversees the approval and implementation of local water plans, provides funding, training, and technical assistance to local governments.
- MDH has responsibility for managing groundwater quality with respect to setting drinking water standards, overseeing the Minnesota Well Code, and aiding public and community water suppliers in complying with the Safe Drinking Water Act.
- The DNR is responsible for issues related to groundwater quantity, which is accomplished through water appropriation permits, protection of natural resources, and other programs. The DNR also works with the Minnesota Geological Survey to complete County Geologic Atlases. The DNR completed Part B of the Washington County atlas in 2019.
- The MPCA operates primarily in a regulatory role for water quality, through permitting programs, monitoring, investigation, and management of contaminated sites.
- MDA works primarily on pesticide and fertilizer management efforts.
- Of note, the MPCA and the DNR jointly manage the 3M Settlement fund, see Chapter 6, Groundwater Quality, for more information.

Refer to the state framework and Figure 6 for more details on the services provided by each agency.

Metropolitan Council

Under state law, the Metropolitan Council (Council) is charged with guiding regional development in the Twin Cities area. This regional framework is adopted by the Council every 10 years and sets in motion the next round of comprehensive plans for counties, cities and townships within the 7-county metro area. The current regional framework, Thrive MSP 2040, is approaching the end of its cycle. The Council is actively developing an updated regional framework, Imagine 2050. This framework includes "Policy Plans" that guide efforts in the metro, including a 2050 Water Policy Plan.

Part of the Council's responsibilities include management of the regional wastewater system, known as the Metropolitan Urban Service Area (MUSA). Centralized sewer and water serve most of the area within the MUSA or the boundary of an urban reserve area. Figure 33 in Chapter 6 depicts the location of the MUSA within the county.

In addition to centralized wastewater, the Metropolitan Council also has responsibility for developing a Metro Area Water Supply Plan. At the time of this plan's drafting, a draft Metro Area Water Supply Plan has been released along with the 2050 Water Policy Plan.

Local Government Units

Local Government Units (LGUs) can have a lot of influence and responsibility with respect to groundwater management. LGUs include cities, townships, watershed organizations, and soil and water conservation districts. Sound water resource management requires partnership between these many local entities.

Cities and Townships

The county has 27 cities and 6 townships. All municipalities rely on groundwater for their drinking water source. Figure 4 shows the locations of LGUs.

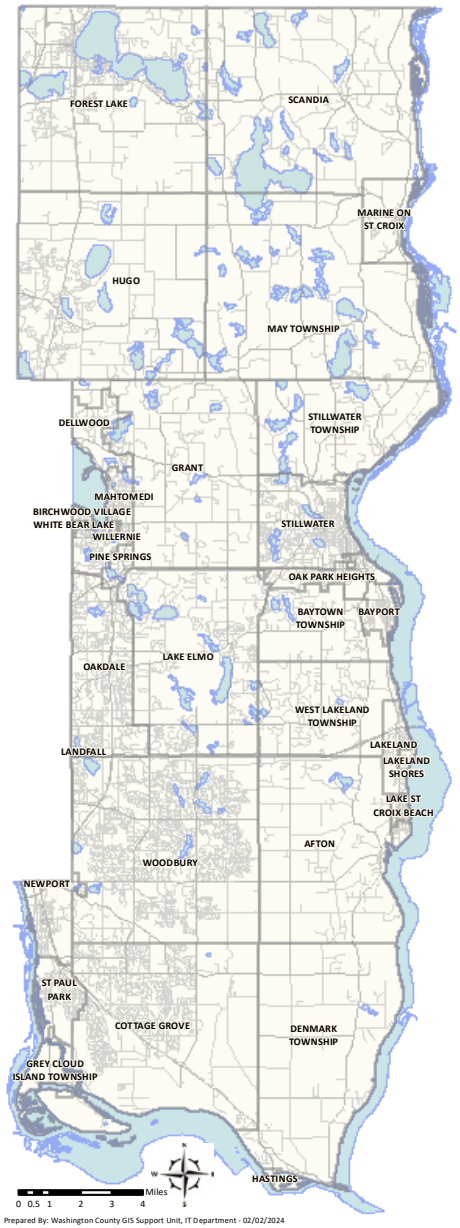


Figure 4. Location of Local Government Units in Washington County Map

Chapter 5 includes more information about population and development patterns for cities and townships. All cities and townships in the county are responsible for land use planning and zoning, except for shoreland and mining permits, which the county regulates in townships only.

Comprehensive Plans

Cities and townships develop comprehensive plans and zoning ordinances based on an overall direction set by elected officials and planning commissioners. Plans and ordinances are developed working within parameters set by state statutes and on guidelines set by the Metropolitan Council through the regional framework described in the previous section. Comprehensive Plans are reviewed by the Metropolitan Council and state agencies for adherence to their policies and plans.

Land use planning and land use decisions have an important role in protecting groundwater resources. It is imperative that groundwater protection strategies are incorporated into city comprehensive plans to better protect groundwater resources. These strategies should address the siting of commercial and industrial development using hazardous materials, the potential impact of impervious surfaces to groundwater recharge, and the long-term sustainability of groundwater supplies.

Wellhead Protection Planning and Water Supply Plans

Cities that are public water suppliers have additional responsibilities and planning efforts related to groundwater. Municipal water suppliers are required to develop Wellhead Protection Plans (WHPPs). Some non-municipal public water suppliers have WHPPs which local cities and townships to need be aware of for land use planning purposes. The major components of a WHPP include a map showing the boundaries of the wellhead protection area, an inventory of potential sources of contamination, and a plan to manage these sources.

Public Water Suppliers must also develop a Water Supply Plan (WSP), per Minnesota Statue 103G.291. These plans describe the water system, emergency preparedness procedures, and water conversation measures. Also, they are often developed in conjunction with a city's comprehensive plan. WSPs are approved by the DNR.

Both WHPPs and WSPs contain elements that complement the county's Groundwater Plan. The county will continue to review and provide comments on these plans to ensure alignment with Plan activities.

Watershed Management Organizations

In the Twin Cities Metropolitan Area, the watershed management organizations (WMOs) are responsible for surface water management planning, implementation, and enforcement. Under statute, watershed districts are required to address groundwater protection in their comprehensive watershed management plans. The county has defined its role in surface water management as one of providing leadership and oversight, including appointing watershed district board members, providing fiscal oversight and accountability, facilitating cross-jurisdictional coordination on common issues, managing special projects, and staffing the Washington County Water Consortium.

The county currently has eight watershed organizations that cover the entire county. Seven are watershed districts (WDs), whose managers are appointed by the County Board of Commissioners. One is a joint powers watershed management organization (WMO). The 8 organizations are:

- Browns Creek Watershed District
- Carnelian-Marine-St. Croix Watershed District
- Comfort Lake-Forest Lake Watershed District
- Middle St. Croix Watershed Management Organization

- Ramsey-Washington Metro Watershed District
- Rice Creek Watershed District
- South Washington Watershed District
- Valley Branch Watershed District

See Figure 5 for a map of watersheds in the county.

Washington Conservation District

The Washington Conservation District (WCD) is a special purpose local unit of government dedicated to managing soil and water resources in the county under the direction of a five-member elected board. The mission of the organization is to enhance, protect, and preserve the natural resources of Washington County through conservation projects, technical guidance, and educational services to citizens, local governments, and other partners.

The state's soil and water conservation policy (MN State Statute 103C.005) encourages land occupiers to conserve soil, water, and natural resources through partnerships with the state and others, including such things as improving habitat, protecting water quality, controlling erosion, and reducing damage caused by floods.

The WCD implements the following programs through funding from the state and partnerships with the county, WMOs, and other entities:

- Water monitoring and other resource assessments, including implementing a County Baseline Monitoring Program.
- Wetland Conservation Act (WCA) technical assistance.
- Education and outreach, including providing staff support for the East Metro Water Resource Education Program (EMWREP).
- Best management practice (BMP) technical assistance, including administering the Soil Health Program and working with WMOs to plan, design, and install water

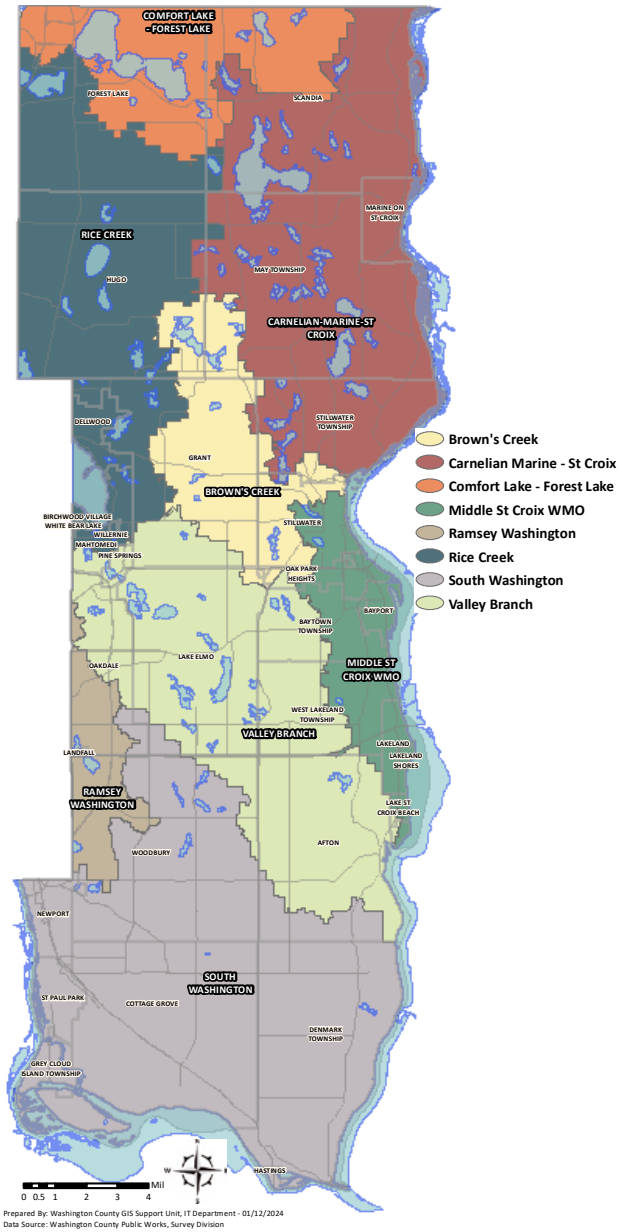


Figure 5. Location of Watersheds in Washington County Map

quality, forestry, soil health, erosion control, and habitat improvement projects in urban and rural portions of the county.

- Construction site erosion control Inspections and maintenance of BMPs for local partners.
- Management and prevention of terrestrial and aquatic invasive species.
- Works with federal partners like the Natural Resources Conversation Service (NRCS).

Lower St. Croix Partnership

New since adoption of the last county Groundwater Plan, a Comprehensive Watershed Management Plan was developed as part of the State of Minnesota's One Watershed One Plan (1W1P) program. The State's vision and purpose of the 1W1P program is to align local water planning on major watershed boundaries with state strategies towards prioritized, targeted, and measurable implementation plans.

The process results in a comprehensive watershed plan and offers the opportunity for groups and organizations to work together in both planning and implementation across jurisdictional boundaries. While the resulting plan is comprehensive in that it includes improvements and protection for a variety of natural resources across a large geographic area, it also incorporates detail in its prioritization and targeting actions and outcomes for specific waterbodies. The Lower St. Croix Partnership Comprehensive Watershed Plan was developed through a memorandum of agreement and collaborative partnership among 15 local governments including 4 counties, 5 soil and water conservation districts (SWCD), 2 watershed management organizations (WMO), and 4 watershed districts (WD). Partners included Anoka SCWD, Brown's Creek WD, Carnelian-Marine-St. Croix WD, Chisago County, Chisago SWCD, Comfort Lake-Forest Lake WD, Isanti County, Isanti SWCD, Middle St. Croix WMO, Pine County, Pine SWCD, South Washington WD, Valley Branch WD, Washington County, and Washington Conservation District. Together, these groups are known as the Lower St. Croix (LSC) Partners or Partnership.

Strategies in this Groundwater Plan align with and complement the LSC plan where possible, though the county Groundwater Plan covers the entirety of Washington County, where the LSC plan only covers the portion found in the LSC watershed. For more information, visit the Lower St. Croix Watershed Partnership.

Adjacent County Plans

Metro County Groundwater Planning is an optional authority under Minnesota Statute 103B. Only two other metro counties have current approved groundwater plans as of 2024, Carver County and Dakota County, one of which, Dakota, is an adjacent county. The State approved the Carver County plan in 2015, and the Dakota County plan in 2020. Other adjacent metro counties (Anoka, Ramsey) do not have currently approved groundwater plans but do address groundwater concerns through other efforts.

The other county plans address similar issues around groundwater quality and quantity. Washington County and Dakota County have collaborated on joint initiatives with respect to education around chlorides and private wells, and Washington County will continue to identify opportunities to partner in the future.

No Conflicts Between Groundwater Plan and Other Local Plans

Review of groundwater-related plans did not identify any potential conflicts. The county reviews other plans and related processes (environmental review, watershed rules) through the lens of the Groundwater Plan, to ensure that groundwater issues are identified and can align when possible.

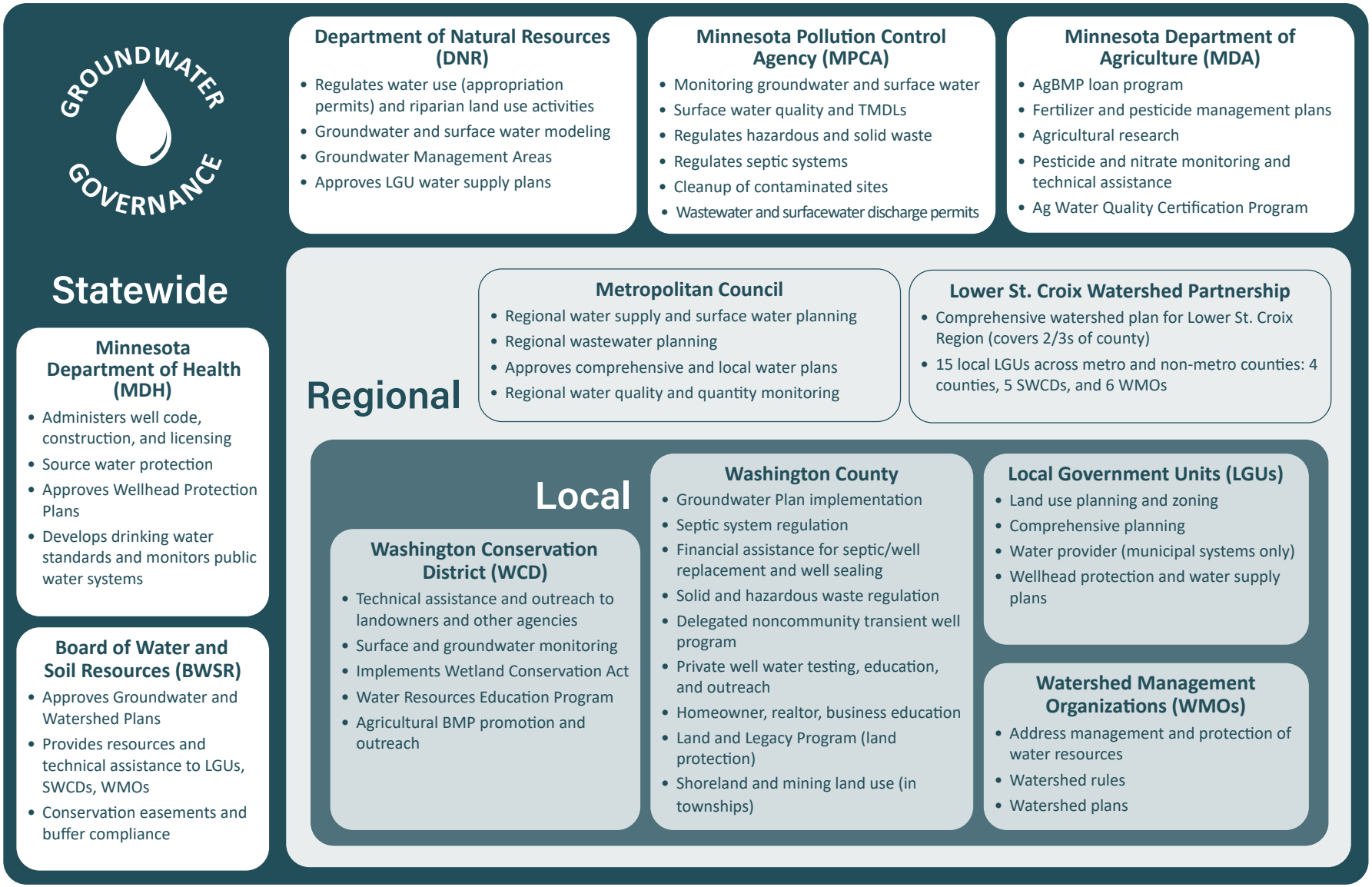


Figure 6. Water Governance Figure

3.3 Non-Governmental Roles

University of Minnesota

The University of Minnesota (UMN) also has roles related to groundwater and drinking water. These include:

- The Minnesota Geological Survey (MGS), a research and service unit of the University, provides systematic geoscience information to support stewardship of water, land, and mineral resources. A primary component of that work is the development of County Geologic Atlases, done in partnership with the DNR, as well as maintaining the Minnesota Well Index with MDH. The County Atlas and Well Index are valuable tools for the state, regional, and local partners including the county. MGS completed an update of Part A of the Geologic Atlas for Washington County in 2016.
- UMN Extension provides specialized training and outreach throughout Minnesota for groups such as farmers, turf and landscape professionals, and licensed septic system contractors.
- The Water Resources Center (WRC) conducts research, education, outreach, training, and Extension to advance the science of clean water in Minnesota.
- The College of Food, Agricultural, and Natural Resources Sciences (CFANS) conducts research within several water resources areas, including agricultural water quality research and BMPs.

Other Organizations

In addition to government agencies, there are many local, state and regional organizations that have a role in groundwater protection in the county. This can include education and outreach, land protection and preservation, volunteer management, and other types of water resources protection.

This includes (and is not limited to):

Belwin Conservancy's Oxbow Trails in Afton. Like many of the non-governmental organziations listed below, Belwin champions land protection and habitat restoration efforts that bolster biodiversity and create natural groundwater quality and quantity protections. Belwin works to conserve 1,500 acres of Minnesota St. Croix Valley land. Please read more into the incredbile conservation work of each of these organizations.

- Belwin Conservancy
- Environmental Initiative
- Freshwater
- Friends of the Mississippi River
- Great River Greening
- Manitou Fund
- Minnesota Ground Water Association
- Minnesota Land Trust
- Minnesota Water Well Association
- Minnesota Well Owners Association
- Minnesota Land Trust
- Nature Centers
- Wild Rivers Conservancy

Chapter 4. Groundwater Resource Overview

Groundwater resources are a major component of the region's basic infrastructure and must be managed, protected, and conserved to sustain the economic vitality and environmental health of the county. To accomplish this, the science of groundwater must be understood. The Groundwater Resource Overview provides technical information necessary for understanding and addressing groundwater issues in the county. Topics discussed include geology, geomorphology, groundwater hydrology, current climate patterns, surface water interaction, and groundwater related natural resources. Much of this information comes from the Geologic Atlas, a joint venture between the Minnesota Geological Survey (MGS) out of the University of Minnesota, and the Minnesota Department of Natural Resources (DNR). For more information, including access to the maps and data, one can go to the County Geologic Atlas site.

4.1 Geology and Landscape

Groundwater moves through several geologic formations within the county. Advancing and retreating marine seas left behind a sequence of limestone, sandstone, and shale bedrock layers dating back to the Paleozoic Era (570 to 245 million years ago). Following these events, the bedrock was subjected to a long period of erosion. Beginning about 1.5 million years ago in the Quaternary period, a sequence of glaciers advanced and retreated across the county shaping the land and leaving in their wake formations of clay, silt, sand, and gravel on top of bedrock formations.

Bedrock Formations and Structure

Bedrock found at the land surface or immediately beneath younger glacial deposits was formed in shallow seas during the Paleozoic Era (570 to 245 million years ago). These layers or beds of sandstone, shale, and limestone are collectively referred to as sedimentary rocks. These rocks are divided into groups or formations based on similarities in age or rock type. Figure 7 illustrates the bedrock geology of the county showing the differing rock types and groupings. Table 8, on the following page, provides a description of the bedrock geologic formations or groups.

The bedrock structure refers to the angle of the layers or beds, faults, fractures, and erosional features. Sedimentary rocks are typically deposited in horizontal beds or

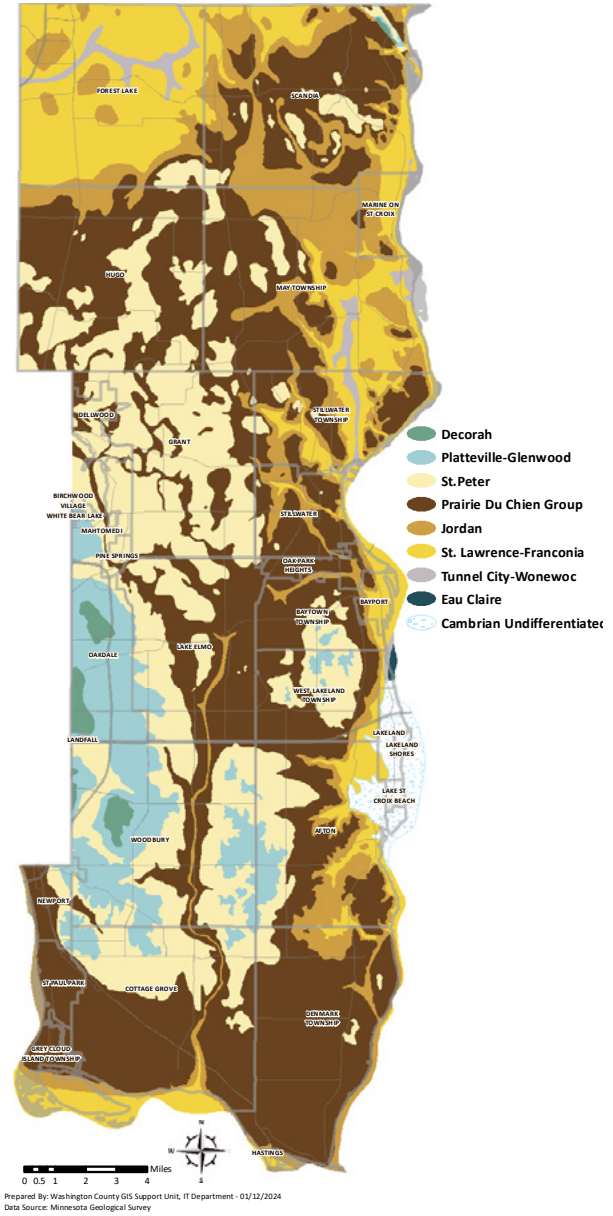


Figure 7. Bedrock Geology Map

layers. Over time, these beds are subjected to small movements within the earth's crust causing downward and upward folding, fracturing, and faulting. In most cases in the county, the bedrock layers tilt gently to the west. Minor folding of the rock occurs in eastern portions of the county. Some faulting of the rock also occurs near the St. Croix River. The Twin Cities Basin is a result of many small folds and faults in a stepwise fashion. Faults appear to be a much more important structural feature in southern Washington County than folds. One large fold, the Hudson-Afton anticline, is likely better described as a series of northeast-southwest trending normal step faults with a displacement of 50 to 150 feet. Numerous block faults in the southeastern portion of southern Washington County were identified during an evaluation of nitrate concentrations in bedrock aquifers.

In addition to the minor movements and fracturing, bedrock is subject to weathering and erosion. Weathering is caused by the actions of freezing and thawing, and by chemical dissolution of minerals in the rock. Sinkholes and caves are known to exist in areas along the Mississippi and St. Croix River Valleys. These features were formed by the chemical erosion of limestone bedrock. Sinkholes and caves are referred to as karst features which are visible in the southern part of the county where shallow depressions on the land surface have been caused by the sinking of underlying bedrock. These features can be seen in Figure 9 on page 46. The bedrock formations in the county were eroded first by water and then by glacial ice over a several hundred-million-year period. Figure 8 (page 46) illustrates the present topography of the bedrock surface as it exists below the surface or glacial sediment. This map represents the extent to which the original bedrock formations were eroded. Prior to the advance of glaciers, the land surface was dissected by stream gullies and valleys separated by bedrock uplands and plateaus. This eroded bedrock surface was later buried by sediment derived from glaciers. The present topography of the county was influenced to a major extent by the pre-glacial topography. Many current low elevation areas are situated over bedrock valleys, becoming concentrated spots for lakes and wetlands. The dissected bedrock surface has an important effect on groundwater resources as is described later in this chapter.

Table 8. Bedrock Geology, Washington County

Age	Bedrock Formation or Groups	Description	Thickness (ft)
Upper Ordovician	Decorah Shale Platteville and Glenwood Formations	These three formations (including the St. Peter Sandstone) make up the youngest or uppermost bedrock found in Washington County. They are found only in south central portions of the County. The Decorah Shale is predominantly shale atop a bed of limestone, leading into the limestone-based Platteville Formation. The Glenwood Formation issues back a relatively thin layer of shale.	0- 40
	Platteville and Glenwood Formations		30-35
Middle Ordovician	St. Peter Sandstone	The St. Peter Sandstone consists of poorly cemented (crumbly) medium- grained, pure quartz sandstone. The lower portions contain inter-layered beds of shale and coarse sand. The St. Peter subcrops in much of the western portion of the County, and there are scattered remnants of the unit found throughout the northern and eastern parts of the County.	30- 35

Lower Ordovician	Prairie Du Chien Group	Dolostone dominates most of this unit. Minor sandstone and shale layers are found in the lower portions. The Prairie Du Chien is known to contain abundant fractures and openings and, in some areas, sinkholes and caves occur. Areas with sinkholes, large fractures and caves are called Karst areas. The Prairie Du Chien underlies most of Washington County. Notable absences of this unit occur in deeply incised bedrock valleys and in the extreme northwest and east- ern parts of the County. In central and southern parts of Washington County where the Prairie du Chien is thicker the lower 40 feet is a leaky aquitard.	130- 160
Upper Cambrian	Jordan Sandstone	The Jordan Sandstone consists of poorly layered, poorly cemented, medium- to coarse-grained quartz sandstone. The Jordan is found throughout Washington County with notable exceptions in deeply incised bedrock valleys in the north and east and a region in the extreme northwest part of the County.	50 - 300
	St. Lawrence Formation	The St. Lawrence Formation is composed of thin layers of shale and siltstone and is found under all of Washington County except in some areas along the St. Croix River and in the far northwest.	65 - 100
	Tunnel City Group	The Tunnel City Group (formerly the Franconia Formation) consists mostly of fine-grained quartz sandstone in southern Washington County and ranges from medium- to coarse-grained in the north. The upper portion is an aquifer and lower half to one third is an aquitard. The thickness of the Tunnel City Group ranges from 160 to 180 feet. These units underlie the entire County except a minor area in the St. Croix Valley.	35 - 45
	Wonewoc Sandstone	The Wonewoc Sandstone (formerly the Ironton-Galesville Sandstone) is composed of fine to coarse-grained quartz sandstone. This unit is found underlying all of Washington County except in one deeply incised portion of the St. Croix Valley in Lakeland.	50 - 60
Upper Cambrian	Eau Claire Formation	This formation consists of shale, siltstone and very fine-grained sandstone. This unit underlies all of Washington.	80- 100
	Mt. Simon Sandstone	The upper third of this unit consists of very fine-grained sand and siltstone beds. The lower two-thirds are composed of medium to coarse-grained sand- stone. The Mt. Simon underlies all of Washington County.	160- 280
Pre- Cambrian (Mesoproterozoic Age)	Undivided	These consist of layers of shale and sandstone overlying volcanic rocks. Includes Hinckley Sandstone and older rocks, undifferentiated.	?

