WASHINGTON COUNTY

# GROUNDWATER PLAN

**DRAFT**

2014-2024

**Acknowledgements**

2013 Washington County Board of Commissioners
Washington County, Minnesota

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| Bob Fossum | Citizen Member |
| Brian Bachmeier (began January 1, 2013) | Municipal Government |
| Brian Johnson (ended December 31, 2012) | Watershed District |
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# KEY TO ACRONYMS

| | |
|---|---|
| BMP | Best Management Practice |
| BWSR | Board of Water & Soil Resources |
| CRP | Conservation Reserve Program |
| DNR | Minnesota Department of Natural Resources |
| EAW | Environmental Assessment Worksheet |
| EIS | Environmental Impact Statement |
| EOP | Emergency Operations Plan |
| GIS | Geographic Information Systems |
| GPS | Global Positioning System |
| GWAC | Groundwater Advisory Committee |
| HHW | Household Hazardous Waste |
| IBP | Industrial By-Product |
| SSTS | Subsurface Sewage Treatment System |
| 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 Solid Waste |
| MUSA | Metropolitan Urban Service Area |
| NRCS | Natural Resource Conservation Service |
| NPEAP | Non-Point Engineering Assistance Program |
| PFC | Perfluorochemicals |
| PHE | Washington County Department of Public Health & Environment |
| PWS | Public Water Suppliers |
| RCRA | Resource Conservation & Recovery Act |
| SCWRS | St. Croix Watershed Research Station |
| SSTS | Subsurface Sewage Treatment System |
| STATE | State Government (unspecified) |
| SWCD | Soil & Water Conservation District |
| TAC | Technical Advisory Committee |
| TMDL | Total Maximum Daily Load |
| USDA | United States Department of Agriculture |
| U of M | University of Minnesota |
| VOC | Volatile Organic Compounds |
| WCA | Wetland Conservation Act |
| WCD | Washington Conservation District |
| WMO | Watershed Management Organization |

# GLOSSARY OF TERMS

*This glossary provides definitions that are applicable to the region. Some definitions were modified to best fit unique local conditions.*

**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. The water level in the aquifer is the water table and is exposed to the atmosphere through openings in the overlying materials.

**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.

**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.

**Dolostone:** A carbonate rock (e.g. limestone) made up predominately of the mineral calcium magnesium carbonate.

**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.

**Hydrogeology:** The science of water use, quality, occurrence, movement, and transport beneath the earth's surface.

**Hydrologic cycle:** Movement of water in and on the earth and atmosphere. Numerous processes such as precipitation, evaporation, condensation, and runoff comprise the hydrologic cycle.

**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 deposits:** 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.** "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.

**Infiltration:** The movement of water from the soil surface downward into the soil profile.

**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.

**Limestone:** A sedimentary rock composed mostly of the carbonate mineral calcium carbonate.

**Mixed Municipal Solid Waste: is defined in Minnesota Statues Section 115A.03 as follows: Subdivision 21. Mixed municipal solid waste.**

(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, exept 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.

**Paleozoic era:** An era of geologic time lasting from 570 to 245 million years ago.

**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.

**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.

**Quaternary period:** Geologic time beginning about 1.5 million years ago to present.

**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.

**Sandstone:** A sedimentary rock composed of abundant rounded or angular fragments of sand set in a fine-grained cemented matrix of silt or clay.

**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 limestone's, 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.

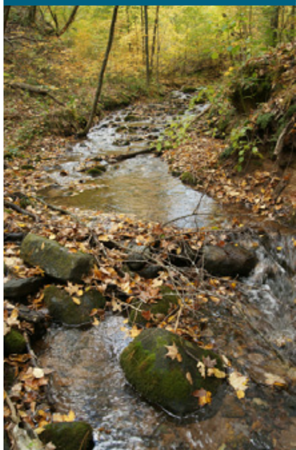
**Total Maximum Daily Load Study (TMDL):** A study required by the MPCA for an impaired water body that sets pollutant reduction goals needed to restore the waters to their designated use such as fishable, swimmable, or drinkable.

**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.

**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.

# 1. INTRODUCTION



Groundwater provides 100 percent of the water supply in the county available for human uses.

Groundwater is perhaps Washington County's (county) most valuable natural resource. High quality drinking water, healthy streams and lakes, fish habitat, rare plants and economic vitality all depend on protecting and conserving groundwater resources. The overall goal of the Washington County Groundwater Plan (Plan) is to:

> **"Manage the quality and quantity of groundwater in Washington County to protect health and ensure sufficient supplies of clean water to support human uses and natural ecosystems."**

There are many competing interests for the use of county groundwater. The two main users, as defined in the Plan's goal, are humans and natural ecosystems. Human uses include domestic, commercial, industrial, and irrigation. Natural ecosystems include streams, lakes, wetlands, and fens.

Groundwater provides 100 percent of the water supply in the county available for human uses. Recent data shows that increased groundwater pumping for human use is having an impact in the county. This includes a decline in water levels of county lakes, stresses on county streams including trout streams, and more inquiries from county residents wondering why their well isn't supplying enough water.

Additionally the county has known groundwater contamination from Perfluorochemicals, Volatile Organic Compounds, and nitrates. The presence of these contaminants decreases the amount of clean drinking water available.

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 technical framework, issues, policies, and strategies to address existing and future groundwater related problems.

By Minnesota Statute 103B.255, county government is responsible for writing, coordinating, and administering the Plan; however, no one entity has the overall authority to implement all the necessary actions. Through this planning effort, the county seeks support from the community in order to protect and conserve this valuable resource now and for future generations.

The Plan is meant to:

- Concisely outline the physical nature of groundwater resources, discuss the issues that threaten groundwater, and provide direction and strategies on how to protect groundwater for future generations.
- Provide context and organization for stakeholders and residents to better understand the complex water governance structure.
- Serve as a framework to develop annual work plans for the county and its stakeholders that give specific implementation actions to address the groundwater issues in this plan.
- Compliment and coordinate with other state, regional, county, and local planning efforts.

- Guide collaboration on groundwater initiatives with state, regional, and local partners more efficiently and effectively.
- Be a resource for stakeholders and residents regarding groundwater information pertinent to the county.

## 1.1 GOVERNANCE

Water governance in Minnesota is complex, with state and local agencies responsible for different aspects of surface and groundwater management. Both surface and groundwater are managed and regulated by State agencies, watershed organizations, and local governments. Historically, surface water management organizations and agencies have not factored groundwater provisions into their plans, policies and rules. While this is starting to change it will take a coordinated effort between State agencies, the county, watershed organizations and local government to provide more effective overall management of both surface water and groundwater. The county Plan is the link to tie the governance of surface and groundwater together in an effort to focus on researching the level of connection between surface water and groundwater, identifying groundwater recharge and discharge zones, and developing policies and rules to protect and holistically manage water resources.