Figure 8. Bedrock Topography Map (left)

Figure 9. Near Surface Sensitivity Rating Map (right)

Sinkholes and caves are referred to as karst features which are visible in the southern part of the county where shallow depressions on the land surface have been caused by the sinking of underlying bedrock. These features can be seen in Figure 9. The bedrock formations in the county were eroded first by water and then by glacial ice over a several hundred-million-year period. Figure 8 illustrates the present topography of the bedrock surface as it exists below the surface or glacial sediment. This map represents the extent to which the original bedrock formations were eroded.

Efforts to protect groundwater should be particularly concentrated in the orange and red areas featured on Figure 9. From the northern- to southern-most areas of the county, these areas are located directly next to or feed into bodies of water (near lakes in the Northern part of the county, and along the St. Croix and Mississippi Rivers along the South & East). This communicates that contamination generated in these areas has potential to impact recharge or discharge groundwater quality- impacting groundwater acquifers and the bodies of water they interact with.

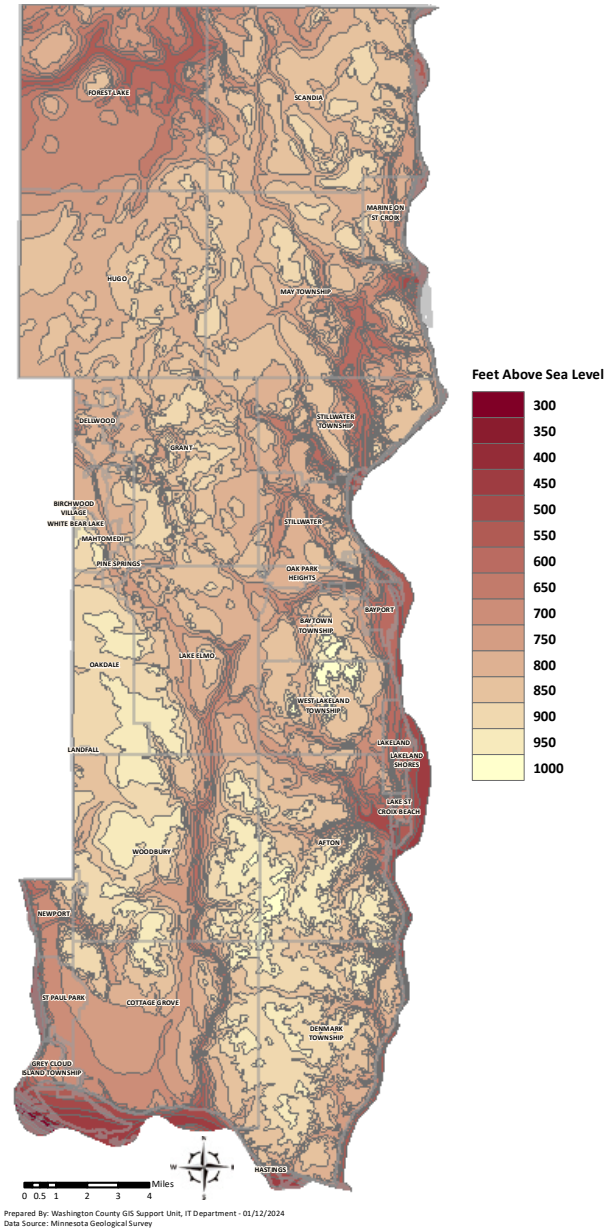


Figure 8. Bedrock Topography

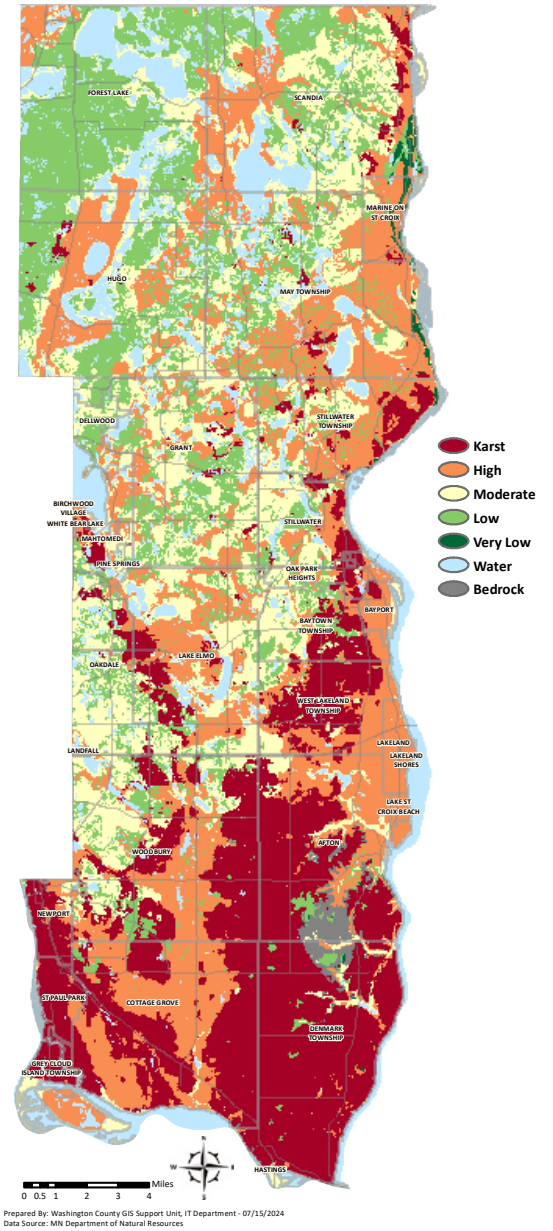


Figure 9. Near Surface Sensitivity Rating Map

4.2 Surface Geology

Understanding the physical characteristics, extent, and relationship of surface geology is key to developing an overall understanding of groundwater. Over the past 1.5 million years (Quaternary Period), continental scale glaciers advanced from northern regions four times into the county, eroding the bedrock and depositing sediment each time. The last two glacial advances significantly influenced the present surface geology and landscape.

These glaciers were several thousand feet thick and moved slowly, transporting and depositing large quantities of clay, silt, sand, and gravel. The glaciers deposited sediment in several different ways, which had a direct bearing on the present geology and landscape.

The southeast corner of the county was not covered during the last two glacial advances but was covered by older glaciers. Remnants of older glacial till cover some of the region. The landscape is dissected by ravines, gullies, and streams. Surface sediment has filled in some of these features but, in general, bedrock is found at or near the surface. Soils in this region tend to be thin and composed of fine sand and silt.

Figure 10 illustrates the Surface Geology in the county, providing the distribution of four glacial deposit types as grouped by the MGS. These deposit types, sand and gravel, fine sand, sandy silt, and glacial till, are described in Table 9.

Geomorphology

The shape of the land, or geomorphology, is a product of the long-term geologic processes described above. The pre-glacial landscape was strongly modified by glaciers in most of the county. Large quantities of coarse glacial sediment were deposited haphazardly at the glacier margin, creating a landscape dominated by hills and depressions. Farther from the glacier margin, broad, gently rolling plains of sand were deposited. Glacial lakes left behind regions of relatively flat silty and sandy soils. The southeast corner of the county represents a contrast to the recently glaciated areas.

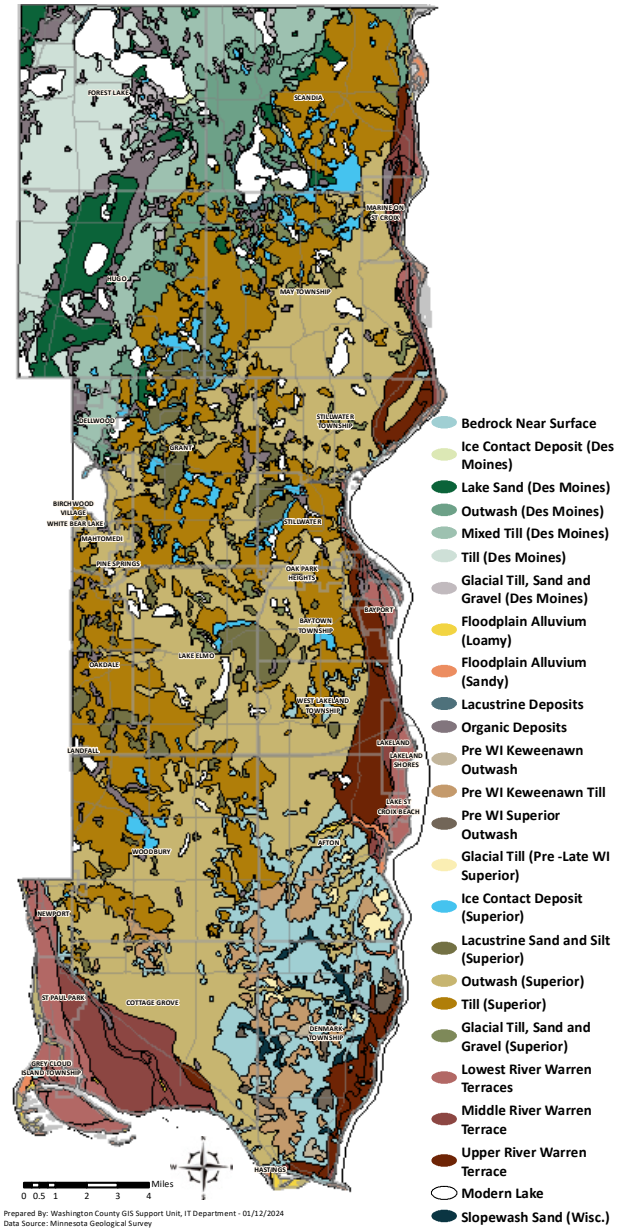


Figure 10. Surface Geology Map

Table 9. Surface Geology Unit Type & Description

Surface Geology Unit Type	Surface Geology Unit Description
Sand and Gravel	Sand and gravel deposits are widespread and deposited in three primary ways: a) at the glacier's margin by melt water, termed ice contact deposits; b) by glacial melt waters away from but still proximal to the ice margin, termed outwash deposits or glacial outwash; and c) by post glacial rivers that coursed through the St. Croix and Mississippi River Valleys. These are termed terrace deposits.
Fine Sand	Fine sand deposits are found in much of Washington County. The principal environment for the deposition of fine sands was in lakes. Fine sand is also found in post- glacial and modern river deposits.
Sandy Silt	In some locations, melt-water formed lakes within depressions of wasting ice mass. Sand and silt deposits structured in the bottom of these lakes are termed ice walled lake deposits or glacial lake deposits. Sandy silt deposits are found throughout the County and were deposited in both lake and river environments.
Glacial Till	Glacial till is deposited directly by glacial ice. Till is highly variable, containing a mix of sediment ranging from clay through sand, gravel, and boulders. Four discernable glacial till units have been mapped based on sediment type within the county. More in Table 10. Till is found at the surface and at greater depths in the northern part of the County. Till units are thickest in the north and thin to the south.

The county can be divided into five distinct geomorphic regions based on common geologic and topographic features. The five regions are described below.

St. Croix Moraine: The St. Croix Moraine is the dominant geomorphic feature in the county, marking the furthest, most eastern advance of the last great ice sheet in the region. Glacial sediment is up to several hundred feet thick. The landscape is characterized by rolling hills, ridges, and closed depressions. A complex mixture of ice-contact, outwash, ice-walled lake, and glacial till deposits cover the bedrock. Lakes and wetlands occupy many of the depressions. Streams are nearly absent. Most surface water either infiltrates into the ground or runs to closed depressions. The moraine dominates the central and northern parts of the county and extends into Woodbury.

Glacial Lake Hugo Plain: The Glacial Lake Hugo Plain lies in the northwestern part of the county. The terrain is gently rolling to flat. The surface geology consists primarily of fine sand and sandy silt glacial lake deposits and outwash. Wetlands and shallow lakes are common.

Lake Elmo-Cottage Grove Outwash Plain: As the last glacial ice melted back, a large area to its south was covered with sandy outwash deposits. The outwash plain is gently rolling and punctuated by shallow depressions and lakes. Parts of the plain are hilly where the outwash deposits overlay the rolling topography of the St. Croix Moraine. The outwash plain covers parts of the south-central region of the county extending from Lake Elmo to Cottage Grove. In the southern portion of the outwash plain, the bedrock surface topography is reflected by the undulating land surface.

Denmark Dissected Plain: The Denmark Dissected Plain lies in the southeastern part of the county outside the region covered by the last glacial advance. This area exhibits a gentle to strongly rolling topography controlled by the topography of the bedrock surface. In general, thin soils cover the bedrock. This region is distinct from the rest of the county because there is a relatively well-developed surface drainage system, and few lakes or wetlands are found.

St. Croix and Mississippi River Terraces: Broad flat to gently rolling areas covered by sand and gravel are found along the eastern and southern edges of

the county. These are called terrace features which were formed from the deposition of sediment in vastly larger glacial melt-water river valleys.

Figure 11 illustrates the locations of these regions. These regions share factors that influence groundwater and the issues that may affect groundwater resources.

4.3 Groundwater Hydrology

Groundwater flows through porous geologic materials. The less porous the geologic material, the greater the difficulty for groundwater to flow through it. The volume and rate that groundwater flows through geologic material is determined by primary and secondary porosity. Primary porosity describes the porosity of the geologic materials when they were originally deposited. Secondary porosity describes the porosity of the geologic materials that occurs after original deposition. Secondary porosity includes fractured and faulted bedrock. Faults can enhance or inhibit groundwater flow through bedrock structures.

Aquifers are geologic formations that transmit groundwater in sufficient quantities to a well for human consumption. Aquifers can exhibit primary porosity, secondary porosity, or a combination of the two. In the county, both porous sand and gravel glacial or surface deposits, and highly fractured, weathered, limestone and sandstone bedrock formations act as aquifers. Geologic units that transmit little groundwater are referred to as aquitards or confining layers. Aquitards can exhibit a range of porosity from nearly impermeable to moderately impermeable. All aquitards have some component of permeability and allow small amounts of water to pass through them. A fractured, faulted confining layer may allow groundwater to flow through faults, reducing the effectiveness of the confining layer.

In the county, clay or silt-rich glacial till (or lake deposits) and shale bedrock formations function as aquitards. Aquitards limit the amount of groundwater flow passing from one aquifer to another, making them either confined or unconfined. Confined aquifers, also called artesian aquifers, have aquitards above them. Unconfined aquifers have no aquitard above them and may also be considered a water table aquifer.

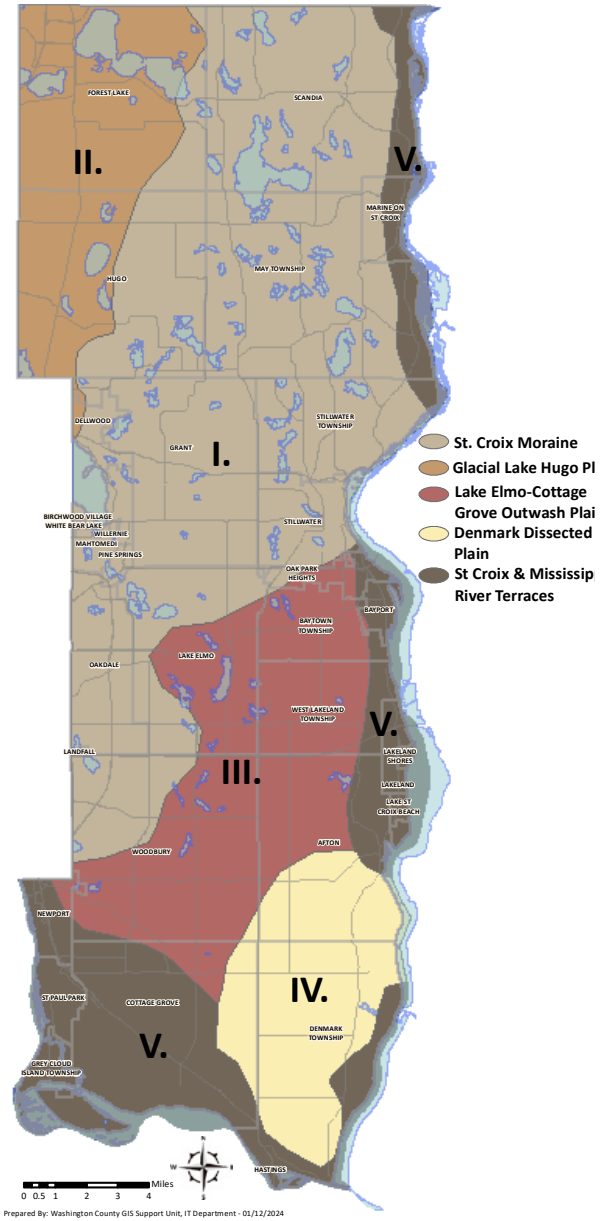


Figure 11. Geomorphology Map

County Aquifers and Aquitards; Hydrostratigraphy

The geologic units described on Tables 8 and 9 can be grouped and divided into either aquifers or aquitards. Hydrostratigraphy is the grouping of geologic units by the properties of groundwater flow.

The Quaternary formations are varied and complex in the county, as is groundwater flow through them. In some cases, such as with broad outwash plains, the geology and hydrology are predictable. In many cases though, especially in deeper, older glacial sediments, geologic formations change over short distances causing groundwater flow to be less predictable. Table 10 provides a description of the Quaternary aquifers and aquitards or hydrostratigraphy.

Bedrock Hydrostratigraphy

Four bedrock aquifer hydrostratigraphic units are found beneath the county. The units vary in thickness, porosity, permeability, and water quality. The principal bedrock groundwater sources used by county communities, well owners, and industry are the Prairie du Chien and Jordan aquifers. Other bedrock aquifers include the St. Peter Sandstone, the Tunnel City Group (formerly named the Franconia formation) the Wonewoc Sandstone (formerly named the Ironton-Galesville Sandstone), and the Mt. Simon Sandstone formations. Three bedrock hydrostratigraphic units function as major aquitards. Table 11 (pages 52 and 53) provides a description of the bedrock hydrostratigraphy of the county.

Table 10. Hydrostratigraphic Unit, Function, and Importance

Hydrostratigraphic Type	Hydrologic Function	Hydrostratigraphic Unit Description & Importance
Sand and Gravel	Major Aquifer and Minor Aquitard	Quaternary sand and gravel deposits are important aquifers in the County. These deposits occur at the surface and at varying depths down to bedrock. Sand and gravel units at or near the land surface function as important groundwater recharge areas. Water moves rapidly and in large quantities through sand and gravel aquifers. Drinking water supply wells in sand and gravel aquifers are found in the northern part of the County and in terrace deposits along the major rivers.
Fine Sand	Minor Aquifer	Quaternary fine sand aquifers are used infrequently for water supply but are important as groundwater recharge areas. Fine sand readily transmits groundwater but in most cases at moderate rates and quantities. Fine sand units tend to be relatively level or contain basins that enhance groundwater recharge.
Sandy Silt	Minor Aquitard	Sandy silt units function as aquitards because they transmit ground- water very slowly and in low quantity. Sandy silt units at the land surface allow less infiltration or recharge to aquifers. Sandy silt is found at the surface and at depth.
Glacial Till	Minor Aquitard to Major Aquitard	Because they vary greatly in sediment size and density, glacial till units can function as minor aquifers to aquitards in Washington County. Sandy, less compacted tills function as minor aquifers. Two tills with higher percentages of sand and gravel have been mapped in the county. Dense, clay and silt rich tills transmit water at lower rates and quantities and function as aquitards. Two till units have been mapped having greater abundance of clay and silt in the county.

Figure 12 provides a Hydrostratigraphic cross section of the Twin Cities' metro, including Washington County, and gives illustration to the content discussed in Tables 8, 11, & 13.

Quaternary bedrock overlays the metro region in various degrees of depth; at the bedrock's shallowest point (the right-most area of the cross section), it represents Washington County. As discussed in Geology & Landscape, glacial movement carved out this top bedrock, leaving the surface of Washington County relatively close to Paleozoic acquifers, not only producing plentiful waterbodies but also producing greater groundwater sensitivity and possibility of contamination. See Table 11 for an overview of the 4 major bedrock aquifers and 3 major bedrock aquitards found in this era of bedrock.

The Precambrian bedrock (undivided) consists of layers of shale and sandstone overlying volcanic rocks. This includes Hinckley Sandstone and older rocks.

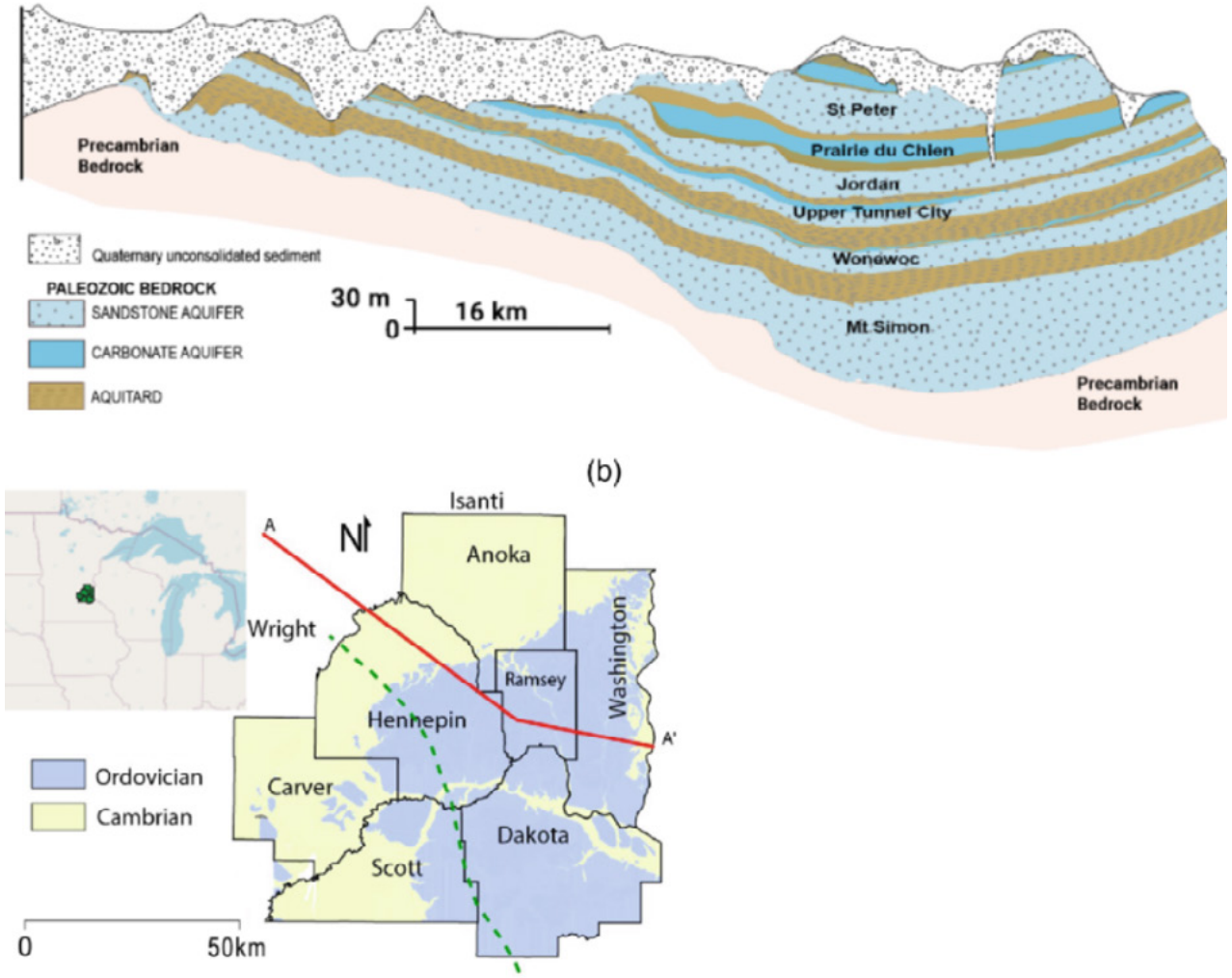


Figure 12. Hydrostratigraphic Cross Section Illustration

Table 11: Hydrostratigraphy, Washington County

Hydrostratigraphic Unit	Hydrologic Function	Hydrostratigraphic Unit Description & Importance	Thickness (ft)
Decorah Shale	Aquitard	The Decorah Shale functions as a groundwater confining unit. Minimally permeable shale tops and, in few locations, interweaves with fossiliferous limestone across this unit. Though discontinuous, water well logs indicate no exposures inside Washington County.	0- 40
Platteville and Glenwood Formations	Aquitard	This unit describes the Platteville Formation and the underlying Glenwood Formation. The Platteville Formation is the dominant uppermost bedrock unit across a large expanse of the southwestern part of the county, largely consisting of limestone and dolostone. The Glenwood formation is comprised of shale. Also, a confining unit.	30- 35
St. Peter Sandstone	Aquifer Minor Aquitard Minor	The St. Peter Sandstone is discontinuous in Washington County. The St. Peter was eroded significantly prior to deposition of glacial sediment. The unit is a minor source of water for private well use. In some areas, the lowest portion of the St. Peter, known as the Pigs Eye Member, contains siltstone and shale and may act as a confining layer.	130- 160
Prairie Du Chien Group	Aquifer Major Aquitard	The Prairie Du Chien Group limestone is an important aquifer in Washington County because it is relatively thick and exhibits a high level of porosity. Many private and public water supplies tap into this source. The aquifer is available nearly County-wide with exceptions in the northwest corner and far eastern side of the County. In central and southern Washington County where the Prairie du Chien is thicker, the lower 40 feet is a leaky aquitard.	50- 300
Jordan Sandstone	Aquifer Major	The Jordan Sandstone is the most used aquifer for municipal purposes in Washington County. It is another relatively thick and porous unit that supplies abundant water to wells. It is available in nearly all areas of the County. It represented about 57% of total water use origination for Washington County in 2016.	65- 100
St. Lawrence Formation	Aquitard	The St. Lawrence Formation is composed of thin layers of shale and siltstone and is found under all of Washington County except in some areas along the St. Croix River and in the far northwest.	35- 45
Tunnel City Group	Aquifer-Upper Aquitard- Lower	The Tunnel City Group (formerly the Franconia Formation) is a thick shale and siltstone unit. The upper portion is an aquifer and lower half to two thirds is an aquitard.	160- 180

Wonewoc Sandstone	Aquifer Major	The Wonewoc Sandstone (formerly the Ironton-Galesville Sandstone) consists of porous sandstone. This aquifer is used in areas of the County where the shallower Prairie Du-Chien-Jordan aquifer is absent or may be unusable. The aquifer underlies most of the County except near Lakeland.	50- 60
Eau Claire Formation	Aquitard	The Eau Claire Formation shale and siltstone transmit little water. This unit acts to effectively separate the Wonewoc Aquifer from the Mt. Simon Aquifer.	80- 100
Mt. Simon Sandstone	Aquifer Major	This is a productive aquifer located beneath the entire County. It is used only in areas adjacent to the St. Croix River and, in one case, in Forest Lake. State Statute limits the use of this aquifer to potable water and only when there are no other feasible or practical alternatives.	160- 280

4.4 Groundwater Recharge

Infiltration of surface water into groundwater, or recharge, occurs in recharge areas. Recharge capability is controlled by the amount and timing of precipitation, the surface geology and geomorphology, bedrock geology, bedrock topography, and land use; each producing a direct bearing on the future of county groundwater quantity and quality. Groundwater recharges water table aquifers in widespread areas of the county where surface sediment is highly to moderately permeable. Recharge is particularly focused in flat areas and in areas where depressions dominate the land surface. Groundwater recharges the bedrock where bedrock aquifers are in contact with water table aquifers or where bedrock is close to the land surface.