In recent years, several statewide efforts have engaged stakeholders around water governance, calling for increased coordination of groundwater and surface water management. These efforts will continue to evolve over the life of this Plan. They include:

- The Clean Water Legacy Act of 2006, which established the Clean Water Fund and the Clean Water Council.
- The Clean Water, Land and Legacy Amendment of 2008, which has served as a powerful incentive for state agencies to collaborate and improve the integration of their programs.
- The University of Minnesota Water Sustainability Framework, which provides recommendations for aligning water, land use and energy policies to ensure water sustainability and providing cross-cutting governance.
- The Local Government Roundtable that is led by the Association of Minnesota Counties, the Minnesota Association of Watershed Districts, and the Minnesota Association of Soil and Water Conservation Districts. The roundtable provides consensus recommendations to members and state policy makers on how to deliver water management in Minnesota.
- The Minnesota Pollution Control Agency Water Governance Evaluation, completed in 2013, evaluates water related statutes, rules, and governing structures to streamline, strengthen, and improve sustainable water management.

The overall governance structure for water management in Washington County, along with the responsibilities of each agency is on the following page. Key state agencies include the Board of Water and Soil Resources (BWSR), the Minnesota Department of Natural Resources (DNR), Minnesota Department of Agriculture (MDA), Minnesota Department of Health (MDH), and the Minnesota Pollution Control Agency (MPCA).

## Washington County Groundwater Plan

### Board of Water and Soil Resources
- Approves Groundwater Plans
- Approves WMO Plans
- Works with SWCDs
- Administers LGU Assistance Grants

### Minnesota Department of Health
- Source Water Protection
- Enforces State Well Code
- Approves Wellhead Protection Plans
- Well Sealing
- Special Well & Boring Construction Areas
- Drinking Water Standards
- Emerging Contaminants
- County Well Index with MGS

### Washington Conservation District
- Provides Technical Assistance for Stormwater & Erosion Control
- Assist with Planning and Implementing of Natural Resource Management Plans
- Assist with Implementing the Wetland Conservation Act
- Natural Resource Education

### Local Government Units
- Comprehensive Plans & Zoning
- Local Water Plans
- Wellhead Protection Plans for Public Water Suppliers
- Water Supply Management Plans
- Septic Systems

### Metropolitan Council
- Approves Comprehensive & Local Water Plans
- Metro Water Supply Plan
- Metro Model—Groundwater
- South Washington County Water Supply Work Group
- Metro Waste Water Planning (MUSA) & Treatment

### Department of Natural Resources
- Water Appropriation for Surface & Groundwater
- Observation Wells Network
- Conservation Plans
- Groundwater Management Plans
- Geologic Atlas with MGS
- Natural Resources Protection & Conservation

### Minnesota Geological Survey
- Investigates Geology
- Provides Technical Assistance
- Develops Geologic Databases
- Geologic Atlas with DNR
- County Well Index with MDH

### Minnesota Pollution Control Agency
- Groundwater Monitoring Ambient & Contaminant
- Cleanup of Contaminated Soil & Groundwater
- Surface Water Quality Standards & TMDLs
- Wastewater & Surface Water Discharge Permits
- Hazardous and Solid Waste
- State Septic System Rules

### Minnesota Department of Agriculture
- Regulation of Pesticides & Fertilizers
- Nitrate Clinics
- Agricultural Research
- Loan Assistance

### Watershed Management Organizations
- Watershed Plans
- Resource Inventories
- Rules & Permitting to Protect Water Resources

From a regional perspective, the Metropolitan Council shares responsibility for water management. At the local level, the county, Washington Conservation District (WCD), Local Government Untis (LGUs) and watershed management organizations (WMOs) all have various roles. Watershed district boundaries are represented in ***Figure 1***.

Many of these agencies engage in planning efforts with regards to water management. These plans are discussed below and throughout the Plan. The county Plan complements these existing plans and fills a gap by identifying strategies that guide communities specifically in groundwater management. In many cases, decision making for groundwater management does not lie directly with the county. However, the county can play a lead role in developing partnerships that will move strategies forward.

**Regional Growth, Land Use and the Urban Service Area**
Under state law, the Metropolitan Council is charged with guiding regional development in the twin cities area. The current "Regional Development Framework" consists of a regional growth strategy into the year 2030. It consists of a compilation of policy statements, goals, standards, programs, and maps prescribing orderly, economic, public, and private development. Metropolitan Council is currently updating this planning effort through Thrive MSP 2040, which will require updates for several of the plans discussed below. See their website for more details: Metropolitan Council Thrive MSP 2040.

The Metropolitan Council also plans for the Metropolitan Urban Service Area (MUSA). Centralized sewer and water serves most of the area within the MUSA or the boundary of an urban reserve area. ***Figure 2*** illustrates the location of the MUSA in the county as of 2010, and projected extensions of the MUSA into 2030. Some cities are already completely within the MUSA (Stillwater, Oakdale, Newport, Mahtomedi, Oak Park Heights, and Bayport) while others are partially included in plans for additional expansion (Forest Lake, Hugo, Lake Elmo, Cottage Grove, and Woodbury). If a community wishes to expand the MUSA they make a request that is either approved or denied by the Metropolitan Council. The availability of centralized sewers and the future growth of the MUSA are major factors in determining housing density in the county. Where the MUSA is extended, higher density development will follow. All of the communities along the St. Croix River north of Stillwater and south of Bayport are considered rural residential, or permanent rural, which indicates that the MUSA would not extend into these areas in the foreseeable future. These areas of the county will continue to utilize subsurface sewage treatment systems (SSTS) for sewage treatment.

The Metropolitan Council's decisions to expand the MUSA will need to consider the impact on groundwater resources as higher density development will increase water supply demands. The Metropolitan Council is authorized to do regional water supply planning as discussed in Chapter 5.

**County Comprehensive Planning Process and Zoning**
In 2010 the County Board of Commissioners adopted its most recent comprehensive plan. The goals and policies in the Washington County 2030 Comprehensive Plan apply to the unincorporated areas of the county. Incorporated cities prepare their own comprehensive plans.