In aquifers, groundwater is driven by gravity, migrating both vertically and horizontally, towards groundwater discharge areas. Groundwater discharge areas include streams, lakes, wetlands and wells. The major groundwater discharge zones in the county are the St. Croix and Mississippi Rivers. Recharge and discharge areas are shown in Figure 13.

Water bodies that do not function as groundwater recharge or discharge features are referred to as perched. Perched lakes and wetlands are separated from groundwater by a confining geologic formation composed of finer grained clay or silt material.

Groundwater Recharge to Water Table Aquifers

The quantity of groundwater recharge varies from year-to-year and decade-to-decade based on climate fluctuations and land use. Differing geology and geomorphology influence where groundwater recharge is more or less prevalent. The quantity and quality of groundwater recharge can be altered by human activity. In urban regions, where the land cover contains a higher percentage of impervious surfaces, groundwater recharge may be reduced. Point source and non-point source pollution released in groundwater recharge areas will degrade water quality.

The five main geomorphic regions of the county function in varying capacities as groundwater recharge areas. The recharge characteristics of the five regions are described in Table 12 (page 55).

Groundwater Recharge to Bedrock Aquifers

As presented in Table 11, one minor and three major bedrock aquifers lay below the county. Aquitards provide separation between these aquifers.

For bedrock aquifers to recharge there must be a pathway for groundwater to move from the surface downward; specifically, in areas where aquitards are absent. The upper bedrock aquifers (St. Peter Sandstone, Prairie du

Chien group, Jordan Sandstone) receive recharge waters from overlying sand and gravel, fine sand, or sandy till glacial sediment. Recharge to deeper bedrock aquifers is concentrated in bedrock valleys where aquitards have eroded away, and the deeper aquifers are in contact with water bearing glacial sediment. Figure 8 shows the locations of bedrock valleys and Figure 7 shows the uppermost bedrock surface beneath the glacial or surface sediment.

Deeper aquifers also receive recharge through leaking aquitards. Recharge through aquitards, though less significant, is an important source of groundwater in the deepest aquifers.

Groundwater Flow and Discharge

Groundwater flows horizontally and vertically through aquifers from recharge areas to discharge areas. Groundwater flow can be mapped using water level elevation data collected from wells and surface water bodies.

Groundwater flow through the water table aquifer follows three general paths:

1. From recharge areas to local discharge areas such as minor streams, ditches, wetlands, and lakes.
2. From recharge areas into the major river valley discharge areas (Mississippi and St. Croix).
3. From recharge areas through the water table aquifer into bedrock aquifers.

In the county, groundwater moves from the central upland regions flowing in a radial pattern to the east, south, and west. Groundwater discharges to both the Mississippi River to the south and west and to the St. Croix River to the east. Along the west edge of the county, groundwater flows into Ramsey and Anoka Counties.

Groundwater discharges into the major rivers through sand and gravel deposits. Discharge is also concentrated in seeps, bedrock fractures, in ravines eroded back from the main river valleys, and along contacts between confining layers and aquifers.

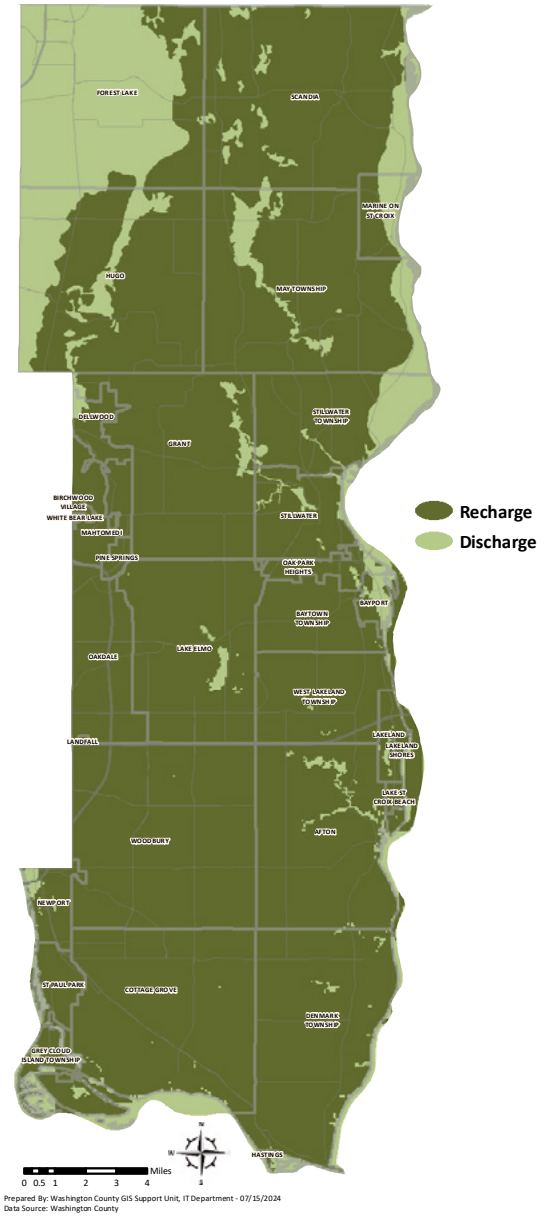


Figure 13. Recharge & Discharge Areas Map

Table 12. Geomorphic Region – Topography/Geology and Groundwater Recharge Function

Geomorphic Region	Topography/Geology	Groundwater Recharge Function
St. Croix Moraine	The heavily rolling moraine land surface is covered with permeable sand and gravel and moderate to less permeable fine sand deposits and glacial till. In urbanized areas of the moraine (Oakdale, Woodbury, Stillwater) there is a higher degree of impervious surfaces. Natural surface water drainage is limited to a few small creeks. Abundant closed depressions containing lakes and wetlands are common. Other depressions are dry.	Recharge occurs over most of the moraine. Areas with higher amounts of clay or silt till and ice walled lake sediments have lower recharge functions. Closed depressions and level sandy regions function as key recharge areas.
Glacial Lake Hugo Plan	Relatively low-lying and gently rolling to flat land. Contains mostly fine sand and silty sand units. The water table is generally very close to or at the land surface. Surface water drainage systems are relatively undeveloped (except in ditched areas).	In areas where there is sufficient thickness of unsaturated materials between the land surface and the water table, a moderate to high amount of recharge will occur. Area largely serves as a discharge area.
Lake Elmo – Cottage Grove Outwash Plain	Moderately flat to rolling and dominated by fine to medium sand material. Closed depressions contain lakes and wetlands, others are dry. There is generally little natural surface water drainage. In the southern part of this region, the sandy outwash unit thins and lies directly in contact with the bedrock.	Because of the gentle terrain, the abundance of permeable geologic material and the presence of numerous closed depressions, this is a key recharge area in the county.
Denmark Dissected Plain	Moderately rolling to rugged terrain with thin soils or bedrock at the surface. There is a well-developed surface water drainage network of small ravines and valleys. Closed depressions (karst features) are present but not abundant and are typically dry. The fractured and karsted Prairie Du Chien aquifer is close to the surface.	Recharge is mainly into the Prairie Du Chien and Jordan Aquifers. Much of the region is subject to rapid infiltration of surface precipitation into the groundwater system.
St. Croix and Mississippi Terraces	These regions border the Mississippi and St. Croix Rivers and are generally level to moderately rolling. The surface geology consists of abundant sand and gravel.	Groundwater recharge is high on the flat sand and gravel plains. Moderate discharge area to St. Croix River.

Table 13 (next page) describes the hydrogeologic factors affecting recharge of bedrock aquifers.

Groundwater is also discharged to domestic, municipal, and industrial wells. High-capacity wells can have a significant impact on groundwater flow, creating zones of influence miles in diameter. When a well is pumped, it creates a drawdown in the aquifer water level. This drawdown, referred to as the cone of depression, can extend for great distances depending on the rate of pumping, capacity of the aquifer, and influence of other wells. Human consumption or use of groundwater has a pronounced impact on groundwater quantity. The conservation of groundwater quantity is important to preserve groundwater resources, particularly in a future altered by climate change. More on this subject is covered in Chapter 7, Groundwater Quantity.

Table 13: Recharge Factors Bedrock Hydrostratigraphy, Washington County

Hydrostratigraphic Unit	Hydrologic Function	Description of Groundwater Recharge Factors
Decorah Shale	Aquitard	Prevents recharge to the St. Peter Sandstone and underlying bedrock aquifers. Present in much of Woodbury and Cottage Grove and in parts of Lakeland, Afton and Denmark Township.
Platteville and Glenwood Formations	Aquitard	The Platteville Formation is the dominant uppermost bedrock unit across a large expanse of the southwestern part of the county. Recharge into lower aquifers may be focused along the edges of the Platteville.
St. Peter Sandstone	Minor Aquifer Minor Aquitard	Recharged in areas where it is not overlain by the Decorah/Platteville/ Glenwood confining layer, generally in the west central part of the County (Mahtomedi, Dellwood and Grant). The lower portion may act as a minor aquitard to the Prairie Du Chien-Jordan Aquifers. Numerous erosion channels and windows are cut through exposing the Prairie Du Chien-Jordan Aquifer to Quaternary sediment and recharge.
Prairie Du Chien Group	Major Aquifer Aquitard	Recharge is from Quaternary aquifers. In general, regions on the St. Croix Moraine, Lake Elmo-Cottage Grove Outwash Plain and St. Croix and Mississippi Terraces not overlain by the Decorah- Platteville-Glenwood aquitard are significant recharge areas. In the Denmark Dissected Plain region, quaternary sediment is thin or absent and groundwater recharges directly to the Prairie Du Chien-Jordan system. In this area as well as areas along the major rivers, karst features may create highly permeable localized recharge conditions. In central and southern Washington County where the Prairie du Chien is thicker, the lower 40 feet is a leaky aquitard. The Jordan Sandstone is the most used aquifer for municipal purposes in Washington County. It is another relatively thick and porous unit that supplies abundant water to wells. It is available in nearly all areas of the County. It represented about 57% of total water use origination for Washington County in 2016.
Jordan Sandstone	Major Aquifer	
St. Lawrence Formation	Aquitard	The St. Lawrence Formation is composed of thin layers of shale and siltstone and is found under all of Washington County except in some areas along the St. Croix River and in the far northwest.
Tunnel City Group	Aquifer-Upper Aquitard- Lower	The Tunnel City Group (formerly the Franconia Formation) is a thick shale and siltstone unit. The upper portion is an aquifer and lower half to two thirds is an aquitard.
Wonewoc Sandstone	Major Aquifer	Recharge occurs in the far northwest and northeast portions of the County in isolated bedrock valleys where the Tunnel City Group is eroded. Communication with the overlying Quaternary aquifers will vary based on the thickness and extent of till that lies above the aquifer. Bedrock valleys are important conduits into this aquifer. Recharge from outside the County and leakage through the Tunnel City Group is also a factor.
Eau Claire Formation	Major Aquifer	A major region-wide aquitard preventing downward migration of groundwater to the Mount Simon Aquifer.
Mt. Simon Sandstone	Major Aquifer	Recharged outside of the county in areas where it is not overlain by the Eau Claire formation. Recharge from leakage through the Eau Claire Formation is also a factor. The Minnesota Department of Natural Resources has currently placed a moratorium on use of the Mt. Simon Aquifer for water supply.

Groundwater Recharge – Land Use

Land cover and land use changes are gradual. The spread of impervious surfaces on the landscape will, over time, slowly reduce groundwater recharge if not accompanied by storm water management and other practices that enhance or redistribute recharge. It would take decades of monitoring to actually measure the effects. To accommodate an expected population growth to 295,813 residents by 2030, activities on the land and alteration of the land surface will continue to have an impact on infiltration and ultimately recharge to the aquifer. The section, Aquifer Drawdown and Groundwater Recharge in Chapter 7, discusses specific tactics that will encourage infiltration and recharge areas in the county to offset continued land use changes. To assure long-term economic and environmental health, groundwater protection and conservation must be incorporated into city and county comprehensive plans, zoning ordinances, and land use decisions.

Figures 14 and 15 give example to factors influencing hydrologic movement and their potential planning impacts to LGUs. Maps such as Figure 14, Hydrogeologic Sensitivity of the water table aquifer, influence what activities may occur and how strongly LGUs regulate water recharge and contamination sources in specific areas of the county. Further, the low or high recharge rankings identified in Figure 15, can influence the planning efforts & recommendations of WMOs in Washington County. WMOs may regulate the use and development of land in their districts.

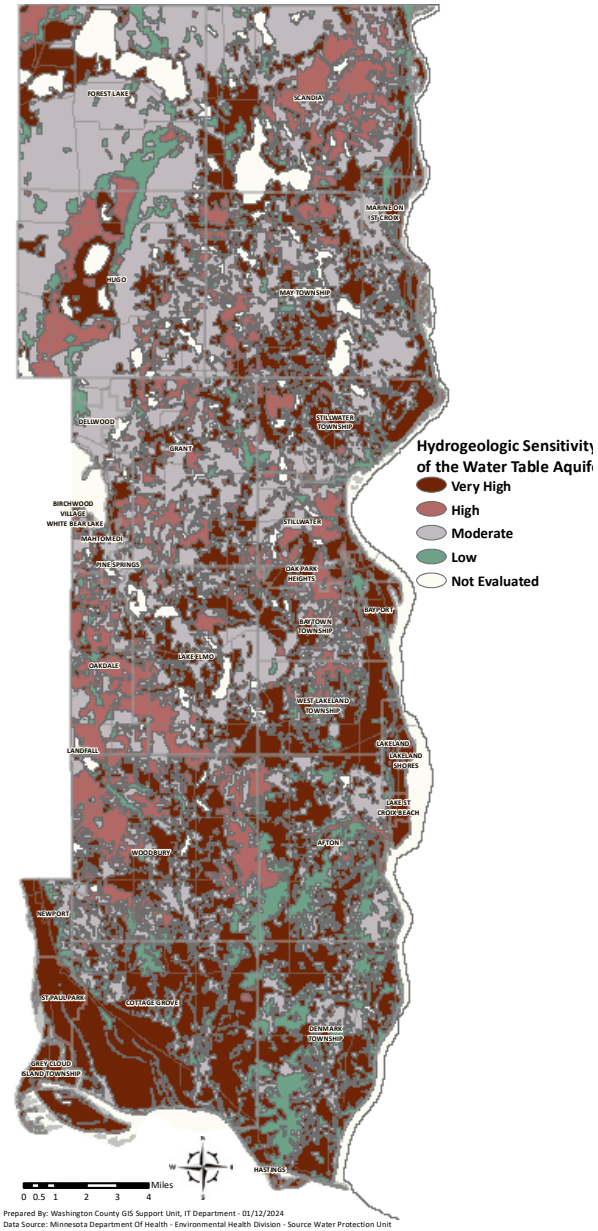


Figure 14. Hydrogeologic Sensitivity of the Water Table Aquifier

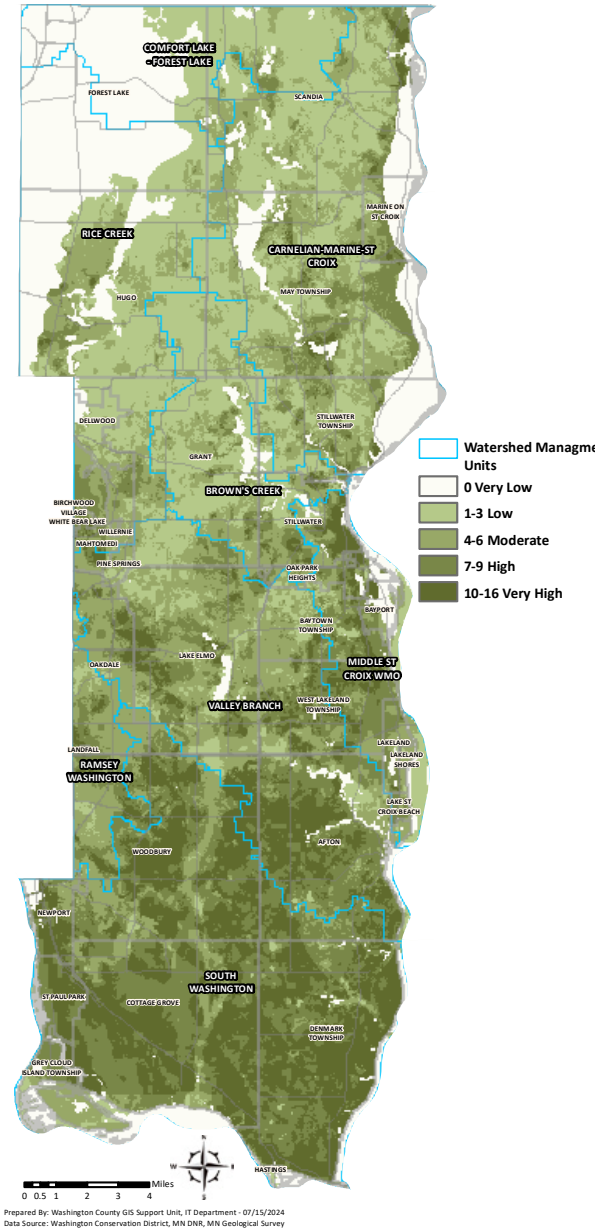


Figure 15. Recharge Priority Ranking & WMO Units

4.5 Climate and Groundwater Recharge

Precipitation amount is the principal driver for groundwater recharge volume. In turn, recharge volume impacts water levels in aquifers, the amount of water available to sustain human consumption, and the volume of water available to supply surface water bodies that depend on groundwater interaction.

The county lies in the northern mid-continental region of North America exhibiting a climate of warm humid summers and cold dry winters. The climate is influenced by three major elements: polar air masses originating in Canada, subtropical air masses originating in the Gulf of Mexico, and variable air masses from the Pacific regions. The region experiences noticeable short, near and long-term climatic variations in temperature and precipitation. In this region, the amount of precipitation considerably exceeds the amount of evaporation resulting in abundant surface water resources and groundwater recharge.

Based on the DNR's data on Minnesota Climate Trends, from 1900-2023, the average annual temperature in Washington County is 47.6°F. Temperatures average 20.4°F in January, the coldest month, and 71.5°F in July, the warmest month. There is a slight variation in temperature from the southern to the northern parts of the county. The first frost usually occurs in early October and the last frost usually occurs in mid-May. Figure 16 displays the average annual temperature over time, from 1900-2023. Since 1900, the overall temperature trend has been increasing. An increasing trend for Minnesota is that we are not dropping down to previous winter lows. Between 1895 and 2015, average daily low temperatures in winter have increased. In the northern part of the state, they're up 4.8 degrees over that period and 3.4 degrees in the south. And a recent study says Minneapolis and Mankato are the second- and third-fastest-warming cities in the country.

Also developed from the DNR's data on Minnesota Climate Trends, precipitation statistics since 1900 indicate an average annual precipitation of 32.5 inches. Figure 17 illustrates precipitation data from 1900 to 2023. As an overall trend, we are seeing an increase in precipitation. Statewide, annual precipitation is up 12 percent (3 inches a year) since 1895. However, there have been several periods of low precipitation in recent years, most notably in the late 1980s, from 2007-2011, and most recently 2021-2023.

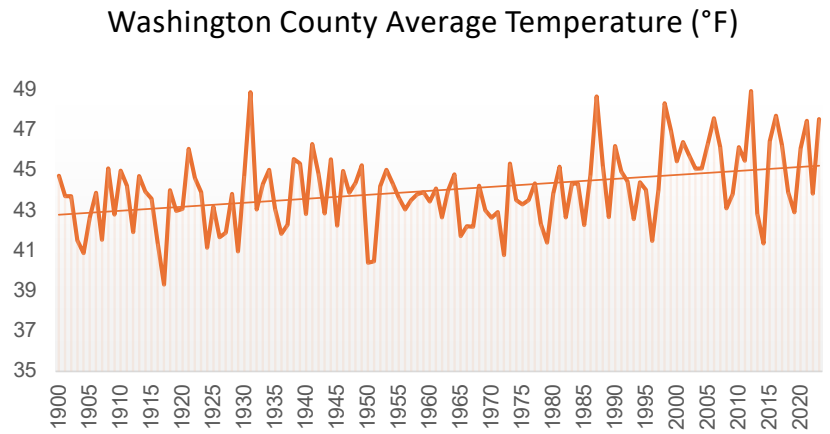


Figure 16. Washington County Average Temperature (°F) Graph

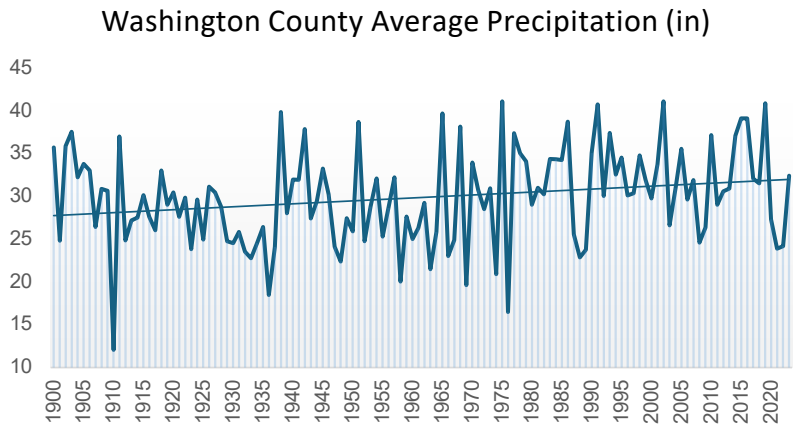


Figure 17. Washington County Average Precipitation (in) Graph

Climate Change and Groundwater Resources

As climate change brings its impact to the county, we must use climate projections to inform how we invest our energy and resources and prepare for the future. Preparation and projections are particularly important for tracking local conditions, as climate change increases precipitation variability and extremity, while generally creating a warmer and wetter environment. The better we can map the water and environmental demands of the future, the better we can plan for them today.

The Metropolitan Council, in coordination with information from the DNR Climatology Office, published the "Climate Vulnerability Assessment" explaining the confidence in specific climate projections for the Metropolitan Area through 2099. Highest among the list were warming winters and extreme rainfall. With warming winters, we will see continual loss of cold extremes and dramatic warming of Minnesota's coldest conditions. Extreme rainfall will bring about a continued increase in rainfall frequency and magnitude in addition to a rise in unprecedented flashfloods. Also high in confidence, heat waves will increase in severity, coverage, and duration. With moderately high confidence, droughts will result in more days between precipitation events, leading to increased drought severity, coverage, and duration. Heavy snowfall as well as severe thunderstorms and tornadoes are categorified as moderately low confidence.

Analyzing the above projections under a groundwater lens can lead to concerns related to our groundwater resources. With warming winters, more frequent freeze-thaw cycles and ice events will lead to greater use of road salt and other road chemicals, increasing the pollutant loading in meltwater. Similarly, more frequent extreme rainfall episodes will result in more recurrent localized and flash flooding. Flooding can often be seen as a water quality issue as flooding in urban or human impacted areas can carry pollutants, bacteria, sediment, and waste into recharge waterbodies. Flooding also demands infrastructure growth and development as well as a personal cost to those affected. Inundated wells and septic systems will need state and local assistance for compliance repairs or sealing. According to the US Federal Emergency Management Agency (FEMA), federal insurance claims for flooding damage averaged $1.9 billion a year annually between 2006 and 2015, making flooding the costliest and most common type of natural disaster in the US. Valley Branch Watershed District, after high flooding in 2023, has taken steps to secure properties in vulnerable flood risk areas.

An increase in heat waves and droughts can also impact the county's groundwater resources. As discussed, precipitation is among the largest factors impacting groundwater recharge. Even droughts of less magnitude, such as occurred in the late 1980s, triggered concerns about diminishing water supplies and lowered lake levels. A prolonged drought (the drought of the 1920s and 1930s is an extreme example) could create groundwater use conflicts between communities and the protection of natural resources. Drought impacts can be improved by human behavior changes in irrigation or water use.

4.6 Groundwater Dependent Resources

Lake Resources and Groundwater

Lakes provide important ecological and hydrological functions in addition to being desirable aesthetic features and important public recreation spots for swimming, boating, and fishing. Lakes function both as groundwater recharge areas and groundwater discharge areas. The role of groundwater in the overall ecological health of lakes and aquifers is important but often not well understood. For the purposes of this plan discussion will continue using the categories of discharge, flow-through, recharge, and perched.

Groundwater Recharge Lakes

Groundwater recharge lakes collect and store water that then recharges regional aquifers. Many lakes in the county are positioned above bedrock valleys, providing a steady source of water for recharging deeper bedrock

aquifers. Groundwater recharge lakes are significant to the maintenance of groundwater quality and quantity. Recharge lakes add stability to aquifer levels by collecting and storing large quantities of precipitation that will eventually infiltrate to groundwater systems. Watershed management goals should focus on maintaining the natural storage function in these lakes to promote groundwater recharge. Diverting water out of lake basins will decrease the amount of water available for recharge.

Groundwater quality can be impacted by the water quality in recharge lakes. Efforts to protect surface water quality will also protect groundwater quality. Examples of recharge lakes include Oneka, Goose, and Long Lakes in the northern part of the county and Tanners, Battle, and Colby Lakes in the southern part of the county.

Groundwater Discharge Lakes

Lakes dependent on groundwater discharge from springs are common in the county. Groundwater input varies by lake with some lakes receiving relatively high levels of spring flow and some lakes only moderate amounts of spring input. Lakes with abundant groundwater input tend to be clear and are highly valued by residents and the visiting public. The clearest and cleanest lakes in Washington County rely on high volumes of groundwater discharge or springs for their primary source of water. Discharge lakes in the county include Lake Elmo and Lake Edith.

Perched Lakes

Perched lakes are lakes with bottoms above the regional water table and do not receive inflow from regional groundwater. Lakes with very different water levels in close proximity are a common indicator of perched conditions.

Flow-Through Lakes

Flow-through lakes are those for which recharge and discharge occur in different areas. These can be important recharge areas and are also very sensitive to changes in groundwater levels. Several lakes in the county are classified as flow-through lakes including Big and Little Carnelian, Big Marine, Carver, Demontreville, Eagle Point, Forest Lake, Square Lake, and White Bear Lake.

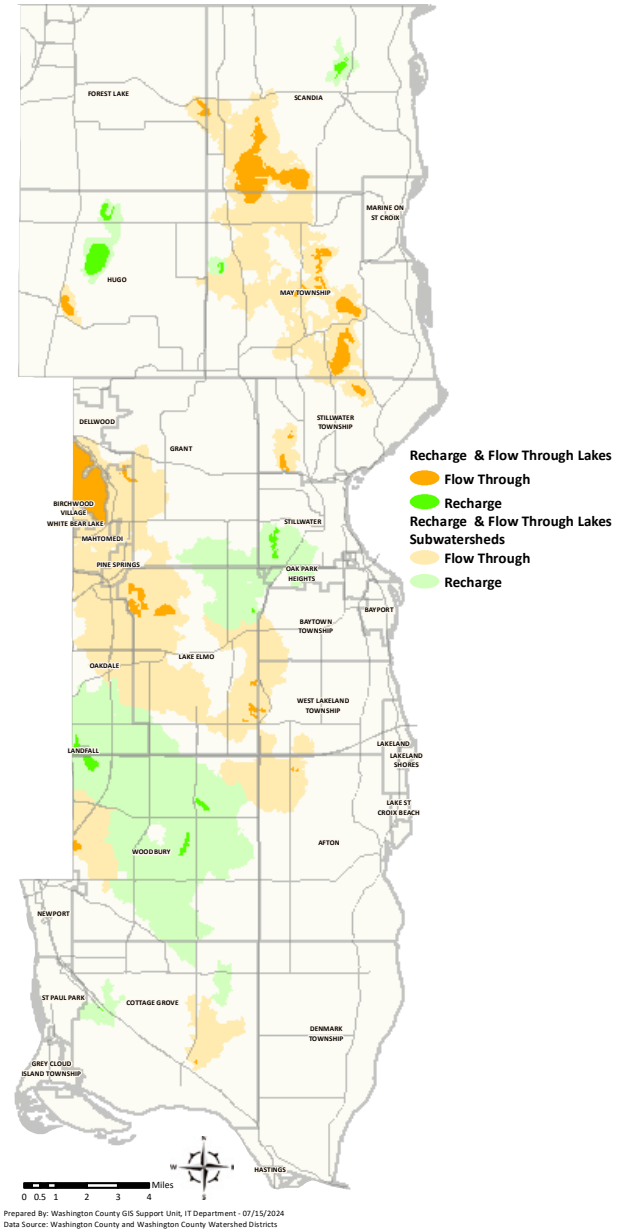


Figure 18. Recharge and Flow Through Lakes Map

Stream Resources and Groundwater

The county contains numerous spring-fed tributaries including Trout Brook, Valley Creek, Brown's Creek, the Mill Stream and other smaller named and unnamed creeks that are dependent on groundwater discharge to maintain flow and ecological health. The majority of the springs and creeks lie along the St. Croix River Valley. As with spring-fed lakes, spring-fed creeks are ecologically fragile.

Many of the Washington County spring-fed creeks are suitable for brook trout and brown trout to thrive and reproduce. The DNR lists six designated trout streams in the county, Figure 19. Numerous other small streams with naturally reproducing brook trout populations also exist in the county. These streams are not DNR "designated trout" waters.

Groundwater systems are the principal source of water for streams in the county. A study conducted by the St. Croix Watershed Research Station found that approximately 85 percent of the total volume of discharge from Brown's Creek was derived from groundwater sources. In the same study, it was found that approximately 92 percent of the volume of stream discharge in Valley Creek was from groundwater discharge. Maintaining sufficient quantities and high-quality groundwater are critical to maintain stream base flow and water temperatures. Spring flows to streams is threatened by both the depletion of groundwater recharge from the increase of impervious surfaces and the increase in pumping from aquifers that feed streams.

The St. Croix and Mississippi Rivers

The St. Croix and Mississippi Rivers border portions of the county – the St. Croix to the east and the Mississippi to the south. The St. Croix and Mississippi serve as surface water collection and recharge waterbodies. Work on bluff stabilization and shoreland protection are efforts that the county partners with the WCD and WMOs to reduce erosion risks and create river quality assurances. In 1968 , 200 miles of the St. Croix was named among the first group of 'Wild and Scenic Rivers' Act –

legislation binding specific protections and funding to the preservation of the river's scenic and ecological functions. In 1972, the 27 miles that represent the Lower St. Croix River, that forms the county's eastern border and stake in the river, were added to the Act.

Groundwater Fed Wetlands

The National Wetlands Inventory Map, Figure 19, illustrates the location of wetlands in the county. Wetlands are a critical resource for Minnesota state agencies and conservation organizations to track as they historically, and continue to be, the most abundant water feature in the state. In 2016, an MPCA study on the "Status and Trends of Wetlands in Minnesota" estimated the number of wetlands in the state to be 10.6 million acres. This number, though, represents a diminished stock of wetlands across the state. European settlement and large-spread agriculture drove the loss of 6.37 million acres of wetland in Minnesota by the 1980s. Each remaining wetland performs one or more of the following vital hydrologic functions: water storage and flood control, water treatment, groundwater recharge, groundwater discharge, or critical habit. It would be extremely difficult to quantify the exact benefit wetlands provide in protecting and conserving groundwater resources. Nevertheless, preserving and protecting the remaining wetlands in the county is critical to maintaining groundwater recharge and water quality.

The Minnesota Wetland Conservation Act (WCA) was signed into law in 1991. The purpose of the law is to prevent further loss of wetlands and to promote restoration of former wetlands. A "net gain" in wetlands is the desired result. The WCA requires persons proposing to drain or fill a wetland to first attempt to avoid the impact; second, attempt to minimize the impact; and finally, replace any impacted area with another wetland of equal function and value. The law is administered by LGUs and the WCD. Some communities within the county have additional rules in place that are meant to protect and preserve wetlands. Several WMOs also have rules in place to protect wetlands. The BWSR oversees WCA programs.

The DNR has tracked the status and trends of wetlands through a long-term monitoring program. Their 2006 to 2020 study concluded the state is accomplishing

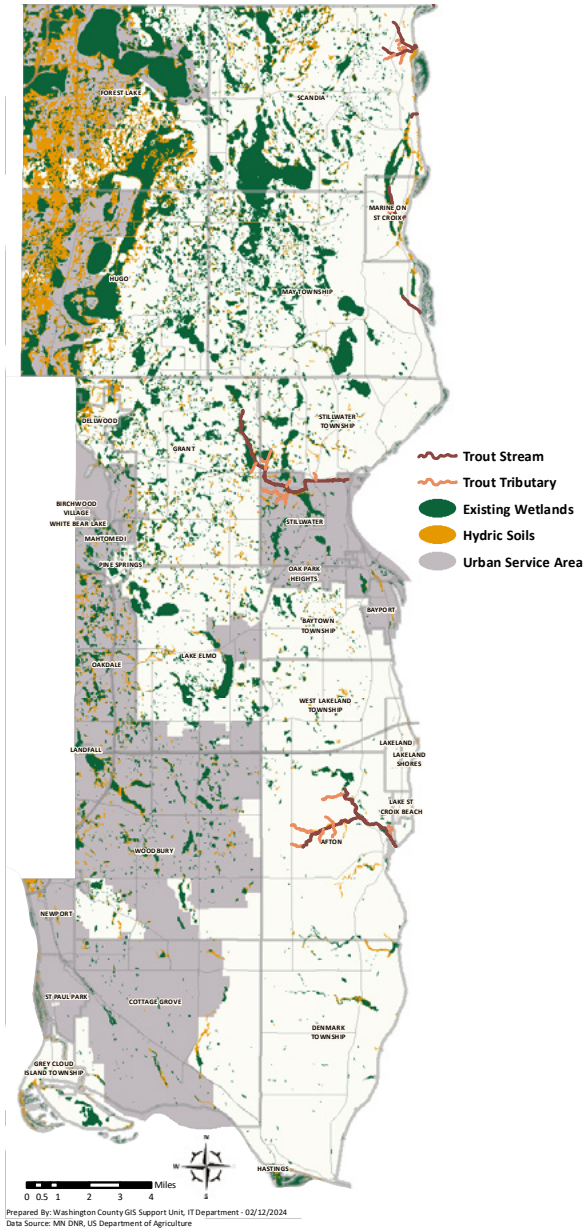
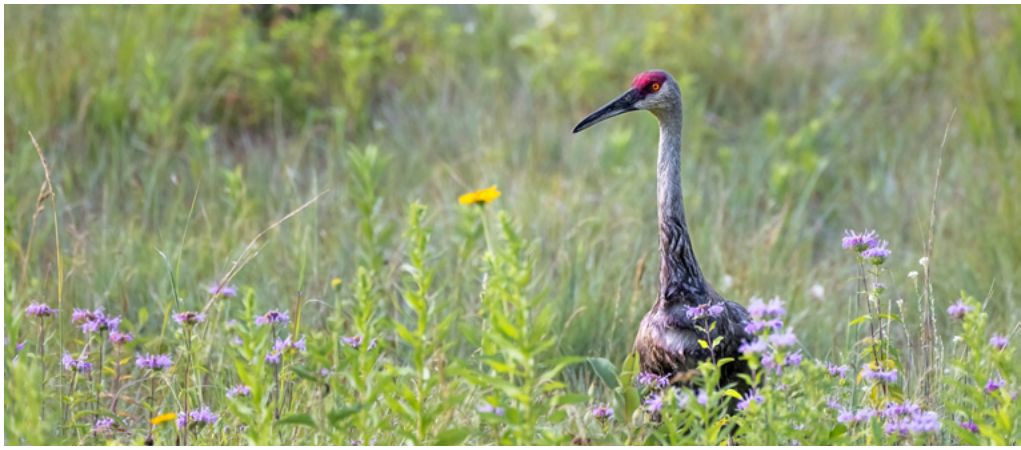


Figure 19. National Wetlands Inventory Map

the goals of WCA, securing gains in wetland preservation and area over time. This is largely seen in emergent and unconsolidated bottom wetlands. Both current gains and losses of wetlands are predominantly a result of direct drivers such as increased precipitation, infrastructure or building development (in accordance with the WCA), beaver activity, changes in agricultural practice – explaining 39-82% of wetland gains and from 88-100% of wetland losses. While Minnesota is achieving its goal of no wetland loss, current gains in wetlands may not capture the diversity of wetland classes lost through time and development. The absence of certain wetland classes results in the loss of unique habitats and environmental functions of these areas.



Unique and Rare Natural Communities

Groundwater discharge supports a number of different wetland types found primarily adjacent to streams and along the edges of the St. Croix and Mississippi River Valleys. Groundwater seepage provides a highly stable source of consistently cool, mineral rich water creating conditions suitable to support unique plant and animal communities. These communities are highly susceptible to disruption in groundwater discharge and from land disturbances.

According to the publication "St. Croix River Valley and Anoka Sand Plain- A Guide to Native Habitats," there are several unique and rare natural community types in the county dependent on groundwater seepage including black ash seepage swamps, hardwood seepage swamps, rich fens, circum neutral tamarack swamps, sedge meadows, wet prairies and moist cliff communities.

Groundwater seepage is the key feature that sustains these relatively rare natural resources. Several unique and rare plant and animal species are found in these groundwater seepage communities including the False Mermaid, American Water- pennywort, Bog Bluegrass, and Halberd-Leaved Tear Thumb. Rare animal species include the Red-Shouldered Hawk and the Louisiana Waterthrush. As with stream resources, threats to seepage wetlands include loss of groundwater flow from over-pumping, increasing impervious surfaces, loss of recharge from water diversion, and groundwater quality degradation.

Chapter 5. Population and Land Use

5.1 Population

The county is the 5th most populated county in Minnesota, with an estimated population of 278,936 as of 2023. Over the last 10 years, the county has added about 32,300 residents, a 13% increase. The Metropolitan Council projects that the county's population will reach 335,272 by 2050 (preliminary estimate, might change). The county has about 106,606 households. Changes in household composition continue to follow trends of recent decades: single person households increased, as did households headed by single females with children, while married couple households with children decreased. The average household size has continued to decrease, and most recent estimates are 2.55 people per household.

The county's population primarily uses public water supplies (87%). However, most cities still have some households that are not connected to the municipal water supply and instead have private wells, Figure 21. Most residents living in townships also rely on private wells.

The county continues to become more diverse. In 2022, White, non-Hispanic residents accounted for 84% of the population. Nearly 8% of the population is foreign-born. In the county, 15% of the population lives 200% below the Federal Poverty Level. This is lower than the state average of 22%; however, when census tracts that face housing, income, and poverty inequalities were tracked, people identifying as Black or African American faced the highest disparities in this area. The most recent data

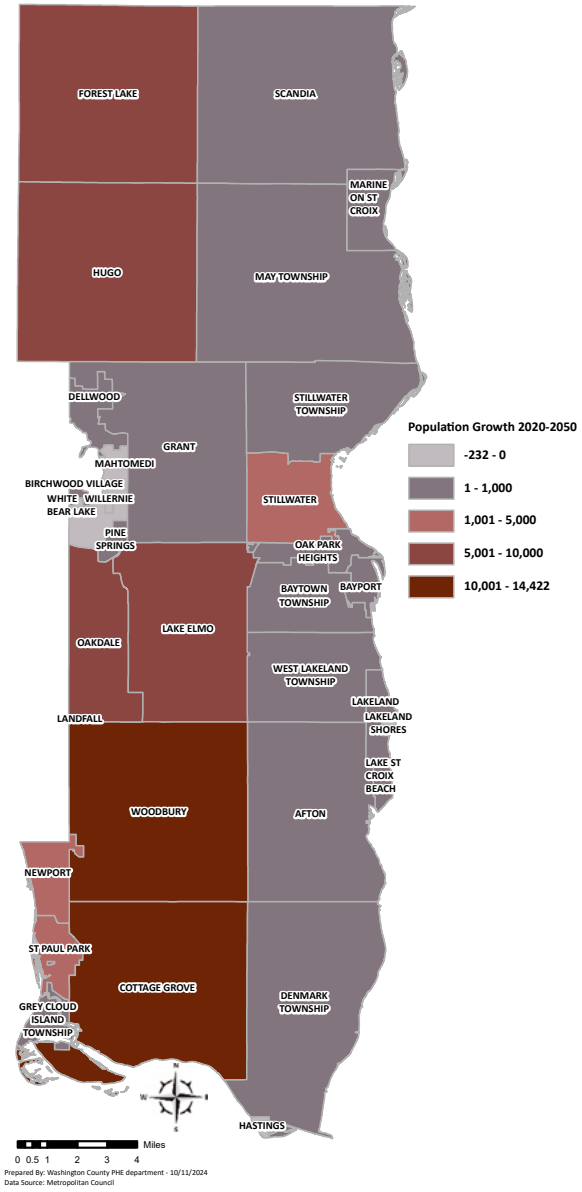


Figure 20. Projected Population Change Map

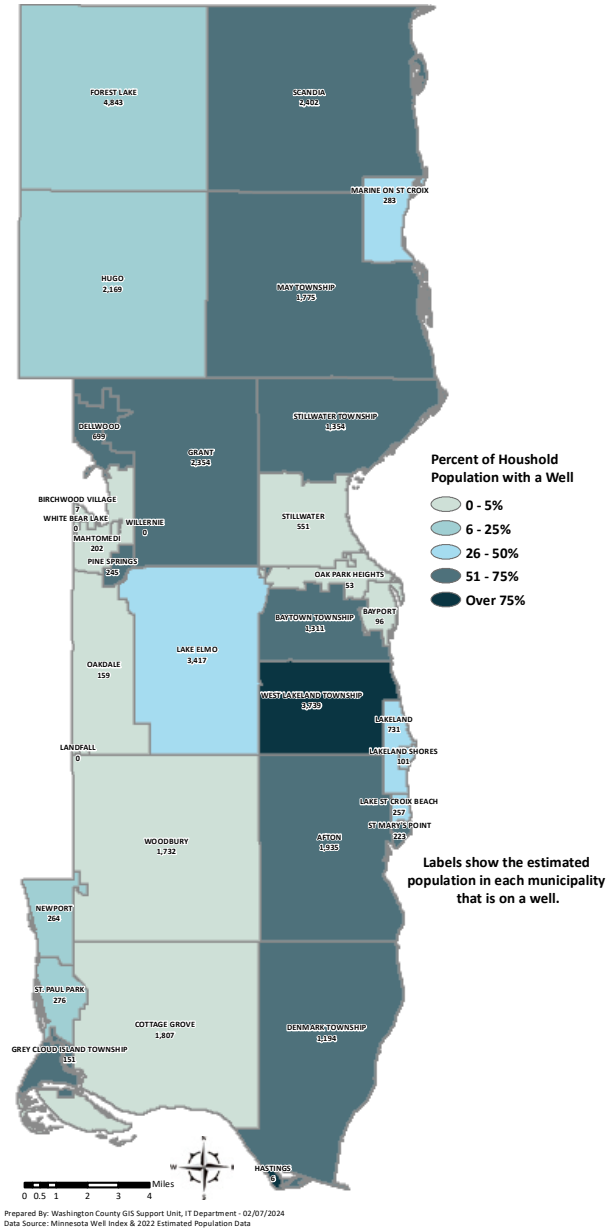


Figure 21. Percent of Household Population with a Well Map

Table 14. Current and Projected Population, Washington County

LGUs	Population, 2020 Census	Population, 2010 Census	Population Percent Change (2010 to 2020)	Households, 2023 Estimate (Met Council)
Afton	2,955	2,886	2.39%	1,146
Bayport	4,024	3,471	15.93%	1,106
Baytown Township	2,088	1,723	21.18%	744
Birchwood Village	863	870	-0.80%	357
Cottage Grove	38,839	34,589	12.29%	14,508
Dellwood	1,171	1,063	10.16%	387
Denmark township	1,801	1,737	3.68%	699
Forest Lake	20,611	18,375	12.17%	8,599
Grant	3,970	4,096	-3.08%	1,504
Grey Cloud Island Township	283	289	-2.08%	100
Hastings (part)	2	0	0	1
Hugo	15,766	13,332	18.26%	6,525
Lake Elmo	11,335	8,069	40.48%	5,206
Lakeland	1,710	1,796	-4.79%	688
Lakeland Shores	339	311	9.00%	118
Lake St. Croix Beach	1,043	1,051	-0.76%	472
Landfall	843	686	22.89%	298
Mahtomedi	8,134	7,676	5.97%	3,140
Marine on St. Croix	664	689	-3.63%	307
May Township	2,670	2,776	-3.82%	1,104
Newport	3,797	3,435	10.54%	1,725
Oakdale	28,303	27,378	3.38%	11,431
Oak Park Heights	4,849	4,339	11.75%	2,279
Pine Springs	377	408	-7.60%	135
St. Mary’s Point	353	368	-4.08%	149

St. Paul Park	5,544	5,279	5.02%	2,032
Scandia	3,984	3,936	1.22%	1,599
Stillwater	19,394	18,225	6.41%	7,880
Stillwater Township	1,866	2,366	-21.13%	709
West Lakeland Township	3,976	4,046	-1.73%	1,299
White Bear Lake (part)	397	403	-1.49%	176
Willernie	515	507	1.58%	224
Woodbury	75,102	61,961	21.21%	29,379
Washington County (total)	267,568	238,136	12.36%	106,026

indicates that the unemployment rate in 2023 was 2.3% in the county which is slightly lower than the Minnesota average of 2.7%. When compared to other races, the Latino population faces a higher unemployment rate of 5% in the county.

Environmental Justice

"Environmental justice" is the fair treatment and meaningful involvement of all people regardless of race, color, national origin or income with respect to the development, implementation, and enforcement of environmental laws, regulations and policies. Environmental justice is achieved when everyone benefits from the same degree of environmental protection and has equal access to the decision-making processes that contribute to a healthy environment.

Environmental justice encompasses the principle that all individuals and communities have the right to be protected from environmental degradation or environmental policies that put them at a disadvantage. It adopts a public health model of prevention, protecting people and the natural environment.

Impacted Communities

Although Washington County consistently ranks as one of the least socially vulnerable counties in the Metro County area overall, several communities within the county face disparities in health outcomes. Factors that are determinates of

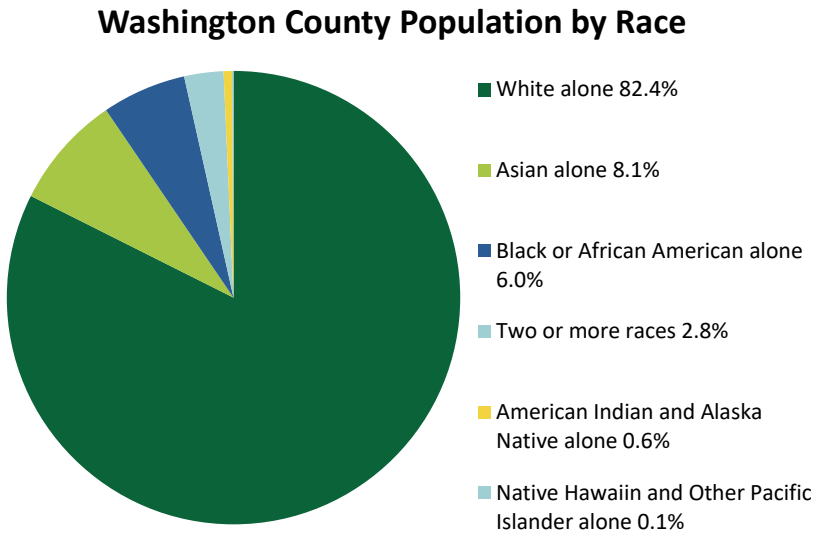


Figure 22. Washington County Population by Race Chart

who faces these challenges disproportionately include: socioeconomic status, race/ethnicity/language, household composition and housing/transportation. Low-income communities and communities of color are at greater risk of exposure to environmental hazards.

Figure 23 shows solid waste facility locations and census tracts that are considered areas of concern for environmental justice in the county. These are defined by the MPCA, using data from the U.S. Census and American Community Survey, as census tracts that meet one or both of the following demographic criteria:

- Total population of people of color greater than 40%
- At least 35% of people reported less than 200% of the Federal Poverty Level

The MPCA chose these two criteria because "research indicates that people of color and low-income people are disproportionately exposed to pollution, and bear disproportionate heath impacts from pollution, regardless of other population characteristics."

Areas marked with purple lines are census tracts with more than 40% of the population earning income less than 185% of the federal poverty level. As of 2022, this is an annual income of $51,338 for a family of four. Areas shaded in green are census tracts with greater than 50% people of color.

Populations that are served by non-municipal community public water supply systems and those that are renters are also at risk for water equity issues. Non-municipal community public water supply systems are held to the same standards as municipal systems but often do not have the same resources to acheive compliance or to address contamination prevention through source water protection. Further, renters that are on a municipal or non-municipal community public water supply system may not get the same information about the status and quality of their drinking water that property owners do.

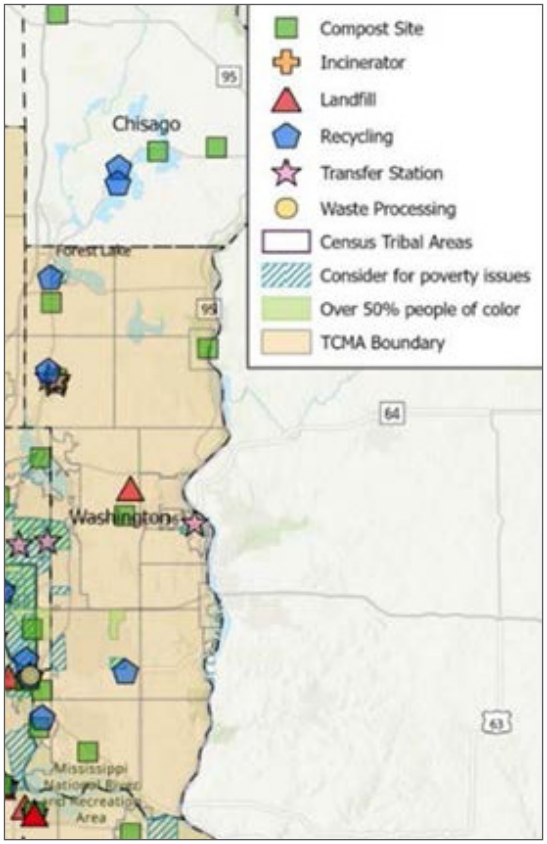


Figure 23. Areas of Concern for Environmental Justice Map

Population & Climate Change

United States Environmental Protection Agency (EPA) analysis shows that the most severe harms from climate change fall disproportionately upon underserved communities who are least able to prepare for, and recover from, heat waves, poor air quality, flooding, and other impacts. EPA's analysis indicates that Black, Indigenous, and other people of color (BIPOC) communities are particularly vulnerable to the greatest impacts of climate

change. A 2021 EPA report identified that for a 2°C rise in global warming, Black and African American populations are 34% more likely to live in areas with the highest projection for childhood asthma diagnoses and 40% more likely to live in areas with the highest projected increases in extreme temperature related deaths. The report also sites Latino and Hispanic high participation in weather-exposed industries, such as construction or agriculture. With a 2°C rise in global warming, this population is 43% more likely to currently live in areas with the highest projected reductions in labor hours due to extreme temperatures. In the Midwest specifically, those without a high school diploma, are 10% more likely than those with a high school diploma to currently live in areas with the highest projected inland flooding damages. About 8,790 people over the age of 25 in the county do not have a high school diploma.

Impacts to water from climate change will disproportionately affect Minnesota tribes. Increased risk of flooding and extreme weather could place additional burdens on reservations already struggling with infrastructure challenges. Tribal Nations depend on clean water for healthy communities, economic security and cultural survival. Water is central to Ojibwe and Dakota cultures. Climate change threatens the waters and ecosystems tribes depend on. Species with aquatic habitats are important for health, sustainability and cultural well-being. These species are also very sensitive to climate change, and vulnerable to the effects of rising temperatures and increased precipitation. At the time of this writing, the Prairie Island Indian Community owns 111 acres of undeveloped land in West Lakeland Township. They are party to the 3M Settlement activities to ensure clean drinking water for future uses of the land they own.

Recognition of environmental and climate justice issues will include providing targeted services and advocacy for vulnerable populations who have and continue to face environmental justice issues in Washington County.