The Washington County 2030 Comprehensive Plan outlines several goals to protect its natural resources while managing growth and development. The elements of the Comprehensive Plan relating most directly to groundwater protection are found in the Land Use and Natural Resources sections. The Comprehensive Plan promotes development in urban areas where urban services can be provided, and encourages open space design of housing in the rural areas. Open space design allows the housing to be clustered on lots that are much smaller than those in conventional subdivisions keeping a substantial percentage of the property as permanently protected open space. The purpose of clustering houses is to provide a more efficient use of the land while preserving good agricultural land, open space, scenic views and natural drainage systems.

With regard to the effect of land use on groundwater the comprehensive plan states: "Washington County will regulate development so that groundwater quality and quantity is protected from degradation and depletion and is maintained in a safe condition for the benefit of all citizens. Pollution prevention will be the top priority. Standards to prevent the contamination of groundwater will be established and enforced. More stringent standards will be adopted to protect areas of significant groundwater recharge."

In the Natural Resources section of the comprehensive plan Goal 6-2 and its strategies are specific to water resources. Goal 6-2 states: "Protect groundwater and surface water resources through coordination and collaboration with state and local water resource organizations."

This plan uses the County's Comprehensive Plan as a guide to move forward on its groundwater strategies.

**City Comprehensive Planning and Zoning**

Incorporated cities develop their own 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. City Comprehensive Plans are reviewed by the Metropolitan Council and state agencies for adherence to their policies and plans.

Cities across the county are growing at varying rates. Those served by the MUSA are developing at higher residential densities and with greater percentages of commercial and industrial land use. Communities outside the MUSA set growth rates and densities established by regional and local goals, policies, and comprehensive plans developed by local elected officials, but many factors determine the actual rate of growth.

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.

**Local Government Units**

Per Minnesota Statute 103B.235 local governments having land use planning authorities within a watershed shall prepare a local water management plan (LWMP) . If the metropolitan county that the LGU resides in has an approved groundwater plan, the county must be given the opportunity to review and comment on the LWMP. The LWMP provides an effective opportunity for LGUs to incorporate groundwater considerations into their future growth plans.

**Land Use and Source Water Protection**

Source water protection is the process of protecting the source of drinking water from becoming contaminated. For example a stream, river, lake, or an aquifer can be a source of drinking water. The Minnesota Department of Health (MDH) administers the State's Source Water Protection Program. Part of this program is wellhead protection. Wellhead protection is the process of managing land use in critical zones of groundwater recharge to reduce the risk of contaminating water supplies. Public Water Suppliers (PWSs) are required to write and implement Wellhead Protection Plans that provide a scientific analysis to identify key groundwater recharge area and guidelines for land use and zoning that are protective of groundwater. It is imperative to groundwater protection that county and city land use plans and zoning ordinances incorporate wellhead protection. Chapter 8 discusses source water and wellhead protection in further detail.

**Watershed Plans**

Watershed Management Organizations are required to complete a watershed plan. Although the Board of Water and Soil Resources encourages integrated water planning, surface water planning and groundwater planning are essentially dealt with separately in the metropolitan area. The required components for watershed plans are defined by statute and include:

- An inventory of the water resources in the watershed.
- An assessment of issues facing the water resources in the watershed.
- Established goals and policies to protect the water resources in the watershed.
- An implementation program and prioritization of activities.

## 1.2 PLAN IMPLEMENTATION

The county's Department of Public Health and Environment (PHE) will provide the overall coordination for implementing the Plan. It is not expected that all the strategies identified in this Plan will be initiated at once. As a ten year plan, once adopted and each year after, PHE will develop an annual work plan detailing the next year's activities and measuring the effectiveness of the activities completed the current year. The strategies included in the annual work plans will be determined by the priority of the issues at the time and the available resources to accomplish the strategies. For instance, a drought would most likely raise the awareness and magnitude of water conservation. In that situation, there will be a greater public will to implement actions to address water conservation and preserve the water supply.

The users of this Plan will include state agencies, regional organizations, county and city officials, watershed organizations, and active citizens. PHE will provide overall leadership, coordination, and annual review for implementing the Plan but it will take the concerted and coordinated efforts of all stakeholders and residents to effectively carry it out.

**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 with stakeholders, implementing Plan strategies, 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 Master Plan. The purpose of a county solid waste plan is to coordinate the implementation of an integrated waste management system in order to protect public health and the environment. The work from the county's solid waste and groundwater plans complement each other in the protection groundwater.

Additional supportive funding comes from the BWSR Natural Resources Block Grant, the county water testing program, 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. 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 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 Washington Conservation District is also an important partner in providing base technical services.

**Measurement**
The PHE Department is committed to integrating performance management and continuous improvement into its environmental programs and services. 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 between the present condition and the desired future condition. The performance measures presented in the plan were developed through a process that took both population and performance accountability into consideration.

*Population accountability* is about the well-being of whole populations; it refers to the results or quality of life conditions that we want to exist for our whole population: clean and sustainable groundwater for all Washington County residents. ***Appendix A*** provides a definition of the quality of life result that the plan addresses, why it is important, and the causes and forces contributing to the current state of the county's groundwater quality and quantity.

*Performance accountability* refers to the county groundwater program's accountability to partners and stakeholders for the performance of the program. The principle distinction between the two types of accountability is between ends and means. Results addressed in the population accountability component are about the "ends" we want for residents, while performance measures are about the "means" to get there by measuring how well programs are working. The measures represent the activities that need to take place in order to "turn the curve" on our current state- that is, what it would take to do better and each partner's contribution.

The following tool was used to identify and organize measures for each of the issues outlined in the plan*:

| | Quantity | Quality |
|---|---|---|
| Effort | **How much did we do (#)?** *What did we do? How much service did we deliver?* | **How well did we do it (%)?** *How well did we deliver service?* |
| Effect | **Is anyone better off (#/%)?** *How much change for the better did we produce (#)?/ What quality of change for the better did we produce(%)?* | |

| |
|---|
| **Headline Performance Measures** *Those measures you would use to present or explain your program's performance to policy makers or the public.* |
| **Secondary Measures** *All other measures for which you now have data. These measures will be used to help manage the program.* |
| **Data Development Agenda** *Measures you would like to have, listed in priority order.* |

**Measures were not developed at this time for land spreading, mining and landfills but will be developed as strategies are implemented in annual work plans.*

In order to effectively use the performance measures, progress on achieving results will be continuously monitored and evaluated. Overall plan measures will be used to select and prioritize annual work plan activities. Progress on work plan activities will be monitored on a quarterly basis and overall plan measures will be evaluated annually to ensure they are relevant.

The GWAC and the TAC helped create the foundation for the Plan and identified primary issues.

## 1.3 GROUNDWATER ISSUES & PLAN STRUCTURE

To develop the plan the County Commissioners appointed a Groundwater Advisory Committee (GWAC), as required in Minnesota Statute 103B.255. The GWAC members represent the perspectives of citizens, rural and urban LGUs, WMOs, construction, well drilling, agriculture, and hydrology professionals. A Technical Advisory Committee (TAC) made up of professional and agency stakeholders, staff from other county departments, LGUs, WMOs, regional, and state agencies was also formed. The GWAC and the TAC helped create the foundation for the Plan and identified the primary issues that need to be addressed to ensure enough clean groundwater is available into the future. These issues are shown on the next page. To further organize these issues they were divided into groups of either groundwater quantity or groundwater quality.

Work groups were convened to discuss and develop the plan strategies. The work group members included GWAC and TAC members but also identified experts working in or affected by each particular issue. These work groups were imperative to developing thoughtful and action oriented strategies.

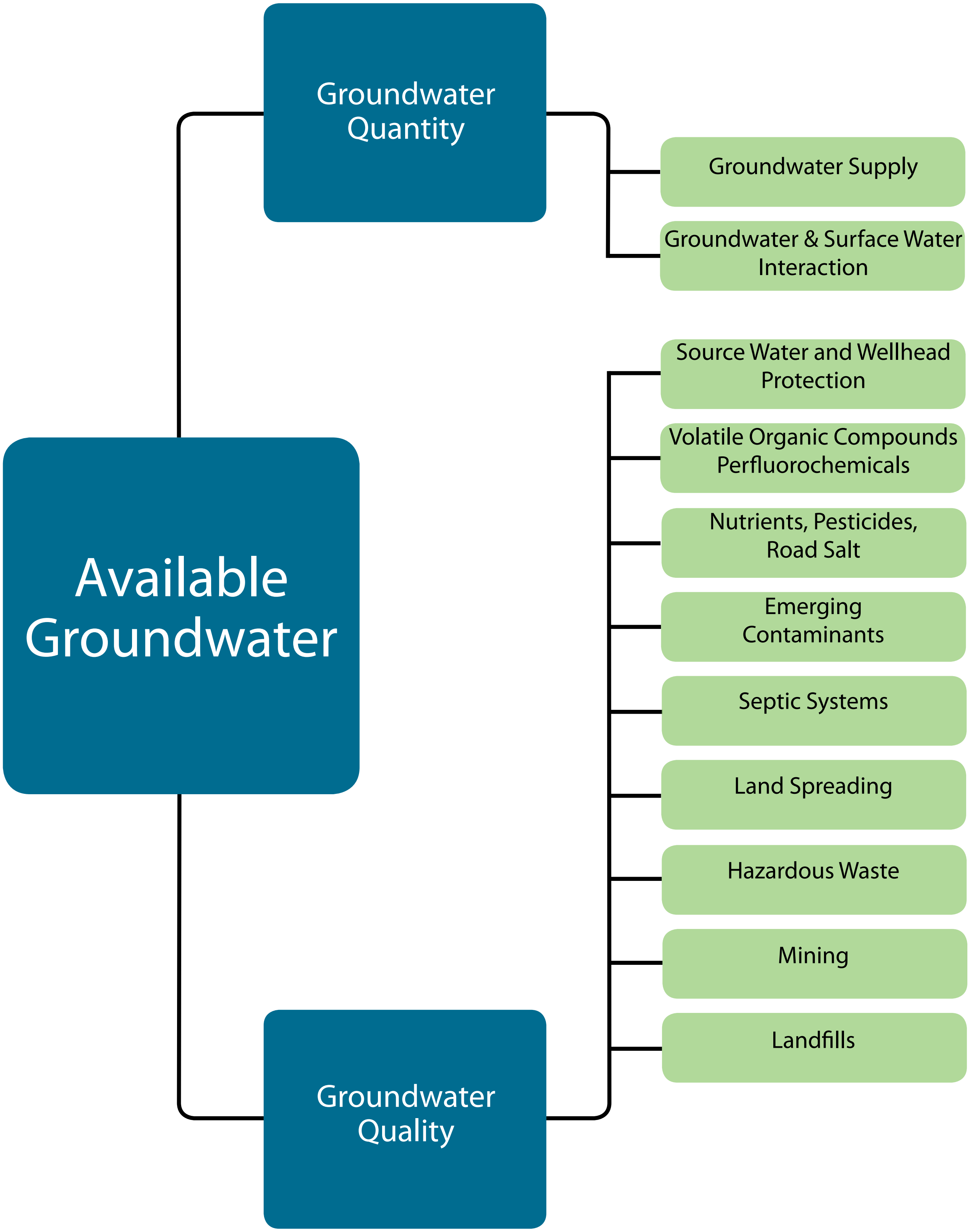
Chapter 2 provides an overview of the groundwater resources, including geology, hydrology, groundwater recharge, and groundwater dependent resources.

Chapters 3 through 8 focus on main issues identified by the GWAC, and are organized as follows:

- An overview of the issue, including any pertinent research and background information.
- A "policy" outlining the specific concerns, needs, and rationale for protecting and conserving groundwater resources and;
- Strategies providing direction to protect and conserve groundwater resources.

Changing climate and unpredictable precipitation were identified as primary issues during the early stages of plan development. The climate change work group discussed where climate change issues should be addressed in the plan. It was decided that climate change should not be its own chapter, but needs to be addressed through numerous portions of the document and more specifically in the strategies for groundwater and surface water interaction and supply.

# The Groundwater Plan Structure



Humans affect the land surface where groundwater recharge occurs.

**1.3.1 Groundwater Quantity**
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 quantity available for use by humans and natural ecosystems.

The county's population is projected to increase by 52 percent to a total of 363,190 residents from 2010 to the year 2030. The growth in population will create an increase in groundwater pumping to serve household, irrigation, commercial, and industrial needs. Historically, the region's aquifers have served populations with abundant water; however, there are limits to the amount of water available for pumping (withdrawals) before aquifers are depleted, lake levels are lowered and stream flows are diminished. Managing the groundwater bank account will take a concerted effort to balance recharge (deposits) with discharge (withdrawals). Multiple communities share the region's aquifers and it will take a collaborative, coordinated approach to develop a sustainable groundwater management system.

For the purpose of this Plan the groundwater quantity issues are groundwater supply and groundwater and surface water interaction.

**1.3.2 Groundwater Quality**
Maintaining clean, safe, drinkable groundwater is critical to human and environmental health and to the 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. 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.