5.2 Land Use

The county has continued to become more developed over the last 20 years. Between 2000 and 2020 there was a 16% decrease in the number of acres used for agriculture. Despite this continued development, over half the land in the county is still either

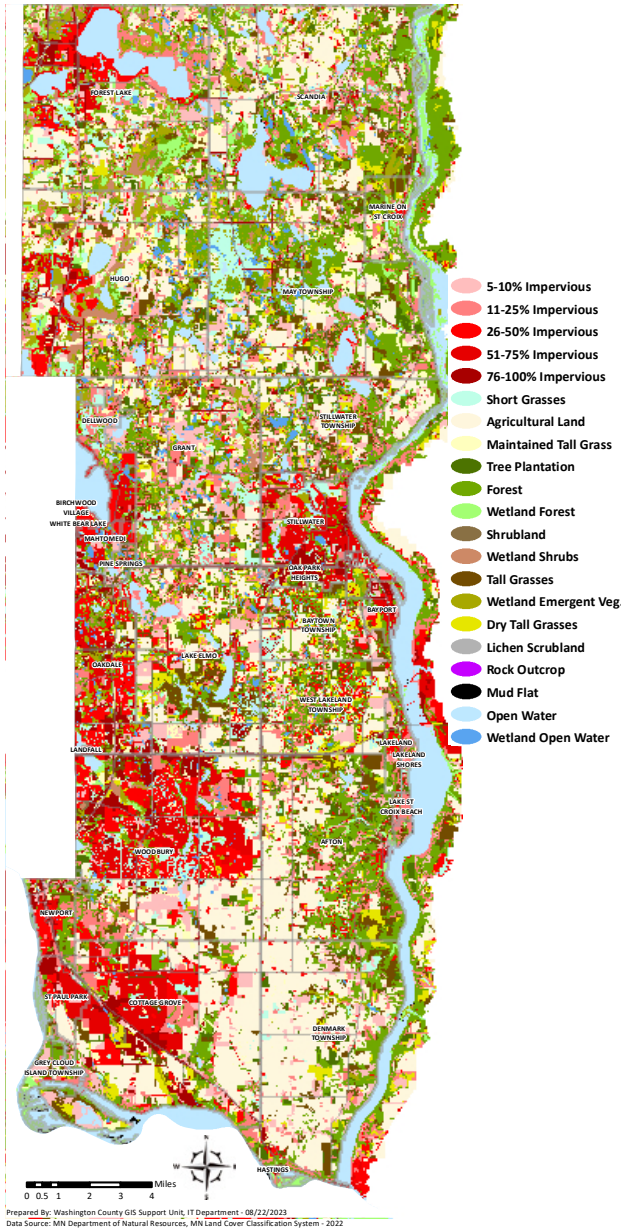


Figure 24. Land Cover Map

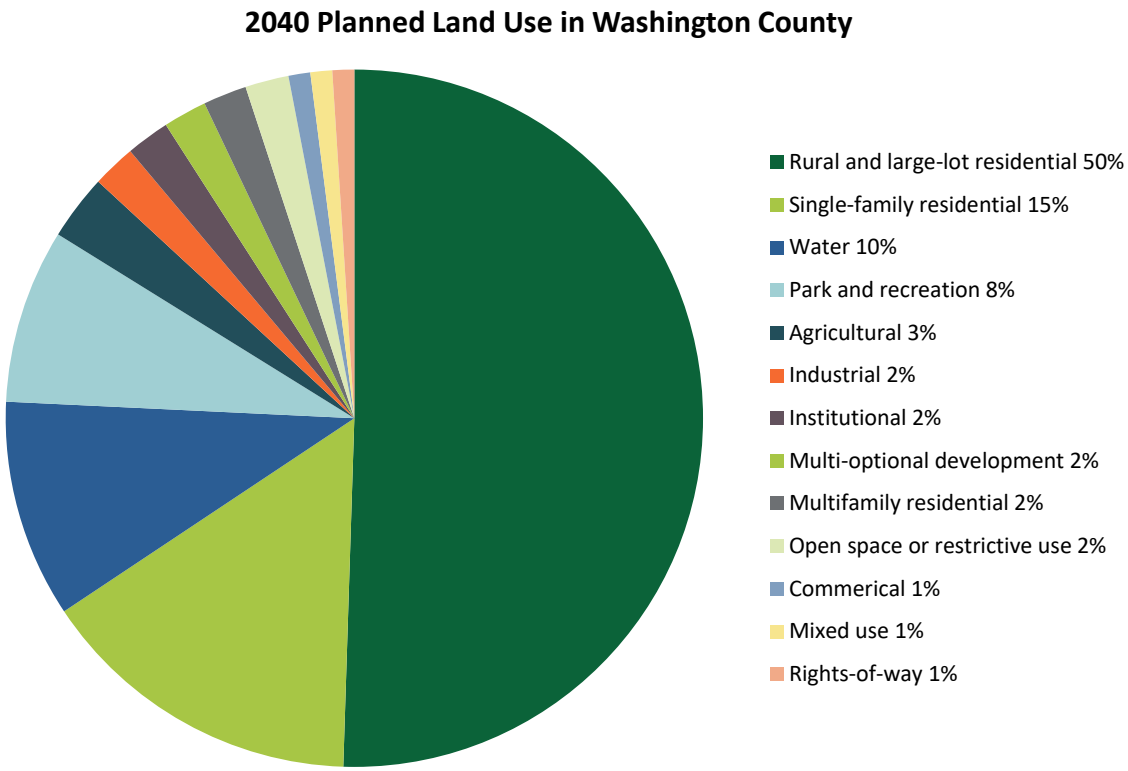


Figure 25. 2040 Planned Land Use Chart

undeveloped or being used for agriculture. There were large increases in the amount of land used for mixed use (47.8%), industrial (13.8%), park, and recreational or preserve (7.27%) between 2016 and 2020. The portion of the county's population that still does not live within a half mile of a park is 23.3%, which is important as access to parks leads to increased physical activity and improved mental health. Land cover in the county is shown in Figure 24.

Figure 25 shows the planned land use by percent for the county, predominantly gathered from 2040 Comprehensive Plan updates. Individual city and township comprehensive plans should be consulted for further information on all planned land use changes.

Land use decisions in the county are primarily made by cities and townships, which administer zoning and comprehensive planning land use controls. However, the county does continue to have the following official controls in the townships:

- Subdivision
- Lower St. Croix River Bluffland and Shoreland Management
- Shoreland Management
- Mining

- Floodplain
- Subsurface Sewage Treatment Systems (SSTS)

Climate Change & Land Use

Groundwater levels are closely tied to surface water levels in much of the northern part of the county. Fluctuation of groundwater levels due to climatic variations has several major implications on local and regional planning efforts. Growth of housing in parts of the county with shallow water tables may be affected by short and long-term groundwater level fluctuations. Prior to new development, flooding potential should be evaluated in landlocked areas and areas with shallow groundwater. Climate change may also cause more periods of drought, which would reduce soil moisture and groundwater and stream flows. This may also decrease water supply for drinking water and agriculture.

Changing cycles of precipitation and drought will impact Minnesota agriculture and growing seasons. Minnesota will experience greater variation in annual crop production and yields. Both items will be impacted by changes in temperature, humidity, cloud cover, precipitation trends, and extreme weather events. Crop yields may be impacted by changes in temperature, humidity, cloud cover, and precipitation trends and extremes. This may have a positive, negative, or no effect on crop yields. Crop losses may increase due to both direct and indirect impact from weeds, insects, and diseases that accompany changes in both average weather trends and extreme weather events. Soil and water quality and quantity are expected to decline due to increasing extremes in precipitation. Animal health, growth, and reproduction are also highly sensitive to temperature changes. Higher summer temperatures may lead to increased deaths due to heat stress, lower production of milk from dairy cattle and eggs from poultry, slower weight gain and corresponding longer time to market, and decreased reproduction that can result in smaller herds.

Climate change may lead to requests from outside entities to request an appropriation of the county's groundwater. Based on feedback from decision

makers and partners, the county wishes to see groundwater appropriation requests to remain principally within the county boundaries.

Based on Minnesota's current and continued projected temperate climate, relative protection from natural disasters, and proximity to ample groundwater resources (Groundwater Resources Overview – Chapter 4), both the Twin Cities metro and Northern regional centers, like Duluth, have been identified as probable climate migration sites. Minnesota has a history of migration-friendly policies, and many cities and counties have taken steps to welcome immigrants. As we anticipate further immigration to Washington County and the state, groundwater resource planning must consider migration models to plan for increased water consumption and wastewater treatment.

Chapter 6. Groundwater Quality

6.1 Groundwater Sensitivity

Maintaining clean, safe, drinkable groundwater is critical to human and environmental health. It is also integral to the continued economic and social vitality of our communities. While much of the county's groundwater supply is in good condition, the quality of groundwater in many areas is suffering. Due to the geologic conditions of the county, most of the county's groundwater reserves are highly sensitive to contamination. If not protected, they could become unusable as a source of potable water. There are locations where contaminants in groundwater are at levels above state human health guidance values, which identify how much is safe to drink. In these areas, there are added financial and social costs to manage the affected water supply to assure it is treated and filtered to meet safe drinking water standards. Existing groundwater contamination was caused by a combination of land use and waste disposal practices, and natural geologic conditions. To learn more about a wide variety of environmental information in your community, including properties previously contaminated and those being investigated for contamination visit What's in My Neighborhood.

There are other counties with similar land use and industrial practices that do not have the extent of groundwater contamination that Washington County does. Figure 26 Bedrock Sensitivity and Figure 27 Bedrock Surface Sensitivity Rating (featured on next page) illustrate the sensitivity of the county's groundwater to contamination. These figures show the increased ability for surface contaminants to get into groundwater because of the natural geology of the county. Karstic features are prevalent in the south/southeast parts of the county, and along the St. Croix River. There are areas with bedrock close to the land surface which decreases the time and ability for soil to filter out contaminants before they flow into the aquifers. Factors that determine a groundwater system's sensitivity include surface geology, bedrock geology, bedrock fractures and land use. More information about this can be found in the Groundwater Resource Overview, Chapter 4.

Prevention against and early detection of groundwater contamination is essential to protect public health and natural ecosystems. It limits human exposure to harmful contaminants and prevents the spread of groundwater pollution in the environment. Once groundwater is contaminated it may remain contaminated for decades. Groundwater clean-up is costly, complex, and not always feasible.

Groundwater in the county has contaminants above the established health risk limits in several aquifers. The contamination is generally of three types:

- Contamination from wastes containing perfluoro-alkyl substances (PFAS), disposed of by the 3M Company at the 3M disposal sites in Oakdale, Woodbury, and Cottage Grove, and the former Washington County Landfill in Lake Elmo. Additionally, the MPCA is investigating the possibility for other sources of PFAS contamination in the county.
- Contamination resulting from volatile organic compounds (VOCs) leaching from legal and illegal waste disposal and underground storage tanks.
- Contamination of nitrates in parts of the county resulting from certain land use practices and sensitive geologic conditions.

Climate change may also impact groundwater quality. Temperature is important to groundwater chemistry as it can influence several chemical and physical processes that affect the quality and composition of groundwater. Several studies have shown the possibility that groundwater up to 100 meters or 328 feet deep is vulnerable to global warming. Climate change can lead to an increase in rainfall and enhance the frequency of floods. Increasing rainfall frequency and intensity also increases the down flux of chemicals of the surface and vadose zone which increases the input of suspended and dissolved solids to aquifers.

6.2 Contaminants

PFAS

PFAS are a group of manufactured chemicals that have been widely used in industry and consumer products since the 1940s. These chemicals do not break down in the environment, earning them the nickname “forever chemicals”. These chemicals can build up in people, animals, and the environment over time. PFAS can be present in our water, soil, air and food, as well as materials found in our homes and workplaces.

Water is one of the most managed and monitored areas when it comes to PFAS. But it’s important to note that PFAS are present in many other areas of our environment and in thousands of products. According to the Minnesota Department of Health (MDH), some products that might contain PFAS include:

- stain resistant carpets, upholstery, and other fabrics,
- water resistant clothing,
- cleaning products,
- non-stick cookware,
- personal care products and cosmetics (e.g., shampoo, dental floss, nail polish, and eye makeup); and
- paints, varnishes and sealants.

Current scientific research suggests that exposure to certain PFAS may lead to adverse health outcomes. However, research is still ongoing to determine how different levels of exposure to different PFAS can lead to a variety of health

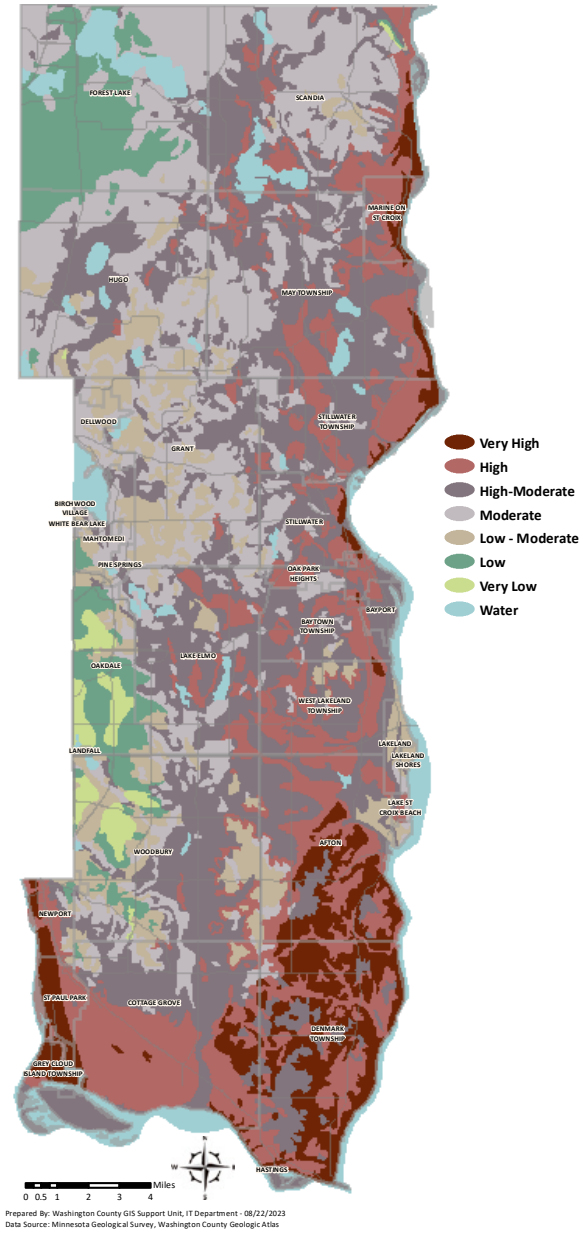


Figure 26. Bedrock Sensitivity Map

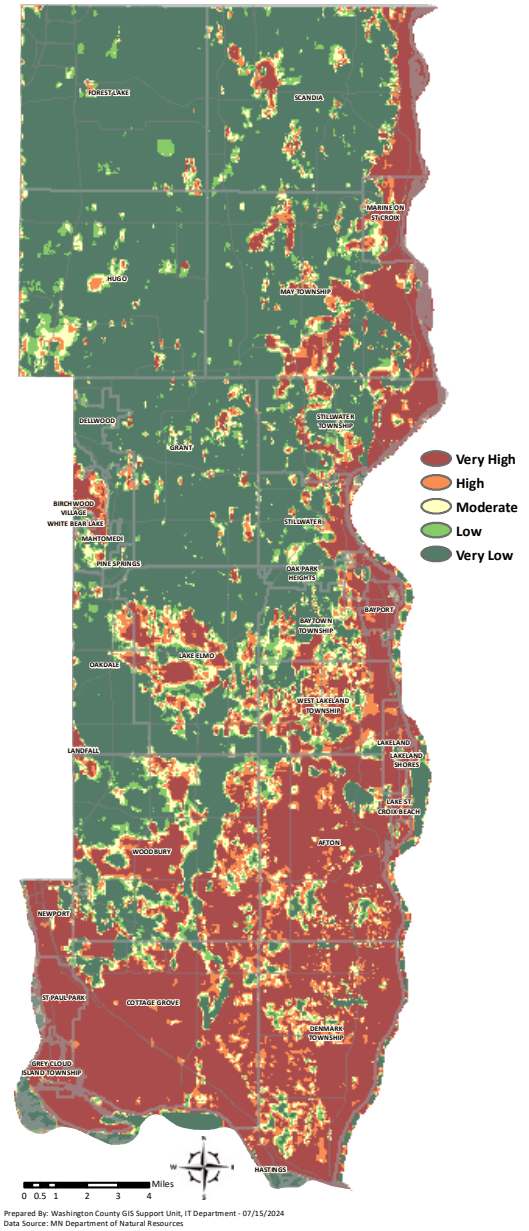


Figure 27. Bedrock Surface Sensitivity Rating Map

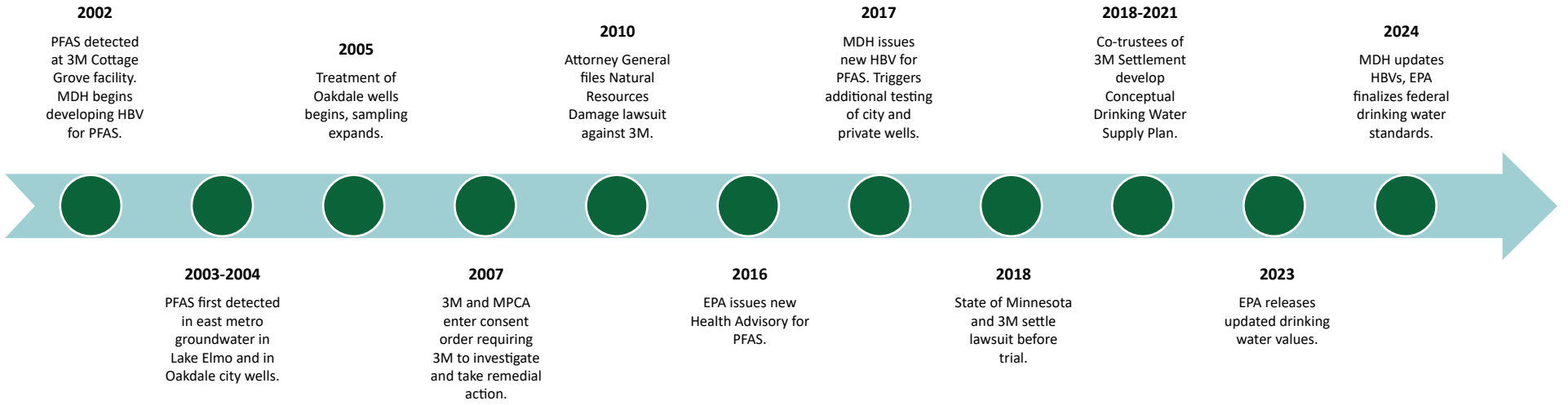


Figure 28. PFAS Timeline

effects. In Minnesota, MDH first developed Health Based Values (HBV) for two PFAS chemicals in 2002. Those values have been updated several times, including as recently as January 2024. The new health-based values, based on daily consumption over a lifetime, for PFOS and PFOA are 2.3 and 0.24 parts per trillion, respectively. These are extremely low levels, and, in some cases, technology does not exist to detect these levels. EPA sets federal drinking water standards that change over time.

In the county the drinking water sources of 18 cities and townships currently have PFAS above MDH guidance levels. An additional 4 community water systems have PFAS below the guidance levels. In terms of private wells, as of August 2024, 1,695 well advisories have been issued for PFAS, out of approximately 4,400 wells sampled. New state laws will lessen new PFAS pollution by phasing out nonessential PFAS use in Minnesota by 2032, but due to these chemicals' current widespread use and longevity, identifying how they enter and move through the environment is important to reducing or removing these chemicals. The monitoring plan is part of Minnesota's interagency PFAS Blueprint to prevent, manage, and clean up PFAS pollution.

Minnesota 3M PFAS Settlement:

On February 20, 2018, the state of Minnesota settled its lawsuit again the 3M Company in return for a settlement of $850 million. Minnesota's attorney general sued 3M in 2010 alleging that the company's production of chemicals known as PFAS had damaged drinking water and natural resources in the Twin Cities Metropolitan Area. After legal and other expenses are paid, about $720 million will be invested in drinking water and natural resource projects in the 14 East Metro communities that have PFAS. Figure 28 illustrates the timeline and events of the lawsuit. The following lists the 14 communities affected, all except one is in Washington County:

- Afton
- Cottage Grove
- Denmark Township
- Grey Cloud Island Township

Surface activated foam fractionation (SAFF) units, inject outdoor air into contaminated water and turn PFAS into foam which can be separated from the water. Once the foam is removed, the water is returned to the environment. The PFAS concentrate (foam) then goes to the DEFLUORO unit, a second technology where the carbon-fluorine bonds are broken through electrochemical oxidation. Both technologies work without adding any chemicals back into the surface or groundwater.

The unit shown in the photo was purchased by the MPCA with funds from the 3M settlement and is currently located at Tablyn Park in Lake Elmo.

- Lake Elmo
- Lakeland
- Lakeland Shores
- Maplewood
- Newport
- Oakdale
- Prairie Island Indian Community
- Saint Paul Park
- West Lakeland Township
- Woodbury

Changes to federal and state drinking water standards, and additional monitoring data, may lead to additional communities impacted. For the most recent information on the 3M PFAS settlement: https://3msettlement.state.mn.us/. Washington County continues to monitor and engage in PFAS and 3M Settlement activities.

Volatile Organic Compounds (VOCs)

VOCs are carbon-containing compounds that evaporate easily from water into air at normal air temperatures. VOCs are contained in a wide variety of commercial, industrial, and residential products including fuel oils, gasoline, solvents, cleaners and degreasers, paints, inks, dyes, refrigerants, and pesticides. County residents can purchase a VOC test for their private well through the county's Department of Public Health and Environment (PHE). The Figure shows four identified locations in the county that are contaminated with VOCs at a level that poses a public health risk:

- Lake Elmo/Oakdale
- Baytown/West Lakeland Townships
- Lakeland/Lakeland Shores
- St. Paul Park/Newport

Special Well and Boring Construction Area (SWBCA)

The MDH declares a Special Well and Boring Construction Area (SWBCA), sometimes called a well advisory, for areas where contaminants are found at a level that poses public health risks. The purpose of a SWBCA is to inform the public of potential health risks in areas of groundwater contamination, provide for the construction of safe water supplies, and prevent the spread of contamination due to the improper drilling of wells or borings. The SWBCA designation provides for controls on the drilling or alteration of public and private water supply wells, and the monitoring of wells in the area. Washington County has four SWBCAs:

- Lake Elmo/Oakdale- established due to VOC & PFAS contamination at the Washington County Landfill and the Oakdale Disposal Site.
- Baytown/West Lakeland Townships – established due to the discovery of VOC contaminants in several private wells in the area. The primary contaminant present in the groundwater is trichloroethylene (TCE). TCE was most used as a degreasing agent for washing metal parts and a dry-cleaning solvent. The source of the TCE contamination is suspected to be a former metal working business known as Neilsen Products Company, that previously occupied (1950s-60s) the property at 11325 Stillwater Boulevard in Lake Elmo. This contamination plume affects 1 public water supply, as well as approximately 351 private wells (as of August 2024).
- Lakeland/Lakeland Shores – established due to the presence of a variety of VOCs. At least two sources and plumes are suspected as the source of contamination, with the northerly plume containing fluorocarbons and petroleum products, and the southerly plume containing solvents.
- St. Paul Park/Newport – established due to contamination because of spills, leaks, and disposal of chlorinated solvents and petroleum products at several industrial sites including the Ashland Refinery, the former Aero Precision Engineering Company, and the former Park Penta Corporation. The contaminants of concern are petroleum products, several VOCs, and pentachlorophenol (PCP).

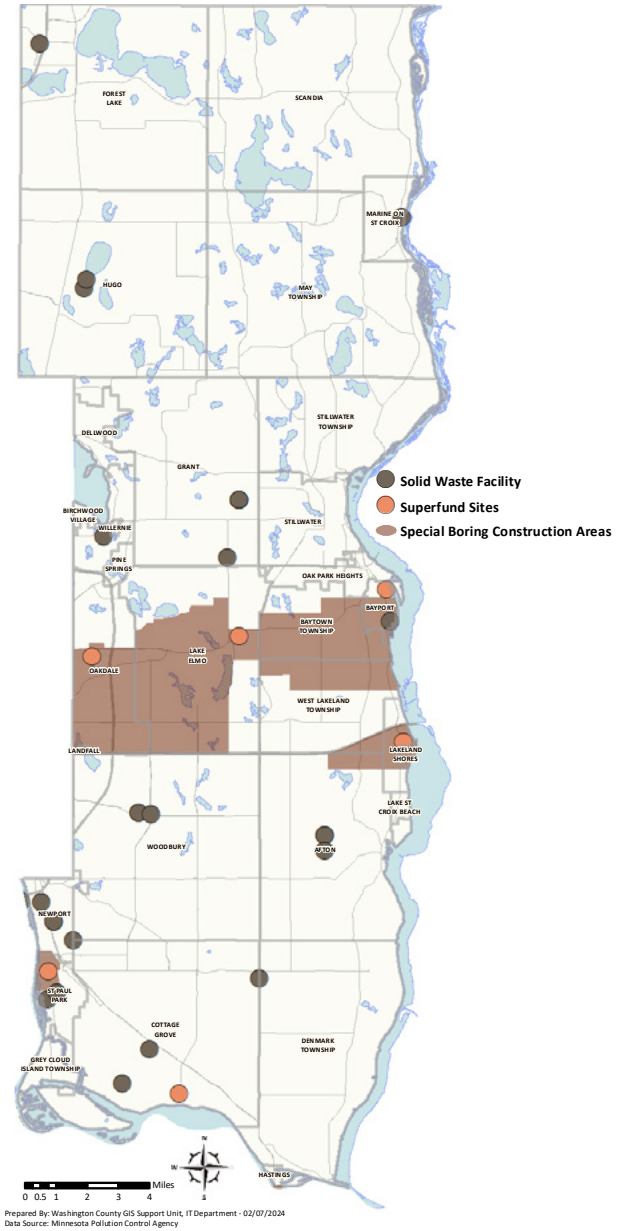


Figure 29. Solid Waste, Superfund, and SBCA Map

Private Well Testing

Private well owners are responsible for their own drinking water quality. The county offers a private well water testing program for residents. This program includes consultation with PHE staff about drinking water concerns and testing options for drinking water quality. The MDH recommends well users test their water for coliform bacteria, nitrate, arsenic, lead, and manganese. Private well owners need to be well informed and diligent in caring for their drinking water.

Coliform Bacteria

The presence of coliform bacteria are disease-causing microorganisms that may indicate fecal contamination. Potential sources of contamination include sewers, septic systems, feedlots, animal yards, and surface water inundating wells. Symptoms of waterborne diseases may include gastrointestinal illnesses such as severe diarrhea, nausea, and possibly jaundice as well as associated headaches and fatigue. If present, the water supply should be disinfected and retested. MDH recommends that wells be tested every year for coliform bacteria.

Nitrates

Nitrates are a common component of fertilizers that easily dissolve in water and move readily through soil into regional aquifers. Most wells in the county affected by nitrate contamination are found in Cottage Grove and Denmark Township, though high nitrates may exist in other areas, from localized sources such as human and animal waste concentrations. The primary health concern associated with exposure to nitrate is methemoglobinemia, commonly known as “blue baby syndrome.” This condition occurs when nitrates are absorbed into the blood stream where it reacts with hemoglobin to produce methemoglobinemia, thus impairing the blood’s ability to carry oxygen to the tissues of the body. According to the MDH, this condition rarely occurs in children older than 6 months or in adults MDH recommends wells are tested every year for nitrates.

Arsenic

Arsenic naturally occurs in rocks and soil across Minnesota. From these sources, small amounts can dissolve into groundwater that may be used for drinking water. Drinking water with arsenic in it can increase the risk of cancer and other serious health effects. Arsenic can be removed or reduced from well water by using a reverse-osmosis treatment system that is specifically labeled for arsenic. MDH recommends that every well be tested for arsenic at least once. The EPA’s federal drinking water standard for arsenic in drinking water is 10 micrograms per liter (µg/L). While the maximum contaminant level is 10 µg/L, the maximum contaminant level goal is 0 µg/L.

Lead

Lead is a poisonous metal that can cause long-term health and behavioral problems. Lead is not usually found in well water. Lead may enter your drinking water as it travels from your well through your plumbing system. Wells, pipes, solder, and fixtures built before 1995 may have parts that contain lead. Exposure to lead can cause serious health problems for everyone. There is no safe level of lead. Babies, children under six years, and pregnant women are at the highest risk. Drinking, breathing, eating or touching food, water and other materials that contain lead can damage the brain, kidneys, and nervous system. In children, lead can also slow development or cause learning, behavior, and hearing problems. MDH recommends testing well water for lead at least once.

Manganese

Manganese occurs naturally in rocks and soil across Minnesota and is often found in surface and groundwater. Your body needs some manganese to stay healthy, but too much can be harmful. Children and adults who drink water with high levels of manganese for a long time may have problems with memory, attention, and motor skills. Infants (babies under one year old) may develop learning and behavior problems if they drink water with too much manganese in it. Drinking water with a level of manganese above the MDH

guidance level can be harmful for your health but taking a bath or a shower in it is not. If you have an infant who drinks tap water or drinks formula made with tap water, a safe level of manganese in your water is 0.1 milligrams of manganese per liter of water (mg/L) or less. If you have an infant who never drinks tap water or formula made with tap water, a safe level of manganese in your water is 0.3 mg/L or less. If everyone in your household is more than one year old, a safe level of manganese in your water is 0.3 mg/L or less. MDH recommends that every well be tested for manganese at least once. Figure 31 shows manganese results from the county's private well testing program.

Contaminants of Emerging Concern (CEC)

Contaminants of emerging concern are substances that have been released to, found in, or have the potential to enter groundwater or surface water and do not have state human health-based guidance that identifies how much of it is safe to drink. In recent years, more research and monitoring is going towards discovery of this group of contaminants. This is due in part to:

- better methods for detecting substances at lower levels;
- detection of additional substances;
- use of new substances; and
- use of old substances in new ways.

Emerging contaminants include pharmaceuticals, pesticides, industrial effluents, personal care products,

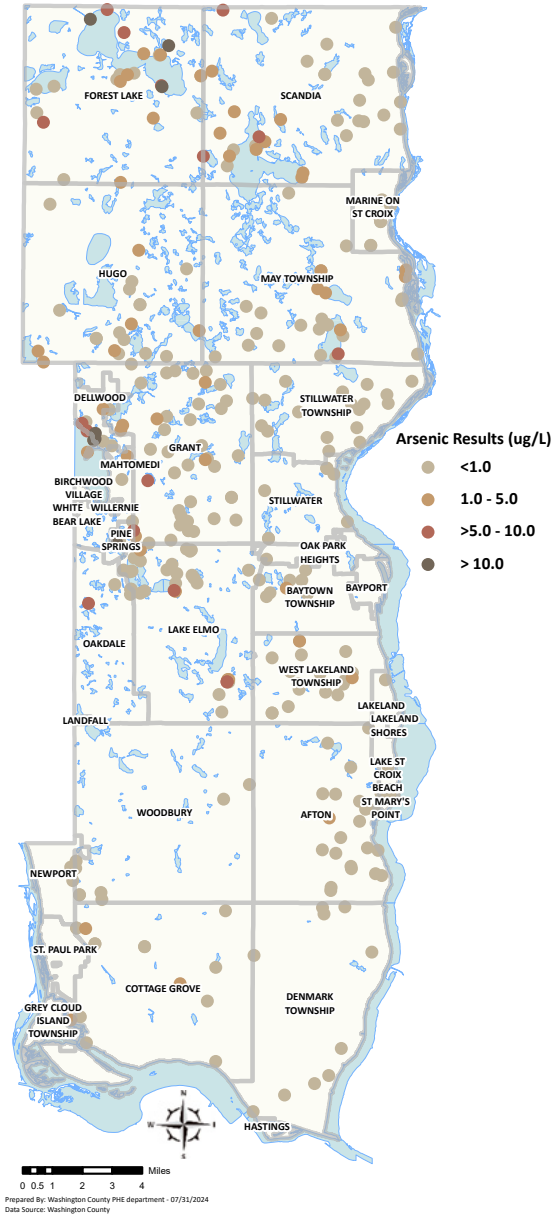


Figure 30. Arsenic Map

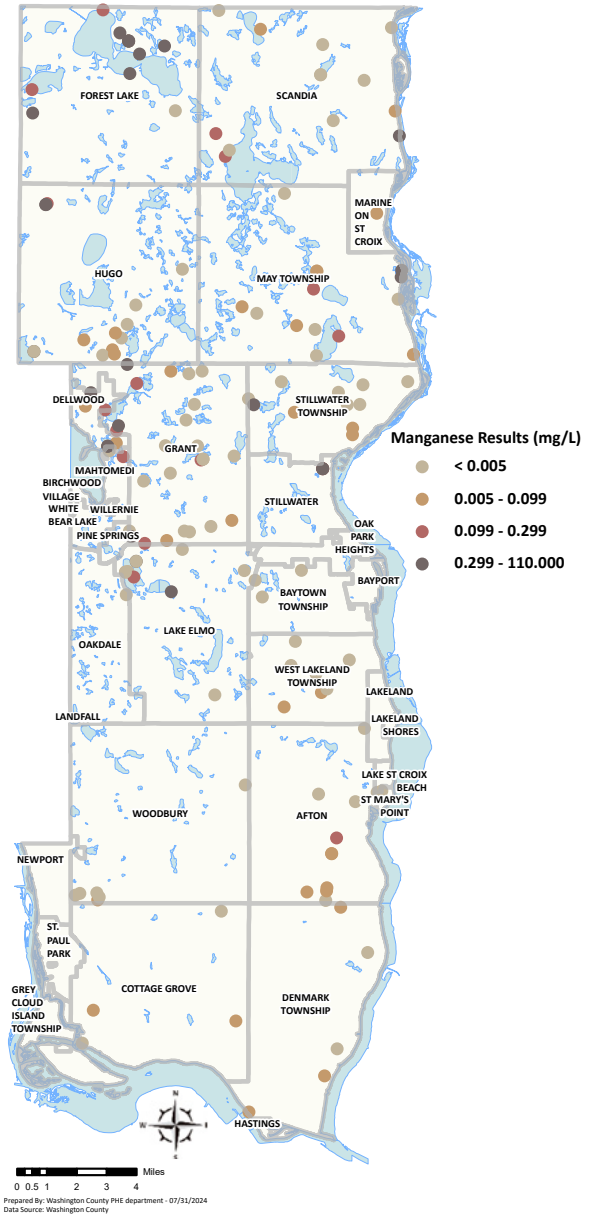


Figure 31. Manganese Map

fire retardants, and other items that are washed down drains and not able to be processed by municipal wastewater treatment plants or septic systems. Some current examples of emerging contaminants are:

- Codeine- a pharmaceutical painkiller, cough suppressant, and anti-diarrhea medication. Codeine is also used to manufacture other painkillers including hydrocodone and oxycodone.
- Diquat Dibromide- an herbicide, algaecide, desiccant, and defoliant used on food crops, such as potatoes and crops grown for seed, and in lakes and ponds. In residential areas it is used for weed control on lawns.
- Endothall – primary use is to control aquatic vegetation and algae in lakes, ponds, and irrigation canals in Minnesota.

The MDH and the MPCA each have a role in protecting public health and the environment from emerging contaminants and work closely between programs to do this work. The MDH has a Contaminants of Emerging Concern program that investigates and communicates the health and exposure potential of these contaminants in drinking water. The MDH has recently begun the Drinking Water Ambient Monitoring Program (DWAMP). DWAMP aims to establish ongoing, permanent monitoring capacity for CECs and other priority contaminants in drinking water sources across the state. The goals of this program are to address concerns about public health exposure to CECs and support data-driven water resource management decisions by characterizing water quality conditions in drinking water sources. The MPCA implements the Ambient Groundwater Monitoring Program to monitor groundwater for emerging contaminants. Figure 32 shows the locations of the monitoring wells that MPCA tests in the county.

Pesticides

The MDA began monitoring ambient groundwater in November 1985. The program was redesigned in 1998, and the current program was established with the goal of providing the information necessary to manage pesticide use for water quality protection on a regional basis. The network was designed to track trends over time, by monitoring springs and shallow monitoring wells installed in the uppermost aquifers (MDA, 2011). These springs and shallow wells are sensitive to contamination from

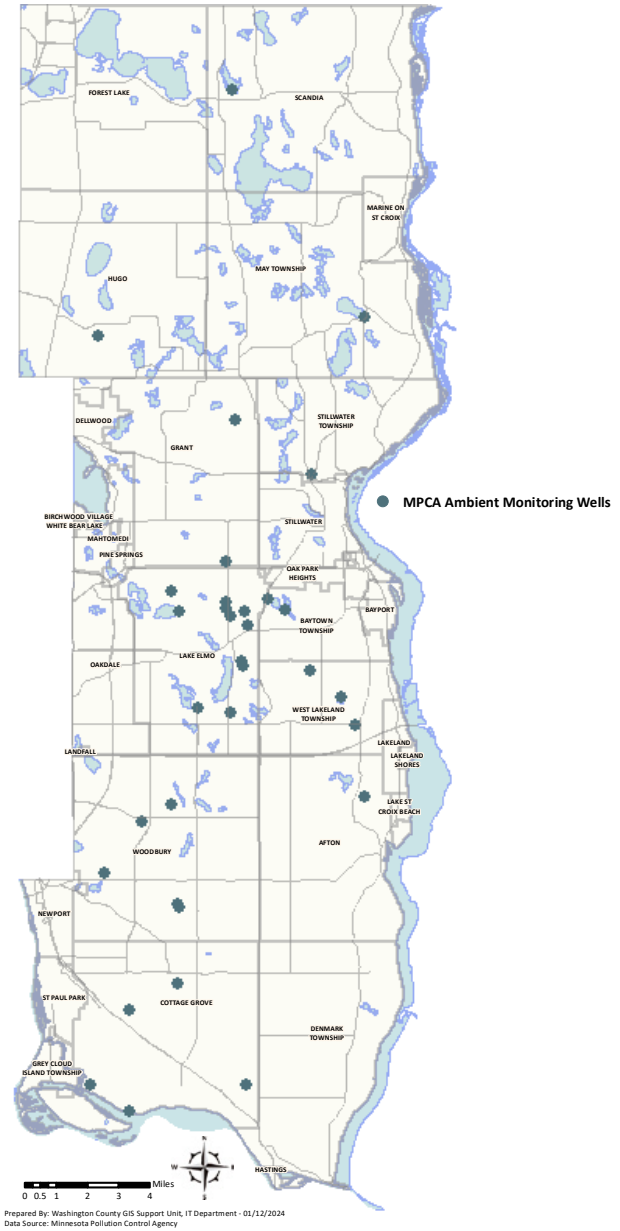


Figure 32. MPCA Ambient Monitoring Wells Map

activities at the land surface and allow the MDA to evaluate pesticide impacts to the most vulnerable groundwater in the different Pesticide Monitoring Regions (PMR) throughout the state.

In 2024, MDA is conducting additional monitoring of private wells at risk for exceedances of health-based values for cyanazine degradates, which includes untested wells in the southern part of the county. Preliminary testing, conducted in 2023, revealed 27 cyanazine exceedances of 105 wells tested in the southernmost areas of the county, a 26% exceedance rate. Additional monitoring, in an expanded testing area, has been ordered for parts of the county that are now developed but were of agricultural usage during cyanazine's peak employment.

A 2000 MPCA study completed in the Cottage Grove area tested 74 private wells and found that 68 percent of the groundwater samples contained pesticide or pesticide breakdown products. None of the samples collected by the MPCA exceeded the federal and state drinking water standards for pesticides. According to the study, there was a strong correlation between pesticides and nitrate occurrences in groundwater. The MPCA states that the correlation between pesticides and nitrate indicates that agricultural practices are the most likely source of the contaminants.

Chlorides

Salts, like sodium chloride and magnesium chloride, are widely used to de-ice roads, parking lots, driveways, and sidewalks. Chloride has been shown to have detrimental effects on aquatic ecology. The storage and application of de-icing salts creates the potential for surface and groundwater pollution.

During winter, snow removal concentrates road salt and sand in ditches and in snow removal stockpiles. Spring melting results in the release of runoff contaminated with chloride and trace metals. The polluted runoff may contaminate surface water causing them to be listed as impaired, or infiltrate into the groundwater.

Unprotected road salt storage sites also pose a risk to water quality by allowing rain and melting snow to leach contaminants into groundwater. Covered and lined facilities will eliminate groundwater contamination from stockpiled road de-icing materials. Limiting de-icing compound use or using less environmentally damaging products will reduce the level of contamination spread during de-icing operations. Smart Salting is a program developed by the MPCA to train operators on methods to imporve effectiveness while reducing chloride pollution. The county is an active participant and hosts a training each year that is offered to all applicators.

Another source of chlorides is water softening from septic systems (localized) and homes on city water (concentrating regionally); these also have potential to contribute to groundwater pollution.

Animal Waste

Animal manure, when used properly, provides essential nutrients, organic matter, and moisture to cropland. Application of manure in geologically sensitive areas, and runoff or seepage from feedlots, horse farms, and hobby farms can increase the level of nitrogen in groundwater to levels of concern and can also contaminate surface waters with E. coli. Manure in feedlots,

and horse and hobby farms may also contain disease-producing organisms that can cause diarrheal diseases, infectious hepatitis, parasitic infections, cholera, dysentery, salmonella, and typhoid fever in humans and domestic animals. Currently the county has areas where high nitrate levels are in the groundwater and some of the streams and creeks have surface water impairments for E.coli. Manure management and operation practices for feedlots, and horse and hobby farms, and geologic conditions are all factors that potentially affect groundwater quality.

The MPCA established a feedlot regulatory program in 2000. This program is administered either by the MPCA or can be delegated to county governments. Currently the MPCA administers the state feedlot program and permits.

Wastewater

Proper treatment of wastewater reduces health risks to humans and animals and reduces the threat of contamination to surface and groundwater. In urban areas of the Twin Cities, including parts of the county, thousands of homes and buildings are connected to the Metropolitan Urban Service Area (MUSA), Figure 33, and publicly owned and operated wastewater treatment plants (WWTP). In lower density, rural settings, where the MUSA does not extend, homes and businesses must rely on SSTS, commonly called septic systems, to treat wastewater. A properly designed, installed, and functioning SSTS effectively treats septage and prevents introduction of bacteria, viruses, and other disease-causing organisms into groundwater. As an added benefit SSTS also take groundwater pumped for human uses and recharges it to the local water table.

SSTS

SSTS are widely used throughout the county. Figure 34 shows the distriution of these systems across the county, equaling over 19,000 SSTS as of 2023, with approximately 17,500 systems for households and another 1,500 for commercial and other properties. For communities served by SSTS there are thousands of individual discharge points that have the potential to contribute pollution, resulting in contamination

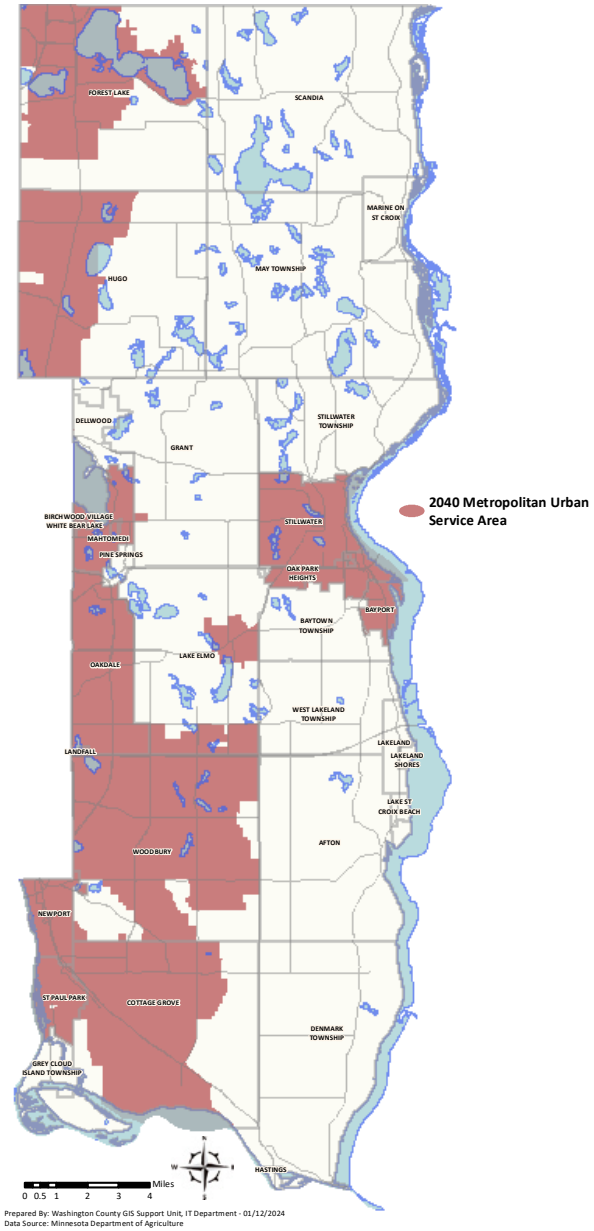


Figure 33. 2040 MUSA Map

of surrounding soils and groundwater. SSTS must be properly maintained and operated to prevent surface and groundwater contamination.

Past studies have shown higher concentrations of nitrates and other pollutants in areas of high-density septic systems. For example, a February 2000 study by the MPCA evaluated contamination related to SSTS beneath an unsewered portion of southeast Washington County. The location was chosen for study based on the higher sensitivity of groundwater systems to contamination (Figures 26 and 27) and the relatively high density of older SSTS. At the same time the study results showed the average nitrate concentration from well samples was 5.92 mg/l, a relatively high average when compared to the county average of 2.05 mg/l. In addition, non-fecal coliform bacteria were detected in 15 of 52 samples. The study concluded "groundwater impacts from nitrate from SSTS can be minimized by balancing lot size and well placement and well depth" and "larger lot sizes and stringent controls on maintenance of SSTS are needed to minimize impacts from septic systems." More information about the county's SSTS ordinances and programs can be found in the governance section.

While SSTSs can be an efficient means of treating waste in rural areas, non-compliant or poorly maintained SSTSs have the potential to release contaminants such as nitrates, coliform bacteria (E. coli), phosphorus, and chlorides (from water softening) to ground and surface waters. In Minnesota, a non-compliant system does not have the required separation from the point of discharge to the water table, bedrock, or some other limiting

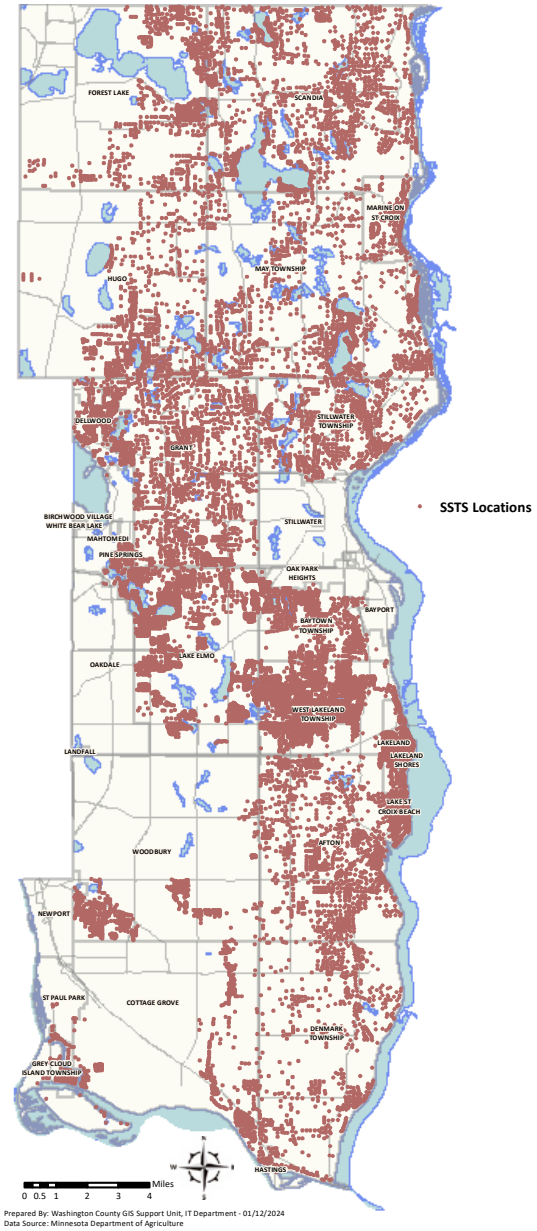


Figure 34. SSTS Locations Map

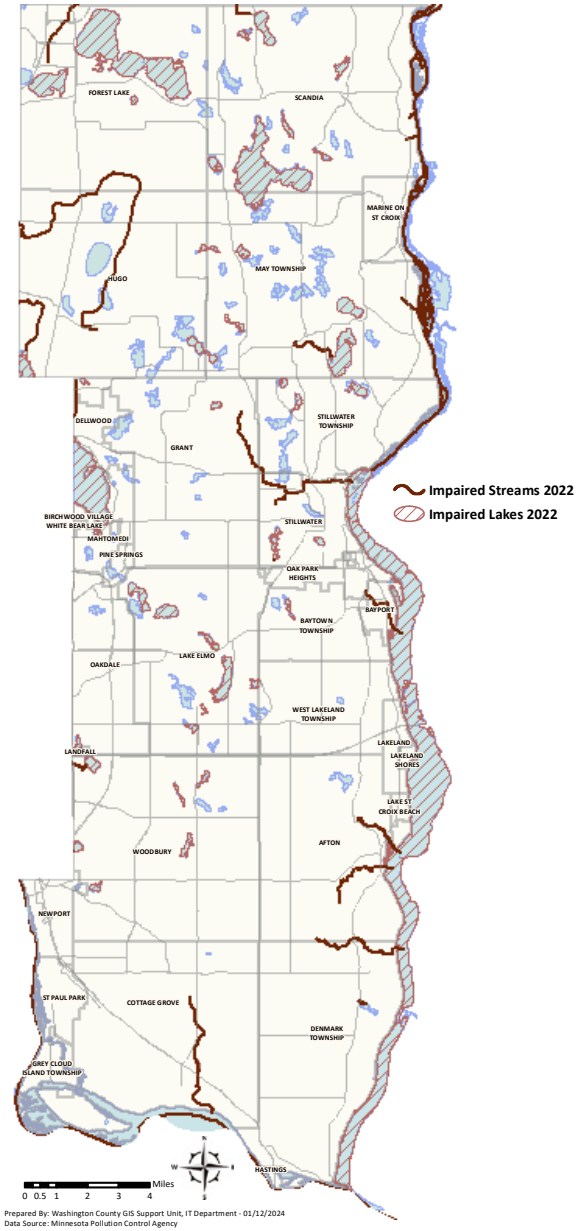


Figure 35. Impaired Waters Map

feature, and is not protective of the environment and receiving water bodies. Furthermore, SSTS with surface discharge or a direct conduit (e.g. pipe) to the environment are considered an imminent public health threat.

TMDLs

Brown's Creek and Valley Branch Watershed Districts have completed Total Maximum Daily Load studies for streams in their districts – Brown's Creek and Kelle's Creek, respectively. A Total Maximum Daily Load Study (TMDL) is a study required by the MPCA for an impaired water body that sets pollutant reduction goals needed to restore the waters to their designated use such as fishable, swimmable, or drinkable. The Brown's Creek Watershed District is also monitoring groundwater levels to determine if lowering aquifers are a cause of the temperature increases in Brown's Creek, that was found to be impaired for aquatic life due to a lack of cold-water fish assemblage and high turbidity. A TMDL completed for Kelle's Creek due to bacterial impairment, identified runoff or non-compliant septic systems as a contributing factor. To remediate the stream and restore core recreational aquatic uses, Valley Branch Watershed District has a continued monitoring plan for stream flow and quality. Carnelian-Marine-St. Croix and Comfort Lake-Forest Lake Watershed Districts as well as neighboring counties in the Lower St. Croix also have approved TMDLs with the EPA. Whether targeting streams or lakes that have impairments, WMO and LGU commitment to the study, monitoring, and protection of waterbodies in Minnesota assures the perpetuation of water resources and their uses. See Figure 35 for the locations of impaired water bodies in the county.

Land Spreading for Beneficial Use

Beneficial use of solid waste is a sustainability practice where an 'Industrial By-Product' (IBP) is spread on agricultural fields to alter soil for crop production. An IBP is classified in State Rule as an Industrial Solid Waste (see Glossary) and defined by the MPCA as a residual material resulting from industrial, commercial, mining, and agricultural operations that are not primary products and are not produced separately in the process. Land spreading of IBPs provides an environmental benefit by reducing the need to use commercial products, reduces the demand for disposal facilities, and is thus a more economical option. However, raw septage carries pathogens and emerging contaminants, which are a public health concern. PFAS compounds have also been identified in IBP. Data shows that long-chain PFAS, such as PFOS, are expected to accumulate in IBP and if land applied at excessive concentrations, will likely accumulate in soils to some degree.

Solid waste land application is a highly regulated state program. Minnesota Administrative Rules 7035.2860, Beneficial Use of Solid Waste, sets the regulatory standards by which solid waste can be land spread. Additionally, the county licenses solid waste applicators under its Solid Waste Management Ordinance #202. This program annually reviews and issues license conditions for the sites, and includes specific approvals for the products the applicator is allowed to apply. The most common IBP that is applied is lime sludge used to raise soil pH for growing alfalfa, although other products are allowed on a case-by-case basis. In addition, the county conducts individual site inspections of all sites prior to an IBP application approval. IBPs cannot be applied without soil tests demonstrating the need for the product, and analytical results of the IBP demonstrating human and environmental safety. Parameters such as slope, distance to water table, distance to a down gradient surface water, permeability of the soil, and soil pH are some of the local concerns addressed in the ordinance.

The Federal Environmental Protection Agency (EPA) has land application regulations for land applying septage. The MPCA does not regulate the land application of septage but does require that any applicable state and LGU requirements must also be followed. The current county septic ordinance does not address land spreading of septage so therefore it is regulated under the EPA Regulations 40 CFR Part 503.