The source of groundwater contamination from Volatile Organic Compounds (VOCs) in the county has been from disposal of cleaning agents at industrial facilities and landfills, spills, leaks, and disposal of chlorinated solvents and petroleum products at several industrial sites. Perfluorochemical (PFC) contamination of groundwater is a result of industrial disposal of these chemicals at various landfills or dump sites throughout the county. The existing groundwater contamination by VOCs and PFCs is discussed in Chapter 6. Additionally the county has areas of high nitrate concentrations in groundwater. The sources of nitrates are primarily from the use of fertilizer for agriculture and turf management. Nitrates will be discussed in Chapter 7.

There are other counties with similar land use and industrial practices that don't have the extent of groundwater contamination that Washington County does. The reason is throughout most of the county, groundwater resources are moderately to highly susceptible to pollution introduced from the surface environment. ***Figure 3*** and ***Figure 4*** illustrate the "Sensitivity of Groundwater Systems to Pollution." These figures show the increased ability for surface contaminants to get into groundwater because of the natural geology of the county. There are areas with little depth to bedrock and that decreases the time and ability for soil to filter out contaminants before they flow into the aquifers. Factors that determine a groundwater systems sensitivity include surface geology, bedrock geology and land use. These factors are discussed in Chapter 2.

Contaminated groundwater affects the health of ecosystems as well. As will be discussed in Chapters 2 and 4, surface water bodies are connected to or interact with groundwater. The connection between the groundwater and surface water body will determine how the surface water is affected by the quality of the groundwater. The federal clean water act requires water bodies be assessed based on water quality standards to ensure the water fulfills its designated use, such as fishable, swimmable, or drinkable. A water body that doesn't meet the clean water standard for its designated use is listed as "impaired" by the MPCA. Various pollutants that are monitored include phosphorus, bacteria, sediment, lack of oxygen, and others. If a water body is listed as impaired the MPCA and responsible LGUs must then complete a Total Maximum Daily Load (TMDL) study, which sets pollutant reduction goals needed to restore the waters. In Washington County, several water bodies have been listed as impaired (Figure 5). Many of the strategies put forth in this Plan will not only address groundwater contamination, but may also work towards addressing surface water quality.

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.

The groundwater quality issues that are addressed in this Plan include Source Water and Wellhead Protection, Volatile Organic Compounds and Perfluorochemicals, Nutrients, Pesticides, and Road Salt, Emerging Contaminants, Septic Systems, Land Spreading, Hazardous Waste, Mining, and Landfills.

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# 2. GROUNDWATER RESOURCE OVERVIEW

Groundwater resources are a major component of the regions 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, groundwater sensitivity to pollution, climate, surface water interaction, and groundwater related natural resources.

## 2.1 GEOLOGY AND LANDSCAPE

Groundwater moves through several geologic formations within the county.

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.

### 2.1.1 Bedrock Formations

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 6*** illustrates the bedrock geology of the county showing the differing rock types and groupings. Table 1, on the following page, provides a description of the bedrock geologic formations or groups sorted by hydrologic significance.

### 2.1.2 Bedrock Structure

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 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 step-wise 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.

**Table 1: Washington County Bedrock Geology**

| Age | Bedrock Formation or Groups | Description | Thickness (Feet) |
|---|---|---|---|
| Middle Ordovician | Decorah Shale<br>Platteville Limestone Group<br>Glenwood Shale | These three formations make up the youngest or uppermost bedrock found in Washington County. They are found only in south central portions of the County. | 0-35 |
| | 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. | 0-66 |
| 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 eastern 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. | 134-203 |
| Upper Cambrian | Jordan Sandstone | The Jordan Sandstone consists of poorly layered, poorly cemented, medium to coarse sand. 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. | 66-96 |
| | 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. | 30-58 |
| | Tunnel City Group | The Tunnel City Group (formerly the Franconia Formation) consists mostly of fine-grained sand 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 154 to 165 feet. These units underlie the entire County except a minor area in the St. Croix Valley. | 154-165 |
| | Wonewoc Sandstone | The Wonewoc Sandstone (formerly the Ironton-Galesville Sandstone) is composed of fine to coarse-grained sand. This unit is found underlying all of Washington County except in one deeply incised portion of the St. Croix Valley in Lakeland. | 45- 66 |
| | Eau Claire Formation | This formation consists of shale, siltstone and very fine-grained sandstone. This unit underlies all of Washington County. | 63-114 |
| | Mt. Simon Formation | 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 sandstone. The Mt. Simon underlies all of Washington County. | 160-255 |
| Pre-Cambrian | Undivided | These consist of layers of shale and sandstone overlying volcanic rocks. | ? |

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 subsidence of underlying bedrock.

The bedrock formations in the county were eroded first by water and then by glacial ice over a several hundred million year period. Figure 7 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 of the current low areas are situated over bedrock valleys. Lakes and wetlands are concentrated in these low areas. The dissected bedrock surface has an important effect on groundwater resources as is described later in this chapter.

### 2.1.3 Surface Geology

Understanding the physical characteristics, extent, and relationship of the 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, further eroding the bedrock and depositing sediment. The last two glacial advances significantly influenced the present surface geology and landscape.

These glaciers were massive - 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.

Sediment deposited directly by glacier ice is called glacial till. As the glaciers receded, they generated a substantial volume of melt water. Melting glaciers deposited great quantities of coarse sand and gravel beneath and close to the glacier margins. These are called ice-contact deposits. Further away from the glacier, braided melt water streams left broad deposits called glacial outwash. In some locations, melt-water formed lakes within depressions in the wasting ice mass and also in front of the glacier. Sand and silt deposits formed in the bottom of the lakes are termed ice walled lake deposits or glacial lake deposits.

The southeast corner of the county was not covered by either of the last two glaciers 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 8*** illustrates the Surface Geology in the county providing the distribution of four glacial deposit types as grouped by the Minnesota Geological Survey (MGS). These deposit types - sand and gravel, fine sand, sandy silt, and glacial till – are described in Table 2.

**Table 2: Surface Geology Washington County, MN**

| 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. These are termed ice contact deposits; b) by glacial melt waters away from but still proximal to the ice margin. These are termed outwash deposits; 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 | 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 characteristically 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 (MGS 1998). 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. |

### 2.1.4 Geomorphology

The shape of the land, or geomorphology, is the product of 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. Further from the glacier margin, broad, gently rolling plains of sand outwash 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.

The county can be divided into five distinct areas, or geomorphic regions, based on common geologic and topographic features. ***Figure 9*** illustrates the locations of these regions. These regions share a commonality of factors that influence groundwater and the issues that may affect groundwater resources. 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 on 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.

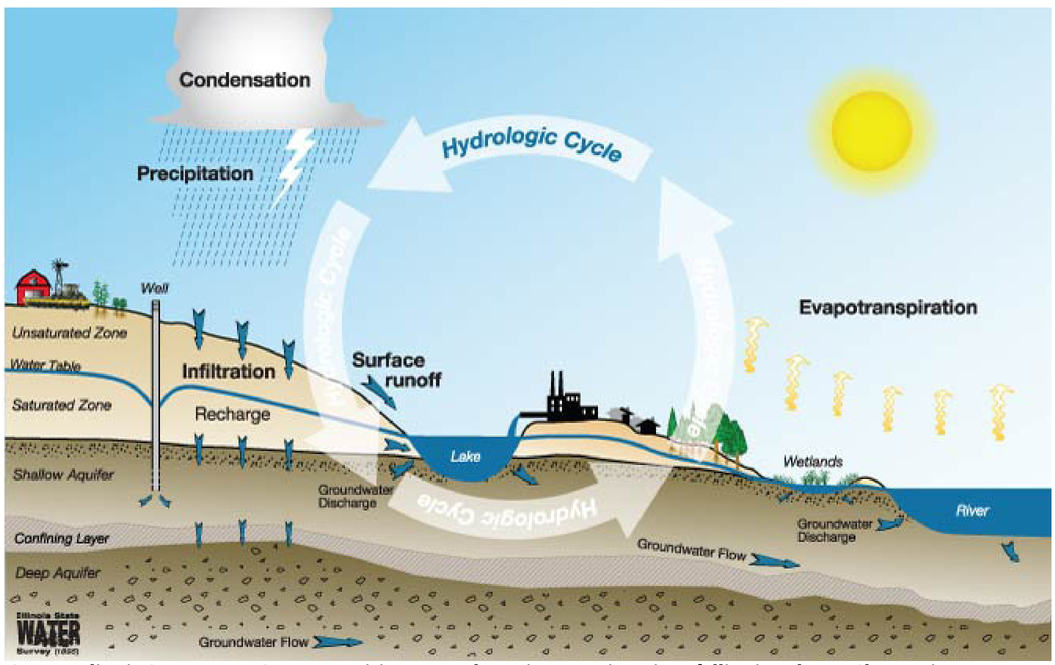
**St. Croix and Mississippi River Terraces:** Broad flat to gently rolling areas covered by sand and gravel are found along the eastern and southern edges of the county. These are called terrace features which were formed from the deposition of sediment in vastly larger glacial melt-water river valleys.

## 2.2 GROUNDWATER HYDROLOGY

Groundwater hydrology or hydrogeology is the study of the interaction between earth materials and water. The occurrence of water in the earth (groundwater) and its movement is the primary focus of the field of hydrogeology. To address groundwater, it is important to step back and first look at the larger "hydrology" picture. The hydrologic cycle is depicted below, in Illustration 1. The hydrologic cycle explains the three paths precipitation takes after falling onto the land surface.

1. Precipitation evaporates into the atmosphere directly or through plants.
2. Precipitation runs off directly to surface water bodies (lakes, streams, wetlands).
3. Precipitation infiltrates downward into geologic formations. Water that infiltrates into the ground moves through an unsaturated zone to the water table. At this point it becomes groundwater.

**Illustration 1**




**Source: Ilinois State Water Survey, Prairie Research Institute. University of Illinois Urbana-Champaign**

The infiltration of precipitation into groundwater is referred to as groundwater recharge.

Groundwater flows through porous geologic materials. The less porous the geologic material, the greater the difficulty for groundwater to flow through it. Aquifers are geologic formations that transmit groundwater in sufficient quantities to a well for human consumption. Permeable sand and gravel create what is called primary porosity. Highly fractured and broken materials like limestone create secondary porosity. Aquifers can exhibit primary porosity, secondary porosity, or a combination of the two. In the county, both porous sand and gravel glacial or surface deposit, 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. 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.

Aquifers can be 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.

Infiltration of surface water into groundwater, or recharge, occurs in recharge areas. The infiltration potential in the county, based on soil types, is depicted in ***Figure 10***. Recharge capability is controlled by the amount and timing of precipitation, the surface geology and geomorphology, bedrock geology, and bedrock topography. Groundwater recharges water table aquifers in widespread areas of the county where surface sediment is highly to moderately permeable. Recharge is especially focused on flat areas and 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. Recharge and discharge areas are shown in ***Figure 11***.

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.

Water bodies that don't 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.

### 2.2.1 County Aquifers and Aquitards (Hydrostratigraphy)

The geologic units described on Tables 1and 2 can be grouped and divided into either aquifers or aquitards. Hydrostratigraphy is the grouping of geologic units by the properties of groundwater flow.

### 2.2.2 Quaternary Hydrostratigraphy

The Quaternary geologic formations are varied and complex in the county and so is groundwater flow through them. In some cases, such as with broad outwash plains, the geology and groundwater hydrology is 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 3 provides a description of the Quaternary aquifers and aquitards or hydrostratigraphy.

**Table 3: Hydrostratigraphy Glacial Sediment Units Washington County**

| Hydro-stratigraphic Unit | Hydrologic Function | Hydrostratigraphic Unit Description/Importance |
|---|---|---|
| Sand and Gravel | Major Aquifer to Minor Aquifer | 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 groundwater 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. |

### 2.2.3 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 Hinckley Sandstone formations. Three bedrock hydrostratigraphic units function as major aquitards. Table 4 provides a description of the bedrock hydrostratigraphy of the county.

## Table 4: Hydrostratigraphy

| Hydro-stratigraphic Unit | Hydro-logic Function | Hydrostratigraphic Unit Description/Importance | Thickness |
|---|---|---|---|
| Decorah Patteville Glenwood | Aquitard | These units are discontinuous and where they occur in Washington County, function as a groundwater confining unit. The shales are least permeable. Parts of the Platteville limestone are permeable and may yield minor amounts of water, but it is not considered an important groundwater source in the County. | 0-35 |
| 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 contains siltstone and shale and may act as a confining layer. | 0-66 |
| Prairie Du Chien | Aquifer Major | 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. | 134-203 |
| Jordan Sandstone | | 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. | 66-96 |
| 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. | 30- 58 |
| 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 one third is an aquitard. | 154-165 |
| 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. | 45-66 |
| 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. | 63-114 |
| Mt. Simon Hinckley Formation | Aquifer Major | This is a productive aquifer located beneath the entire County. It is used only in areas located adjacent to the St. Croix River and, in one case, in Forest Lake. At present, there is a State ordinance prohibiting use of this aquifer except for municipal water supplies. | 160-255 |

## 2.3 GROUNDWATER RECHARGE

Groundwater recharge has a direct bearing on the future of county groundwater quantity and quality. The factors that influence groundwater recharge include geology, geomorphology, climate, and land use.