Mining

Aggregate mining is an important industry in the county. Most mining areas contain an abundance of highly permeable sand and gravel or highly permeable bedrock. Currently the county holds 12 active mining permits, Figure 36. Mining increases potential impacts to groundwater from spilling of chemicals and/or fuel. After mining is completed the mining site may be more sensitive to contamination than the pre-mining condition due to the shallower depth of groundwater and, in some cases, removal of less permeable soils. For more information about the County's Mining Ordinance see Chapter 3 Governance, Roles, and Responsibilities.

Silica sand mining has made a presence in Minnesota, more regionally in the southeastern part of the state. This sand is needed for hydraulic fracturing (fracking) processes to release petroleum and natural gas from deep inside the earth. The county's geology provides the type of silica sand that is most desirable to use in fracking so there is potential for an increase in silica sand mines. There is currently one active silica sand mine in the county located in and regulated by the City of Woodbury.

Hazardous Waste

Improperly handled hazardous waste has contaminated groundwater in localized areas of the county. Hazardous wastes include items that are ignitable, toxic, reactive, and corrosive. Four hazardous waste-related SWBCA have been identified by MDH in the county. In these areas, special well construction practices are in effect to protect the public from contaminated groundwater. In addition, there are six active State or Federally designated soil and groundwater contamination areas, termed Superfund Sites, located in the county. Both SWBCA and Superfund Sites can be seen in Figure 29 (page 75). Sources of contamination in groundwater from hazardous waste include municipal, commercial and industrial dumps; old or unregulated landfills; leaking underground storage tanks; accidental spills from pipeline ruptures or tanker rollovers; improper disposal of household wastes; and mismanagement by hazardous waste generators.

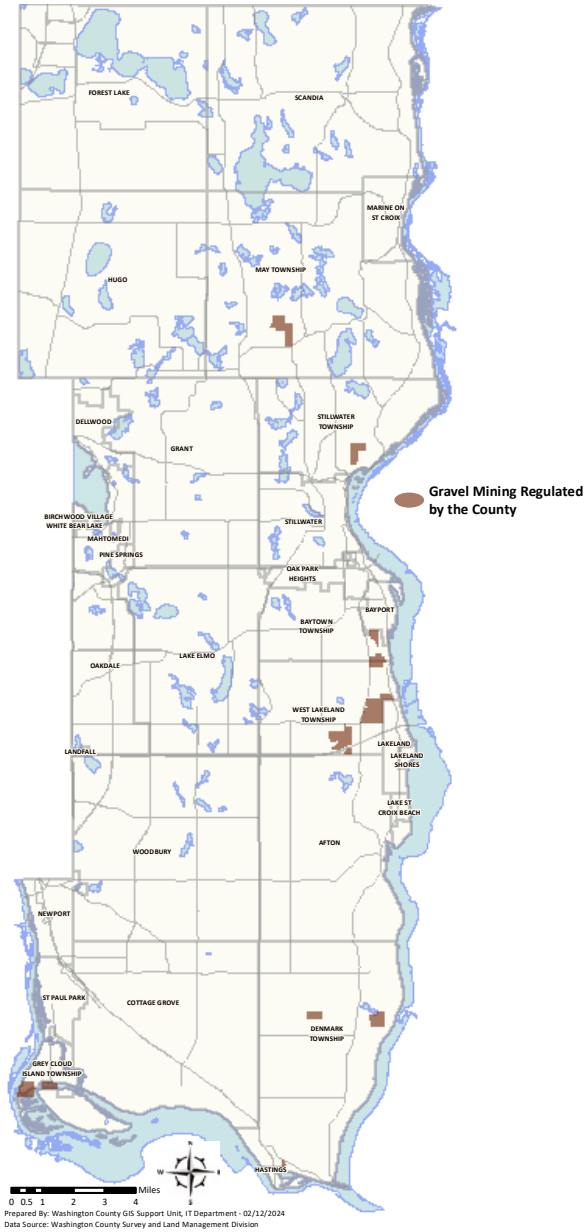


Figure 36. County Regulated Gravel Mining Map

The majority of hazardous waste releases that have contaminated groundwater occurred prior to the implementation of Federal and State regulations in the 1980s. Properly managed hazardous wastes should not pose a threat to groundwater. The Washington County Solid Waste Management Plan 2024-2042 emphasizes the reduction of toxic and hazardous waste. Recycling of waste continues to be an important element of waste management - emphasizing both commercial sector and household hazardous waste disposal programs.

Commercial Hazardous Waste

Washington County has operated a hazardous waste regulation program since 1985 and is mandated by Minnesota Statute §473.811 subd.5 to regulate and enforce state and local hazardous waste regulations. Washington County Ordinance #195, adopted in 2014, describes the county regulations related to hazardous waste management. Any business or non-household entity that is a hazardous waste generator must comply with these regulations. The regulations are designed to protect public health and the environment and focus on preventing hazardous waste releases to the environment or exposure to people.

Hazardous waste generators are required to obtain a license from the county and submit annual waste generation reports and management plans for each regulated waste generated. Management plans identify the quantity of waste produced, how the waste is managed, and where the waste will be disposed. Each plan is reviewed by staff to ensure proper waste management. The county ensures compliance through a variety of methods including technical assistance, training, site visits, and inspections. As of 2024, there were 555 licensed hazardous waste generators in the county.

The county also regulates hazardous waste facilities that treat, store, or dispose of hazardous waste. These facilities are subject to additional regulations beyond those for generators based on the types of waste handled and the size and nature of their operation. Facilities are also required to have a permit from the MPCA and the EPA.

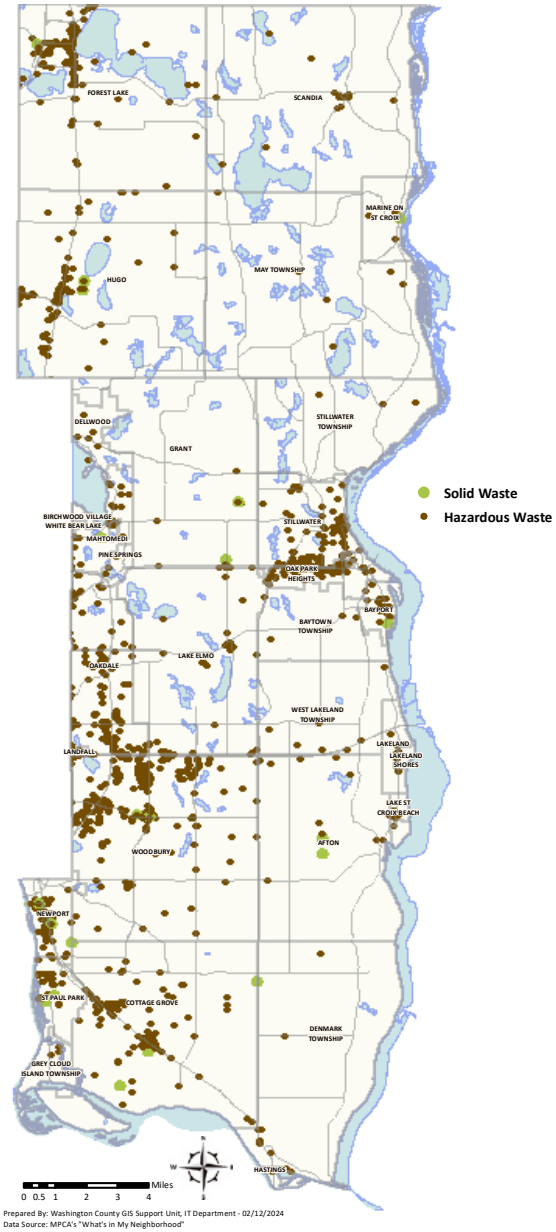


Figure 37. Solid Waste & Hazardous Waste Map

Household Hazardous Waste

The county provides safe disposal options for automotive products, batteries, pesticides, and other hazardous items for free through its Household Hazardous Waste (HHW) collection program. Washington County has operated an HHW facility since 1994, starting with a small facility located in Oakdale and expanding to the current Environmental Center located in Woodbury in the fall of 2009. The Woodbury Environmental Center operates year-round, and a second year-round site is scheduled to open in late 2024 in Forest Lake. The county also hosts one-day collection events throughout the county, operating from April through October. The Household Hazardous Waste program is important in reducing potential groundwater pollution by giving alternatives to residents who might otherwise dispose of hazardous waste down drains, septic systems, and in back yards.

The Washington County Sheriff's Office and PHE have also partnered to provide residents in the county with locations where there are free collection drop boxes to safely dispose of unwanted, expired, and unused medications. Improper disposal of pharmaceuticals, a type of CECs, has caused contamination of our surface and groundwaters. Having these safe disposal options help keep these contaminants out of our environment.

The county also provides technical assistance and education to businesses and the public to minimize or eliminate toxic materials use. This approach has led to the reduction in volume and toxicity of wastes at the generator level, decreasing the potential impacts to the environment and groundwater.

Storage Tank Systems

Underground storage tank (UST) systems that contain petroleum or hazardous waste are a potential threat to water quality. The MPCA regulates the design and operating rules for UST systems including piping and dispensers. The county has no regulatory control over UST systems. The volume of contaminants leaking from failing tanks has been significantly reduced since the implementation of regulatory controls. More information on the MPCA Regulatory Program for UST systems is available at: Underground storage tanks | Minnesota Pollution Control Agency.

Above-ground storage tank (AST) systems that contain petroleum or hazardous waste are very safe when properly designed and operated. However, AST systems are subject to construction flaws, corrosion, stress, cracking, weld and valve failures, overfills, spills during transfers, and occasionally, tank ruptures. When AST systems leak or spill, the stored substances may flow into lakes and rivers, migrate through the soil to the water table, or catch fire, thereby contaminating soil, groundwater, surface water, or air and posing risks to human health.

AST systems which store liquid substances that may pollute the waters of the state are regulated by Minnesota Rules, Chapter 7151, if site capacity is less than one million gallons. Larger facilities (facilities with a capacity of one million gallons or more) must obtain a major facility permit from MPCA. The permit specifies required spill and leak prevention, detection, and containment measures.

Transportation of Hazardous Waste and Hazardous Waste Spills

Hazardous wastes are transported throughout the county by truck, rail, and pipelines. The movement, loading, and off-loading of hazardous wastes pose potential threats of accidents, leaks, and spills. To reduce spill incidents and volume the Minnesota Legislature passed Minnesota Chapter 115E, Oil and Hazardous Substance Discharge Preparedness. This requires hazardous waste transporters to prepare and train to respond to petroleum and chemical spills. When a spill does occur, State agencies and the party responsible for the spill are required to ensure environmental protection. Public safety is the responsibility of local first responders.

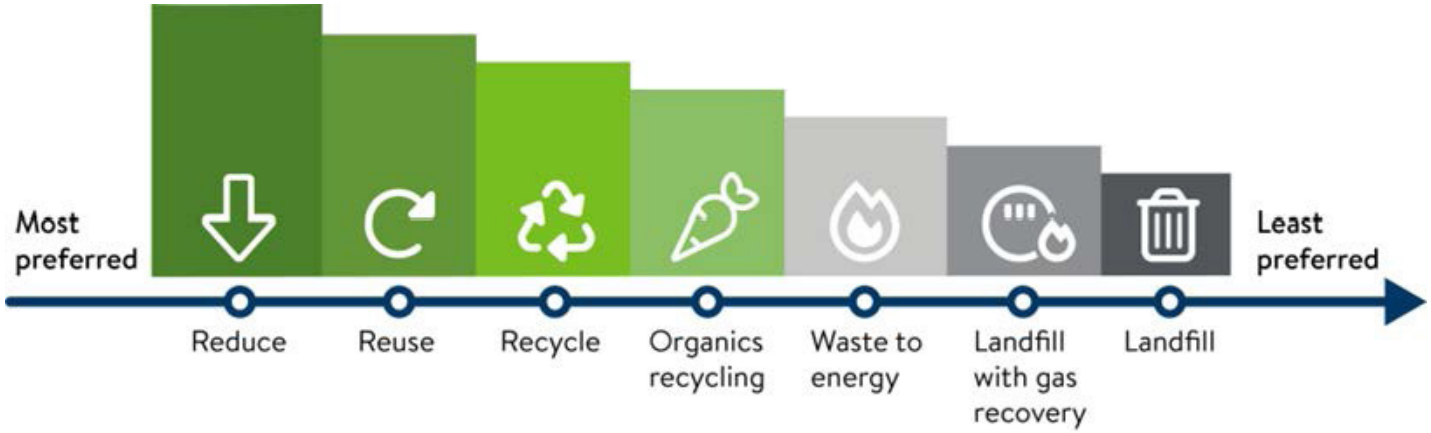


Figure 38. Waste Reduction Ranking Chart

Landfills

The county has a difficult history with landfills and disposal sites in relationship to groundwater. The site formerly known as the Washington County Landfill and disposal sites in Oakdale, Woodbury, and Cottage Grove are sources of PFAS groundwater contamination. The former Washington County Landfill was put in the MPCAs Closed Landfill Program in 2008 and since that time has undergone many years of clean up. The Oakdale, Woodbury, and Cottage Grove disposal sites have been in the State Superfund Program since 2007 and have undergone years of clean up as well. There are various reasons severe groundwater contamination occurred at these sites. One is because they were operating at a time when landfill liners were not required. Another reason is due to the type of geology in the county. The county's geology, particularly in the southern part, does not have sufficient overlying till to ensure protection of bedrock aquifers. The bedrock there is fractured and its common to have areas of karst. All of these characteristics create a situation with great potential for contaminating groundwater.

Mixed Municipal Solid Waste (MSW) is another waste stream where PHE works with partners to protect groundwater. The Washington County Solid Waste Management Plan 2024-2042 guides county waste management activities and was developed with guidance from the MPCA's Metropolitan Solid Waste Management Policy Plan 2022-2042. PHE programs that are impacted by the state waste objectives are solid and hazardous waste management, groundwater protection and management, and energy management. The State of Minnesota has established an order of preference for solid waste management, known as the Solid Waste Hierarchy, which the county's waste management plan has adopted. Based on this hierarchy, landfilling is the least desired waste management option. The order of preference for an integrated solid waste management system is:

1. Waste reduction and reuse;
2. Waste recycling;
3. Composting of source-separated compostable materials, including, but not

limited to yard waste and food waste;

4. Resource recovery through mixed municipal solid waste composting or incineration; and;
5. Land disposal which produces no measurable methane gas or which involves the retrieval of methane gas as a fuel for the production of energy to be used on-site or for sale; and
6. Land disposal which produces measurable methane and which does not involve the retrieval of methane gas as a fuel for the production of energy to be used on-site or for sale.

There is no operating MSW land disposal facilities in Washington County. In 2022, 25,479 tons of MSW from the county was delivered to landfills by private haulers. Haulers transported the waste to a variety of landfills in Inver Grove Heights, Elk River, Burnsville, and Blue Earth County, Minnesota and Eau Claire, Wisconsin. These landfills are owned by private companies, and individual solid waste haulers choose to transport the collected waste to a landfill.

Chapter 7. Groundwater Quantity

Groundwater is a vital resource in Washington County, providing 100 percent of the water used for drinking, commercial, industrial, and irrigation needs. Competing with these uses are natural resources such as streams, lakes, and wetlands that are dependent on a steady groundwater supply to maintain their vitality.

The county's continued population growth and development impacts groundwater quantity in a number of ways. One is the increased demand on water supplies. Overuse of groundwater decreases the amount available for public and private water supplies while also reducing the elevation levels in lakes, wetlands, and streams. Another example is the increased development of impervious surfaces due to higher infrastructure demands. These reduce the land area available for aquifer recharge. To help alleviate some of this loss, infiltration of stormwater has become an important tool in development and re-development projects. Both impact groundwater and surface water interaction as discussed in Chapter 4.

Another factor that affects groundwater quantity is weather. During warm summer months, as people take advantage of longer days and the growing season, water usage increases. The highest demand on aquifers often comes during drought conditions. Droughts pose a serious threat to available groundwater due to the compounded effects of increased water use for lawn sprinkling and crop irrigation and the decrease in the replenishment or recharge of aquifers. In the Twin Cities Metropolitan Area, summer water usage is 2.8 times the water usage in the winter. Many cities in the county are already implementing water reduction measures to reduce water usage in summer. To develop long-term stability of aquifer levels, water use habits must change, as must the misconception that groundwater reserves are infinite. See Chapters 4 and 5 for more information on climate change impacts and population trends in the county.

Groundwater quantity is also impacted by contamination. The county has known groundwater contamination from Per- and polyfluoroalkyl substances (PFAS), volatile organic compounds (VOCs), chlorides, nitrates, pesticides, and

others. The county has long recognized the link between groundwater quantity and groundwater quality, where the threat and presence of contamination impact the available clean water needed for drinking. The available drinking water supply has been significantly impacted in areas of the county with groundwater contamination. See Chapter 6 for more details on the contamination challenges faced by the county.

Communities and businesses in the county are working to create opportunities for water reuse, such as collecting rainwater runoff from the roof of a building and using it for lawn irrigation. There was an interagency workgroup that was started by the legislature in 2015 to "evaluate current regulations, practices, and barriers, and quantify and determine acceptable health risks associated with water reuse applications." The workgroup includes the Minnesota Departments of Agriculture, Health, Labor and Industry, and Natural Resources, Pollution Control Agency, Metropolitan Council, Plumbing Board, University of Minnesota Water Resources Center, and Board of Water and Soil Resources. The University of Minnesota is a research partner. This workgroup met from January 2016 to August 2017 and wrote the report: Advancing Safe and Sustainable Water Reuse in Minnesota 2018 Interagency Report on Water Reuse. MDH also wrote a white paper Reuse of Stormwater and Rainwater in Minnesota: A Public Health Perspective, in January 2022.

Recently partners have come together to plan how to get this work moving again. One area that still needs attention is a conflict in the plumbing code that makes it difficult to store rainwater in tanks inside of a building and then connect it to the irrigation system outside. This is one example where existing rules make it difficult to implement practices that are imperative to conserving our water supply. It will take a coordinated effort by all partners to determine the changes needed in rules and statutes to make water conservation efforts achievable and protective of public health.

Another benefit of water conservation is reduced capital costs for new wells and water treatment plants. Consumers can also save money on water, wastewater management, and energy. Sound water supply management will reduce water use conflicts, protect economic health, and will sustain natural resources dependent on groundwater.

Conservation and water supply planning will require increased coordination among municipalities, public education, and potentially, the formation of sub-regional water supply systems where conflicting needs can be balanced.

7.1 Water Supply

Washington County's residents are served by municipal water suppliers, non-municipal water suppliers (such as mobile home parks and apartment buildings that are on their own well), and private wells. The county has 14 municipal water suppliers with their own water source. Additionally, Birchwood Village runs their own system but purchases water from White Bear Lake. These systems are serving about 87% of residents. Public water suppliers are regulated by MDH under the Safe Drinking Water Act and are tested regularly for contaminants. Many public water suppliers maintain a Drinking Water Supply Management Area (DWSMA) including all municipal public water suppliers, Figure 39. The remaining 13% of county residents, or about 55,000 people, are served by private wells. The exact number of private wells is not known, but can be estimated at around 17,000, that serves about 37,000 households.

Aquifer Drawdown and Groundwater Recharge

The Minnesota Rules Chapter 4725 defines aquifers as stratum of saturated, permeable bedrock or unconsolidated material having a recognizable water table

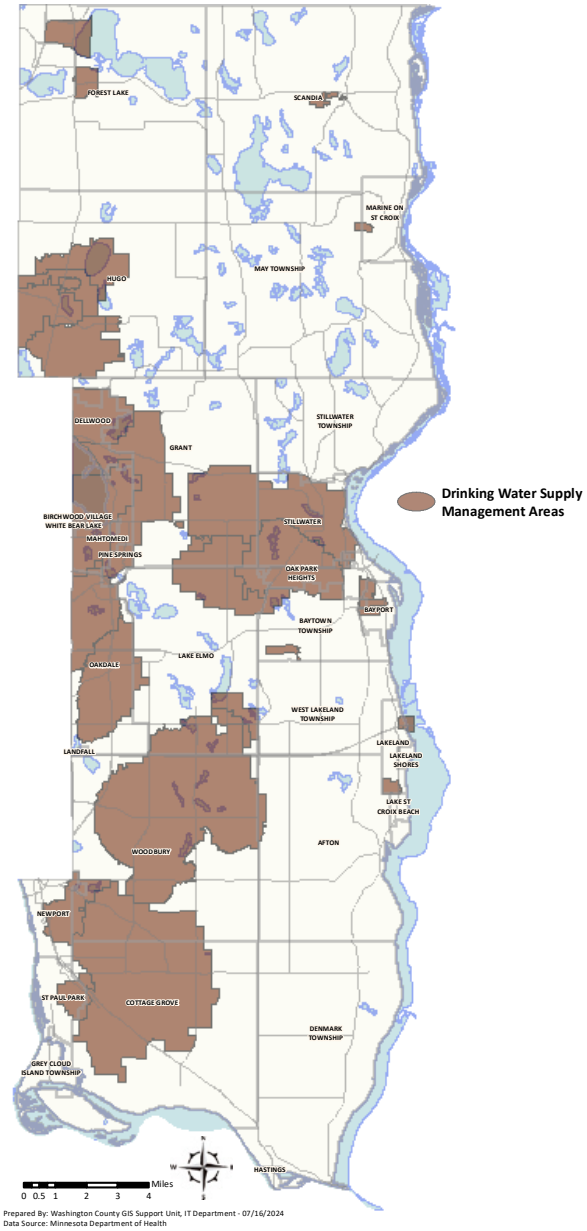


Figure 39. Drinking Water Supply Management Areas Map

or potentiometric surface which is capable of producing water to supply a well. Groundwater recharge is the process whereby surface water infiltrates into groundwater. This process ensures replenishment of groundwater in the aquifer. Groundwater availability and long-term sustainability depends on how much water is recharged. Groundwater is a finite resource. The three main factors affecting groundwater quantity are:

- the amount of groundwater pumped out of aquifers;
- the volume of recharge to aquifers from rainfall, snow melt, and lakes;
- the volume of groundwater naturally discharged to lakes, wetlands, and streams through groundwater and surface water interaction.

Using a banking analogy to explain these factors, the aquifers function as the bank account. Pumping water out of aquifers is analogous to making withdrawals from the bank account. Recharge from infiltration of rainfall and snowmelt is analogous to making a deposit in the bank account. Water stored in the aquifer can be likened to gaining interest in the account. Effectively managing the groundwater account means tracking the amount deposited, monitoring the balance, and making decisions on how much can be withdrawn (pumped) without overdrawing the account.

Humans have no control over weather and, therefore, cannot dictate the volume of water available for replenishing aquifers. However, humans do have an effect on the land surface where groundwater recharge occurs. Development of the land generally increases the amount of impervious surfaces (pavement and buildings) and compacts soil. These actions reduce the area available and the natural ability of precipitation to infiltrate through soils into aquifers. This reduces the volume of recharge (deposits) to aquifers and thus reduces the water available for use by humans and natural ecosystems.

Landowners can implement practices that encourage infiltration and recharge areas in the county to offset continued land use changes. There are strategies and actions in Chapter 2 that support and educate landowners in implementing some of these practices.

In addition to recharge through precipitation and infiltration, efforts to artificially enhance recharge are possible. This can include infiltration or spreading basins, injection wells, or in-stream projects. The most advanced of these is Aquifer Storage and Recharge (ASR). In Minnesota, ASR has not been deployed often. The University of Minnesota, along with Freshwater Society have been jointly conducting research on aquifer injection and recharge potential since 2019. The current regulatory landscape does not allow for artificial or aquifer recharge as a regular practice, and more research, such as the studies by the U of M, are needed to determine feasibility and safety of the practice. The U.S. Environmental Protection Agency (EPA) regulates injection wells under the Safe Drinking Water Act, while the Minnesota Department of Health has permitting authority over extractive wells like those currently used by residents, municipalities and irrigators. According to the U of M, the state well code and a streamlined permitting path would allow more successful development and deployment of ASR. State adoption of control over Class V injection wells from the USEPA is also necessary.

Reducing use or dependence on groundwater, through water conservation and efficiency efforts and water reuse are still a more feasible and preferred method for managing water supply in the short term. Artificial recharge, injection wells and ASR come with many considerations related to impacts on the aquifer, treatment of water, geological sensitivity and lack of sufficient soils for treatment. Research will continue at a regional and state level to look at options like ASR in the future.

Groundwater Supply & Population Growth

Washington County is the 5th most populated county in Minnesota, with an estimated population of 278,936 people in 2023, and continues to grow. More people demands more development, redevelopment, and increasing need for water. The Metropolitan Council projects an increase of about 57,000 people by 2050. Population and land use are discussed in more detail in Chapter 5.

As discussed, drawdown can be a long-term problem if demand of groundwater is consistently higher than the rate of groundwater recharge.

In drought conditions, groundwater drawdown may cause wells to go dry. This leads to the need for deeper wells with more powerful pumps. If drought conditions extend, it puts more pressure on the aquifer, which would require interventions such as water use restrictions, major infrastructure investments, and technological adaptations. Due to climate change, extreme weather patterns are becoming more common. Even though we have been experiencing extended periods of wet weather in recent years, alternating multi-year dry and wet periods are probable, making eventual water shortages more likely.

The Metropolitan Council has developed modeling to estimate future aquifer conditions. The model, called Metro Model 3, was completed in 2014, using municipal pluming data available through 2012 from the DNR. In general, the modeling results show decline in the aquifer over the next 20 years. Even under theoretical steady-state conditions, some portion of the county may experience 20 to 30 feet of drawdown in the Prairie du Chien-Jordan aquifers. These aquifers are major sources of municipal water supply and industrial processing water. The largest drawdowns are predicted in the areas where population is estimated to increase the most, such as Woodbury, Cottage Grove, Oakdale, and Hugo. Additionally, in farming communities, agricultural irrigation may increase with drought conditions, and lead to drawdowns in those areas of the county.

The model also shows scenarios with 20% more pumping and 20% less pumping. With 20% less pumping, the aquifers show much better rates of recharge. It is to be noted that the results are not predictive, and it is difficult to predict groundwater availability and recharge rates due to changing weather patterns. But it is a helpful tool for the communities to be proactive, rather than reactive, in prioritizing areas for additional research and direct resources.

7.2 Water Use

A water-use appropriation permit is required from the DNR for groundwater users withdrawing more than 10,000 gallons of water per day or 1 million gallons per year. This information is recorded using the Minnesota Permitting and Reporting System (MPARS), which helps the DNR track the volume, aquifer source, and the type of water use.