**2.3.1 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 (***Figure 9***). The recharge characteristics of the five regions are described in Table 5.

**2.3.2 Groundwater Recharge to Bedrock Aquifers**

As discussed previously, and as presented on Table 4, 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. Groundwater recharge to bedrock aquifers occurs 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 7*** shows the locations of bedrock valleys and ***Figure 6*** 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.

Table 6 describes the hydrogeologic factors affecting recharge of bedrock aquifers.

**2.3.3 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. Points of equal elevation are connected by lines to draw a contour map of the groundwater level surface. Flow direction can be determined by drawing lines perpendicular to the groundwater contours. The flow direction is towards the contour of lowest elevation.

## Table 5: Recharge Functions of Geomorphic Regions Washington County

| 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 Plain | Relatively low-lying and gently rolling to flat. 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. |
| 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. |

## Table 6: Recharge Factors Bedrock Hydrostratigraphy Washington County

| Hydro-stratigraphic Unit | Hydrologic Function | Description of Groundwater Recharge Factors |
|---|---|---|
| Decorah Platteville Glenwood | 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. 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 | 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. Some recharge probably occurs from the St. Peter Sandstone. Glacial till units may function as local aquitards. 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. |
| Jordan Sandstone | | |
| 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 one third 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 Aquitard | A major region-wide aquitard preventing downward migration of groundwater to the Mount Simon Aquifer. |
| Mt. Simon Sandstone | Major Aquitard | 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. |

### 2.3.4 Groundwater Flow and Discharge: Water Table Aquifer

Groundwater flow through the water table aquifer is illustrated on ***Figure 12***. 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.

### 2.3.5 Groundwater Flow and Discharge: Bedrock Aquifers

***Figures 13-17*** illustrate groundwater flow patterns in the bedrock aquifers. As is depicted on the figures, groundwater moves from the central upland regions of the county 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.

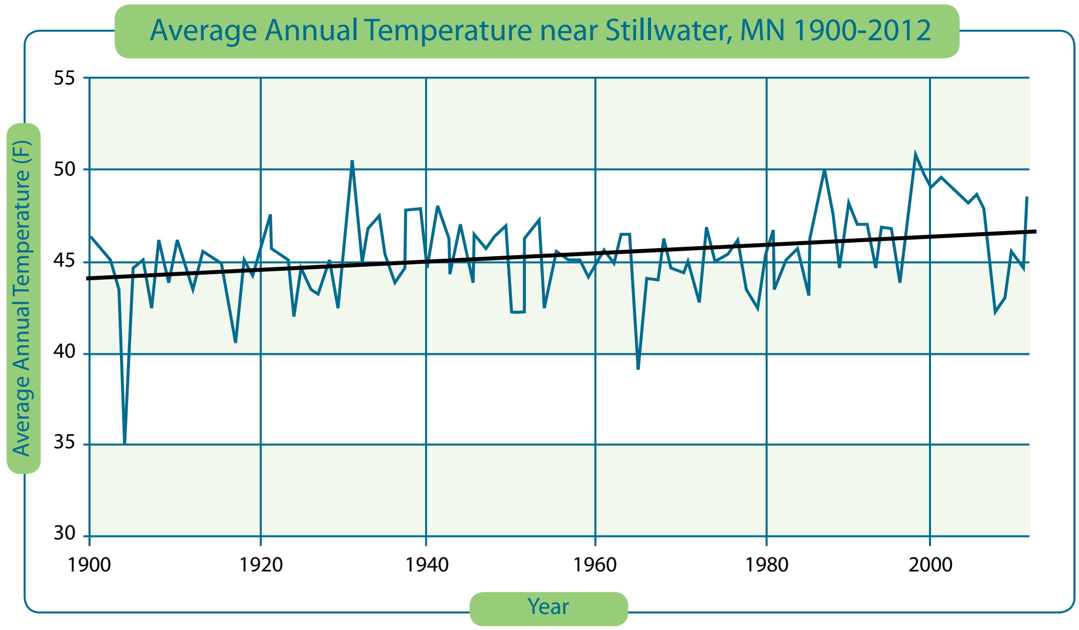
Groundwater also discharges to domestic, municipal, and industrial wells. High capacity wells can have a significant impact on groundwater flow, creating zones of influence miles in diameter. When a well is pumped, it creates a drawdown in the aquifer water level. This drawdown, referred to as the cone of depression, can extend for great distances depending on the rate of pumping, capacity of the aquifer, and influence of other wells.

### 2.3.6 Groundwater Recharge Climate-Precipitation

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.

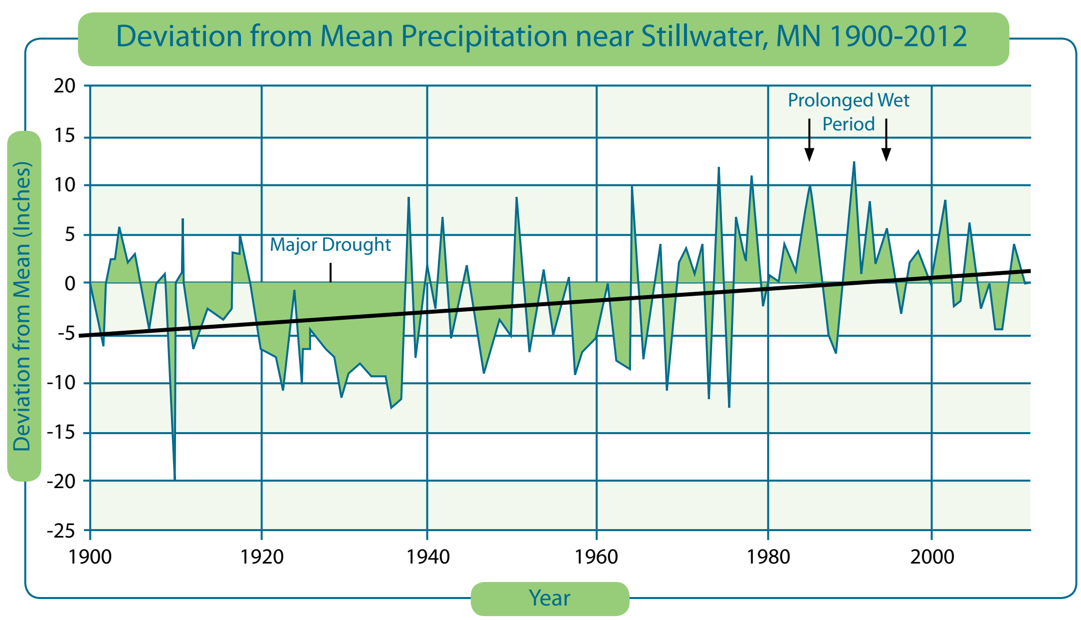
The county lies in the northern mid-continental region of North America exhibiting a climate of warm humid summers and cold dry winters. The climate is influenced by three major elements: polar air masses originating in Canada, subtropical air masses originating in the Gulf of Mexico, and variable air masses from the Pacific regions. The region experiences marked 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 data from 1900-2012, the average annual temperature in Washington County (near Stillwater) is 45.7°F. Temperatures average 13.6°F in January (the coldest month) and 73.4°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. The graph below shows