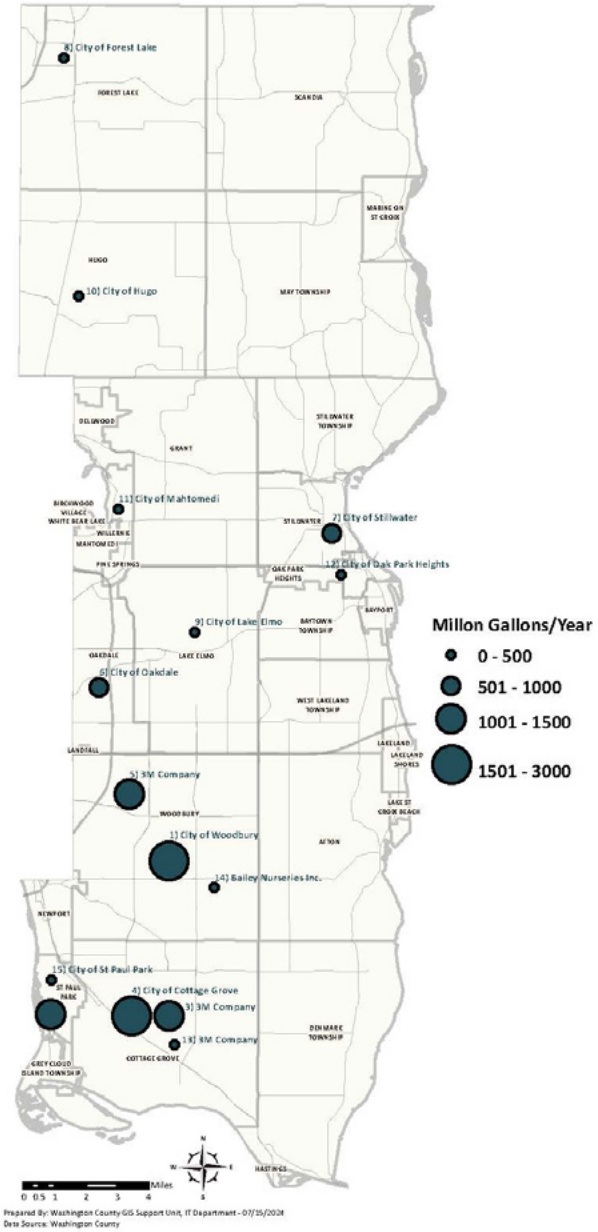


Figure 40. Location of Top 15 Water Users in Washington County Map

Table 15. Washington County Top 15 Water Users by the Five-Year Average (2018-2022)

	Water User	Category	2018-2022 Avg. (MG/Year)	2022 (MG/Year)
1	City of Woodbury	Water Supply	2,704	2,960
2	St. Paul Refining Company LLC	Industrial Processing	1,505	1,422
3	3M Company	Industrial Processing	1,451	1,330
4	3M Company	Special Categories (Pollution Containment)	1,381	1,223
5	City of Cottage Grove- Public Works Dept	Water Supply	1,364	1,624
6	City of Oakdale- Public Works Dept	Water Supply	857	891
7	City of Stillwater	Water Supply	721	738
8	City of Forest Lake	Water Supply	444	441
9	City of Lake Elmo	Water Supply	394	400
10	City of Hugo	Water Supply	387	428
11	City of Mahtomedi	Water Supply	236	248
12	City of Oak Park Heights	Water Supply	215	208
13	Bailey Nurseries Inc	Agricultural Irrigation	185	195
14	City of St Paul Park	Water Supply	184	189
15	City of Bayport	Water Supply	116	118

The DNR groups water uses in the following categories:

- Agricultural Irrigation - crops, nurseries
- Industrial Processing - petroleum-chemical, food processing, mine processing, sand/gravel washing, wood products processing
- Non-crop Irrigation - golf courses, landscaping, athletic fields, cemeteries
- Special Categories - snow/ice making, pollution containment, aquaculture, dust control, sewage treatment
- Water Supply - municipal, public, or private community well supply
- Water Level Maintenance - lake level maintenance, dewatering, pumped sumps

Utilizing the DNR information, Table 15 shows an analysis of water usage in the county. Data from 2022 was the most recent that was available at the time of plan adoption.

In 2022, the total permitted groundwater pumping in the county was 14.03 billion gallons. By DNR category the highest permitted use of groundwater was municipal pumping at approximately 8.43 billion gallons. The second highest use of groundwater was for industrial processing at approximately 2.75 billion gallons, followed by pollution containment at approximately 1.22 billion gallons. Most of the water pumped for pollution containment is pulled out of the 3M Woodbury Disposal site and is routed to the 3M plant in Cottage Grove. The water is treated to surface water standards, with some of the water being used by the 3M plant in Cottage Grove for required cooling of materials during

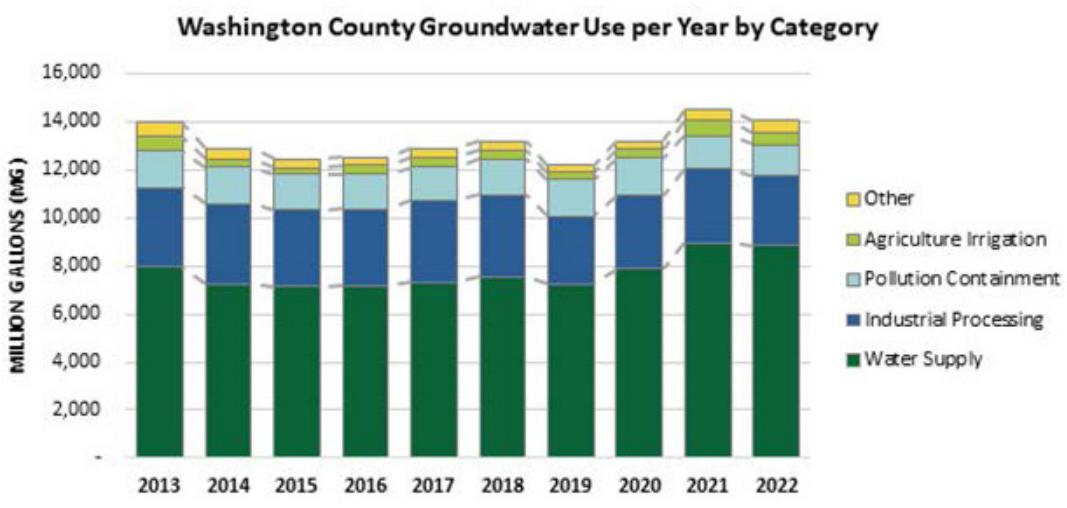


Figure 41. Washington County Groundwater Use (MG) per Year by Category Bar Graph

the manufacturing process, before it is discharged to the Mississippi River. There are other pollution containment efforts around the 3M Oakdale site, former landfill, and for the Baytown/West Lakeland TCE site. Pollution containment amounts to a reduction of approximately 12.5% of the available drinking water supply. Additionally, there are emerging contaminants that are currently being identified and analyzed by MDH. These contaminants are discussed further in Chapter 6.

Private Well Water Usage

According to the DNR, a little over 14 billion gallons of water was used in the county in 2022. This data only includes wells permitted through the DNR, not the private wells. According to the Minnesota Well Index, there are more than 17,000 private wells in the county that supply water for around 37,000 households. Almost all rural households, along with some urban and suburban parts of the county use water from private wells. Private well water usage is estimated at 550 million gallons per year in the county.

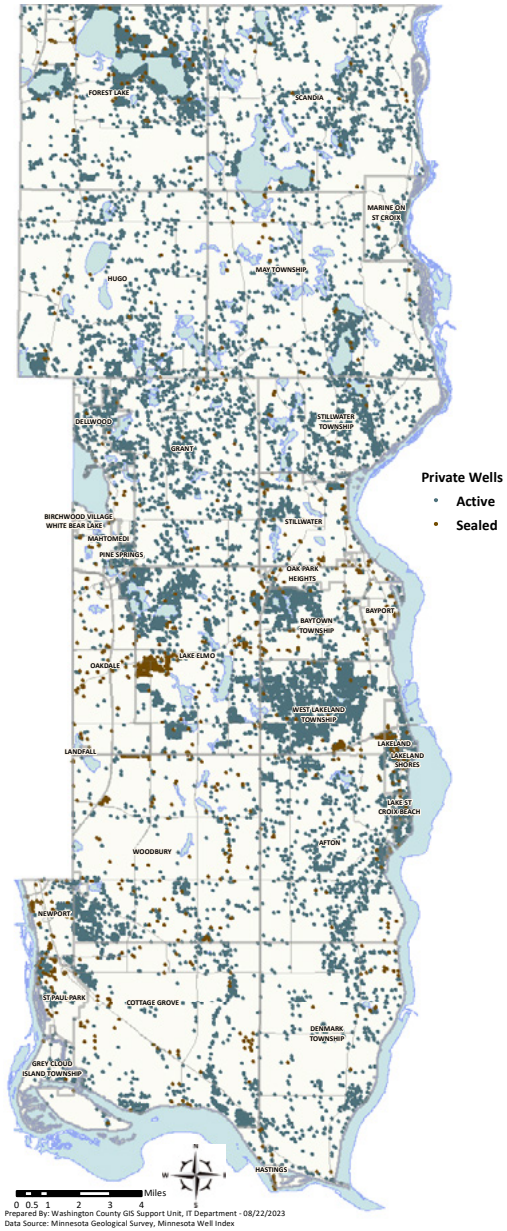


Figure 42. Location of Private Wells Map

White Bear Lake Impacts

White Bear Lake is a 2,427 acre lake which sits between Washington and Ramsey Counites. The lake is a popular recreational destination, and its surface elevation has fluctuated over time. In the late 2000s, the lake began experiencing low water level issues.

In 2015, the DNR designated the North and East Metro Groundwater Management Area (GWMA), in part due to ongoing issues with the levels of White Bear Lake. The Minnesota legislature created groundwater management areas (GWMAs) as a tool for the DNR to address these difficult groundwater-related resource challenges in the state and the North and East Metro GWMA was one of the first three pilot areas.

The lake has been subject to several studies and models to determine the connection between surface and groundwater and impacts of groundwater pumping on the lakes level. A study published in 2016 by the U.S. Geological Survey (USGS) confirmed the connection between White Bear Lake and the groundwater system and suggested that lower lake levels are partially related to increased pumping in the area. The USGS determined long-term declines in lake-water levels can be caused by increased groundwater withdrawals and decreasing precipitation. Excessive groundwater withdrawal during dry periods exacerbates this issue. DNR modeling analysis indicates total water use to the equivalent of about 55 gallons/day/capita (gpcd) would maintain lake levels near or above 922 feet under a normal range of conditions. This is essentially limiting water for first priority uses, which does not include the use of water for schools, hospitals, medical offices, government buildings, commercial uses (restaurants, gas stations, grocery stores, or any other store) hotels, or industrial uses.

The lake has been subject to litigation around its water levels and groundwater use. In 2012, the White Bear Lake Restoration Association filed a lawsuit against the DNR citing the state entity approved excessive groundwater use from the aquifer directly affecting the decline in White Bear Lake's water level.

A series of court actions ensued, including a 2018 Ramsey County District Court ruling in favor of the plaintiffs. This ruling prohibited the DNR from issuing new permits or increases within 5 miles of White Bear Lake unless certain conditions are met. The DNR also has an obligation to maintain lake levels above 922. Actions continue at District Court, as recently as 2022, after a Supreme Court Ruling remanded parts of the lawsuit back to District Court. The DNR continues to work with the district court, plaintiffs and White Bear Lake area communities to identify the next steps required to implement the District Court Order.

The impacts of the White Bear Lake court ruling are felt most by communities within a 5-mile radius of the lake (which includes several communities in the county), but implications from ongoing litigation and court rulings complicate water demand management for the entire region and state.

Appendix A.
References

Almendinger, J. E. (2003) *Watershed hydrology of Valley Creek and Browns Creek: Trout streams influenced by agriculture and urbanization in eastern Washington County, Minnesota, 1998-99.* St. Croix Research Station, Science Museum of Minnesota.

Bauer, Emily J. et al (2016). *Washington County Atlas C-39.* Minnesota Geological Survey.

Berg A. James. et al. (2019). Groundwater/Hydrogeology Report. Minnesota DNR.

DeRusha, Aaron (Dec 2021). *Washington County Groundwater Recharge Zone Prioritization.* Washington Conservation District.

Groundwater Pumping, Precipitation Can Affect Lake Levels in Twin Cities. (2017, September 6). USGS.

McDaris, John R. Fienberg, Joshua. Levine, Johnathan. and Anthony Runkel. (2022, July) *Documentation and Predication of Increasing Groundwater Chloride in the Twin Cities, Minnesota.* Figure 1.

Metropolitan Council (2023, April). *Generalized Land Use - Historical 1984, 1990, 1997, 2000, 2005, 2010, 2016 and 2020, for the Twin Cities Metropolitan Area.*

Metropolitan Council (2023, April). *Regional Planned Land Use – Twin Cities Metropolitan Area.*

Metropolitan Council (2024, July). *2023 Final Population and Household Estimates.*

Metropolitan Council. (2023, September). *Water Supply Planning Atlas for the Twin Cities Metropolitan Area.*

Metropolitan Council. (2024, August). *Proposed Local Forecasts to 2050.*

Metropolitan Council. (n.d.) *Climate Vulnerability Assessment.*

Metropolitan Council (May 2020). *Interactions of Groundwater and Surface Water Resources.*

Metropolitan Council. (n.d.) *Localized Flood Risk.*

Minnesota Department of Agriculture (2022, September). *2000 Nutrient Management Assessment of Producers: Cottage Grove Nitrate Study Area.*

Minnesota Department of Health (2019, July). *Coliform Bacteria.*

Minnesota Department of Health (2021, March). *Manganese in Drinking Water.*

Minnesota Department of Health (2023, August). *Arsenic in Drinking Water.*

Minnesota Department of Health (2023, August). *Lead in Well Water Systems.*

Minnesota Department of Health (2024, August). *Per- and Polyfluoroalkyl Substances (PFAS).*

Minnesota Department of Health (2024, June). *Water Changes.*

Minnesota Department of Health (2024, October). *Contaminants of Emerging Concern (CEC) Initiative.*

Minnesota Department of Health. (2022, January). *Reuse of Stormwater and Rainwater in Minnesota- A Public Health Perspective.*

Minnesota DNR. (2024) *'Status and Trends of Wetlands and Deepwater in Minnesota: 2006 to 2020.'*

Minnesota DNR. (n.d.) *Minnesota Climate Trends.*

Minnesota Pollution Control Agency & Department of Natural Resources (n.d.). *Minnesota 3M PFAS Settlement.*

Minnesota Pollution Control Agency (n.d.) *Environmental justice.*

Appendix A.
References

Minnesota Pollution Control Agency. (2019, June) *'Status and Trends of Wetlands in Minnesota: Minnesota Wetland Condition Assessment (2011/12-2016).'*

National Wild and Scenic Rivers System. (n.d) *'St. Croix River.'*

Phuong, U. D., Heuzard, A. G., Le, T. X. H., Zhao, J., Yin, R., Shang, C., & Fan, C. (2024) *The impacts of climate change on groundwater quality: A review.* Science of The Total Environment, 912, Article 169241.

U.S. Census Bureau (n.d.) *Households and Families, American Community Survey, 1-year Estimates Subject Tables, Table S1101, 2022.*

U.S. Census Bureau (n.d.) *Race, Decennial Census, DEC Redistricting Data, Table P1, 2010.*

U.S. Census Bureau (n.d.) *Race, Decennial Census, DEC Redistricting Data, Table P1, 2020.*

U.S. Census Bureau. (n.d.). *QuickFacts.* U.S. Department of Commerce.

U.S. Centers for Disease Control and Prevention (n.d.). *Environmental Justice Dashboard.*

United States Environmental Protection Agency (2021, September). *Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts.*

United States Environmental Protection Agency (2021, September). *EPA Report Shows Disproportionate Impacts of Climate Change on Socially Vulnerable Populations in the United States.*

United States Environmental Protection Agency (2024, May). *Our Current Understanding of the Human Health and Environmental Risks of PFAS.*

Wisconsin Department of Natural Resources (2024, March). *Interim Strategy for Land Application of Biosolids and Industrial Sludges Containing PFAS.*

Wovcha, Daniel S. Delany, Barabara, C. and Nordquist, Gerda E. (1995) *Minnesota's St. Croix River Valley and Anoka Sandplain. A Guide to Native Habitats*. University of Minnesota Press.

Appendix B.
Glossary

Aquifer	Rock or sediment in a formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield economical quantities of water to wells and springs.
Aquifer, confined	A formation in which the groundwater is isolated from the atmosphere at the point of discharge by impermeable geologic formations. Confined groundwater is generally subject to pressure greater than atmosphere.
Aquifer, unconfined	An aquifer whose upper boundary consists of relatively porous natural material which transmits water readily and does not confine water.
Aquitard (or confining layer)	A geologic formation of low permeability that greatly inhibits the movement of groundwater.
Base flow	Sustained low flow of a stream which is often due to groundwater inflow to the stream channel.
Bedrock	A general term for the rock, usually solid, that underlies soil or other unconsolidated material.
Bedrock Aquifer	An aquifer composed of bedrock formations.
Bedrock Valley	A valley cut into bedrock by water and later filled with unconsolidated materials such as sand and gravel.
Collector System	A sewage treatment system which collects sewage from two or more residents or other establishments, consisting of collector lines, pumps, sewage tanks, and soil treatment unit.
Cone of Depression (or Drawdown)	A depression in the groundwater table or potentiometric surface that has the shape of an inverted cone and develops around a well from which water is being withdrawn. It defines the area of influence of a well.
Contaminants of Emerging Concern	A CEC is a contaminant that: has been newly discovered in the environment; or, is generating increased interest due to new scientific information about its effect on public health or the environment. Can be naturally occuring or human-made.
Contamination Plume	The region of dispersal of groundwater contaminants in an aquifer.
Contour Map	A map displaying lines that connect points of equal value and separate points of higher value from points of lower value. Often used to show land or groundwater level surfaces.
County Environmental Charge	A waste management service charge for solid waste management programs to protect groundwater, such as household hazardous waste, recycling, resource recovery, and groundwater programs, which is collected by haulers as a percentage of the garbage bill.
Geomorphic Regions	Land areas divided into regions by common geologic and topographic features.
Geomorphology	The study of the nature and origin of the processes that create the physical landscape and the landforms that result from these processes. The processes include the effects of tectonic forces, weathering, running water, waves, glacial ice, and wind, resulting in erosion, transportation, deposition of rocks, etc.
Glacial till	Glacial deposits composed of mostly unsorted sand, silt, clay, and boulders deposited directly by the glacial ice.
Groundwater	Water located in inter-connected pores found beneath the water table.
Groundwater Discharge	The process of groundwater leaving an aquifer.
Groundwater Discharge Area	The point or region where groundwater leaves an aquifer. Groundwater discharge areas include the land surface, streams, lakes, wetlands, springs, and seeps. Groundwater also discharges to wells.
Groundwater Recharge	The process whereby surface water infiltrates into groundwater. Also used in this groundwater plan to describe the transfer of groundwater from any one aquifer into another aquifer.
Groundwater Recharge Area	The region or area in which groundwater recharge occurs.
Health Based Value	The concentration of a chemical (or a mixture of chemicals) that is likely to pose little or no risk to human health.
Hydrogeology	The science of water use, quality, occurrence, movement, and transport beneath the earth's surface.

Appendix B.
Glossary

Hydrostratigraphic Unit	A formation, part of a formation, or group of formations in which there are similar hydrologic characteristics allowing for groupings into aquifers or confining layers.
Ice Contact Deposit	Sediment deposited beneath or adjacent to the glacier margin. Ice contact deposits are typically rich in sand and gravel.
Ice Walled Lake Deposits and Glacial Lake Deposits	Sand and silt deposits which were formed in bottoms of lakes within or at the margin of a glacier.
Impaired Water	A water body that fails to meet the necessary water quality standards that are set, by the state, to ensure the water fulfills its designated use such as fishable, swimmable, or drinkable.
Impervious Surfaces	Land cover that is composed of materials that inhibit the infiltration of surface water into the ground. Common impervious surfaces include roads, driveways, parking lots, buildings and compacted soils.
Industrial Solid Waste: is defined in Minn. R. 7035.0300 as follows: Subpart 45.	"Industrial solid waste" means all solid waste generated from an industrial or manufacturing process and solid waste generated from nonmanufacturing activities such as service and commercial establishments. Industrial solid waste does not include office materials, restaurant and food preparation waste, discarded machinery, demolition debris, municipal solid waste combustor ash, or household refuse. Inclusive of 'Industrial By-Products.'
Infiltration	The movement of water from the soil surface downward into the soil profile.
Inner Wellhead Management Zone	The land adjacent to a well, within a 200 foot radius, that all Public Water Suppliers (PWS) supplying groundwater must manage.
Karst	A topography developed largely by groundwater erosion and bedrock dissolution characterized by numerous caves, springs, sinkholes, solution valleys, and disappearing streams. Karst features create conditions of rapid groundwater infiltration and flow.
Land Spreading (or Land Application)	The spreading of biosolids on the soil surface or incorporating or injecting biosolids into the soil. Biosolids land application occurs at various sites including agricultural lands, forests, mine reclamation sites, and other disturbed lands, parks, and golf courses.
Mixed Municipal Solid Waste: is defined in Minnesota Statues Section 115A.03 as follows: Subdivision 21.	(a) "Mixed municipal solid waste" means garbage, refuse, and other solid waste from residential, commercial, industrial, and community activities that the generator of the waste aggregates for collection, except as provided in paragraph (b). (b) Mixed municipal solid waste does not include auto hulks, street sweepings, ash, construction debris, mining waste, sludges, tree and agricultural wastes, tires, lead acid batteries, motor and vehicle fluids and filters, and other materials collected, processed, and disposed of as separate waste streams.
Nitrate	An organic chemical compound composed of one nitrogen and three oxygen molecules (NO3). Sources of nitrate include fertilizers, pesticides, animal and human waste. Nitrate easily dissolves in water and readily moves through soil and into regional aquifers.
Non-Point Source Pollution	Pollution originating from diffuse areas (land surface or atmosphere) having no defined source. Examples include field agricultural chemicals and urban runoff pollutants.
Outwash Deposits	Sediment deposited by the glacier meltwater away from the glacier margin. Outwash is usually composed of sand, sand and gravel, or fine sand and silt.
Outwash Plain	A region of relatively flat to undulating topography covered by glacial outwash.
Perched (Lake or Wetland)	A surface water body that is underlain by a fine-grained geologic unit or aquitard that restricts the downward movement of surface water. Perched lakes and wetlands are less connected to groundwater systems.
Point-Source Pollution	Pollution originating from a single identifiable source. Examples include waste disposal sites, leaking storage tanks, chemical spills, ruptured pipelines, and subsurface sewage treatment systems.
Porosity	The ratio of the volume of void spaces in a rock or sediment to the total volume of the rock or sediment.

Appendix B.
Glossary

Primary Porosity	This is a term typically applied to bedrock and refers to porosity of the rock matrix created as part of the original depositional structure of the geologic materials. It can be high or low. Also used to describe matrix porosity of cohesive geologic materials such as glacial tills.
River Terrace	A mostly level to gently rolling landform that developed along the region's major river valleys by vastly larger glacial melt-water rivers. River terraces contain abundant sand and gravel deposits.
Reverse Osmosis	A water purification process that uses a semi-permeable membrane to separate water molecules from other substances.
Secondary Porosity	Similar to primary porosity this term also is typically applied to bedrock or other cohesive material. It refers to porosity created by fracturing, movement or solution well after the original deposition of geologic material. The term is combined with primary porosity to describe the overall porosity of the rock. In glacial tills some examples of secondary porosity are fractures, macropores due to plant roots, etc.
Sedimentary Rock	Any rock composed of sediment. The sediment may be particles of various sizes such as gravel or sand, the remains of animals or plants as in coal and some limestones, or chemicals in solution that are extracted by organic or inorganic processes. Sandstone, shale, siltstone, and limestone are common sedimentary rocks.
Shale	A fine-grained sedimentary rock, formed by the consolidation of clay, silt, or mud.
Siltstone	A sedimentary rock composed primarily of silt-size materials.
Special Well and Boring Construction Areas (SWBCA)	An area designated by the Minnesota Department of Health where groundwater contamination is known to exist. In these areas well construction, repair, and sealing practices are more stringent than the minimum requirements specified by Minnesota Rules, Chapter 4725 (Well Code) in order to prevent human health exposure to harmful contaminants.
Stratigraphy	The study of rock strata distribution, deposition, and age
Subsurface Sewage Treatment System (SSTS)	. A sewage treatment system connected to a dwelling or establishment, consisting of sewage tanks and a soil treatment area (usually a drainfield or mound).
Superfund	The common name for the Federal program established by the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended in 1986. The Superfund Law authorizes the U.S. Environmental Protection Agency to investigate and clean up sites nominated to the National Priorities List.
Superfund Site	Sites on the National Priorities List that the Environmental Protection Agency has the authority to investigate and clean up under the Superfund Law.
Surface Water Runoff	Precipitation, snow melt, or irrigation in excess of what can infiltrate or be stored in small surface depressions.
Surficial Terrace Deposits	Sand and gravel deposited by vastly large post-glacial rivers that ran through the St. Croix and Mississippi River valleys. Terrace remnants within the Mississippi River valley generally are underlain by finer grained sediment than those within the St. Croix River Valley.
Total Maximum Daily Load Study (TMDL)	A study required by the MPCA for an impaired water body that sets pollutant reduction goals needed to restore the waters to their designated use such as fishable, swimmable, or drinkable.
Unsaturated Zone (or Zone of Aeration)	The part of the soil profile in which the voids are not completely filled with water. The zone between the land surface and the water table.
Volatile Organic Compounds (VOCs)	Carbon-containing compounds that evaporate easily from water into air at normal air temperatures. VOCs are contained in a wide variety of commercial, industrial, and residential products including fuel oils, gasoline, solvents, cleaners and degreasers, paints, inks, dyes, refrigerants, and pesticides.
Washington Conservation District (WCD)	Is Washington County's Soil and Water Conservation District (SWCD). It is a local unit of government that manages and directs natural resource management programs at the local level. The WCD works across the entire county with landowners and with other units of government, to carry out a program for the conservation, use, and development of soil, water, and related resources.

Appendix B.
Glossary

Water Table	The point beneath the unsaturated zone where aquifer materials are fully saturated, and the water levels are directly responsive to changes in atmospheric pressure. The water table level may also be reflected in lakes, streams and wetlands.
Water Table Aquifer	The uppermost unconfined aquifer in any given area. Water table aquifers are commonly found in surface or glacial sediment but can be formed in bedrock aquifers.
Watershed District	Local units of government that operate under Minnesota Statutes Chapter 103B and 103D to work to solve and prevent water-related problems. They are funded by their own levy authority. The boundaries of the districts usually follow those of a natural watershed (an area in which all water drains to one point).
Watershed Management Organization (WMO)	Required under the Metropolitan Area Surface Water Management Act, WMOs are based on watershed boundaries, and can be organized in three ways: 1) As a joint powers agreement (JPA) between the cities and townships within the watershed that is funded by the members of the JPA; 2) As a watershed district defined above; 3) As a function of county government, usually administered by the county planning department.

Appendix C.

Public Comments and County Responses

Developed Upon Next Draft of Plan.

Appendix D.

Plan Approval Documents

Developed Upon Next Draft of Plan.

Washington County
MINNESOTA

Washington County Department of Public Health & Environment
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