the average annual temperature over time, from 1900-2012. Since 1900, the overall temperature trend is increasing, with 8 of the hottest years on record occurring in the last 15 years.

Precipitation statistics since 1900 indicate an average annual precipitation of 29.9 inches. The following graph illustrates precipitation data from 1900 to 2012. The graph shows the difference either greater than or less than the average annual precipitation. This is referred to as the deviation from the mean annual precipitation. The graph helps to illustrate the degree of precipitation fluctuations above and below normal from year-to-year and from decade-to-decade. As an overall trend, we are seeing a slight increase in precipitation. However, there have been several periods of low precipitation in recent years, most notably in the late 1980s, and again from 2007-2011.



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 effected 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.

It will be equally important to understand the affects drought conditions could have on groundwater systems. Even droughts of less magnitude, such as occurred in the late 1980s, triggered concerns about diminishing water supplies and lowered lake levels. A drought of the magnitude seen during the 1920s and 1930s could create a serious shortage of groundwater for pumping and may set up potential conflicts between the needs of different communities and the protection of natural resources.

**2.3.7 Groundwater Recharge – Land Use**
Land cover and land use changes are incremental. The proliferation of impervious surfaces on the landscape will, over time, slowly reduce groundwater recharge. It would take decades of monitoring to actually measure the effects. The infiltration potential in the county, based on soil types, is displayed in ***Figure 10***. To accommodate an expected population growth to 363,190 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. Chapter 3 discusses specific strategies 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.

## 2.4 GROUNDWATER DEPENDENT RESOURCES

As discussed previously and depicted on Page 20, the hydrologic cycle refers to the interaction between water in the atmosphere, surface water, and groundwater. Each element of the hydrologic cycle performs vital functions. The atmospheric contribution, in the form of precipitation, provides the main source of groundwater recharge, and was discussed in the previous section. Surface water resources, and their interaction with groundwater, are also very important for understanding the complete picture of groundwater resources in the county.

**2.4.1 Lake Resources and Groundwater**
Lakes provide important public recreation for swimming, boating, and fishing as well as important ecologic and hydrologic functions. Lakes are also desirable aesthetic features to residents and visitors. Lakes function both as groundwater recharge areas and groundwater discharge areas. The role of groundwater in the overall ecologic health of lakes and aquifers is important, but often not well understood. Two extensive studies completed since the current Plan was adopted in 2003 for the Northern and Southern halves of the county, provide a good overview of groundwater and surface water interaction. The studies categorize lakes and water bodies in terms of recharge, discharge, or flow-through potential, depicted in ***Figures 18-19***.

*Groundwater Recharge Lakes*
Groundwater recharge lakes collect and store water which, in turn, 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 in 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 groundwater recharge 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 ultimately protect groundwater quality. Examples of recharge lakes include Oneka, Goose, 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. Northern Washington County's Square Lake receives over 70 percent of its volume from springs and is regionally renowned for its clear waters, attracting thousands of scuba divers annually. Other discharge lakes include Lake Elmo and Lake Edith.

*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 Elmo, and White Bear Lake. Using White Bear Lake as an example there are areas of groundwater inflow to the lake and areas where lake water discharges to the water table aquifer. The USGS 2013 study's preliminary findings indicate that lower lake levels may be partially explained by increased use of groundwater in the area. However, there are potetially other factors and the USGS is undertaking additional studies to better understand the specific relationship between pumping from deep bedrock aquifers and surface water features in Washington County. White Bear Lake is discussed further in Chapter 4.

**2.4.2 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 20***). Numerous other small streams with naturally reproducing brook trout populations also exist in Washington County. These streams are not DNR "designated trout" waters.

Groundwater systems are the principle source of water for streams in Washington County. A 1999 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. Since that time, Brown's Creek Watershed District has completed a total maximum daily load (TMDL) study for Brown's Creek, which is impaired for aquatic life due to a lack of cold water fish assemblage and due to high turbidity. They are also monitoring groundwater levels to determine if lowering aquifers are a cause of the temperature increases in the creek.

### 2.4.3 Groundwater Fed Wetlands

The National Wetlands Inventory Map (***Figure 21***) illustrates the location of wetlands in the county. A 1984 study (University of Minnesota) calculated that only 42.9 percent of original wetland acreage in the county remained. Each remaining wetland performs one or more of the following vital hydrologic functions:

- water storage and flood control;
- water treatment;
- groundwater recharge;
- groundwater discharge; and
- critical habitat.

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 local government units and the Washington Conservation District. Some communities within the county have additional rules in place that are meant to protect and preserve wetlands. Several water management organizations also have rules in place to protect wetlands. The BWSR oversees WCA programs.

### 2.4.4 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" (University of Minnesota Press 1996), there are several unique and rare natural community types in Washington 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. In 2010 the Brown's Creek Watershed District developed a Groundwater Dependent Natural Resource Comprehensive Management Plan to protect a fen in the City of Grant.

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: 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.

# 3. GROUNDWATER SUPPLY

Groundwater is a vital resource in Washington County.

Groundwater is a vital resource in Washington County, providing 100 percent of the water used for drinking, commercial, industrial, and irrigation needs. Competing with consumptive groundwater 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 puts an increasing demand on water supplies. Overuse of groundwater decreases the amount available for public and private water supplies, and reduces levels in lakes, wetlands, and streams. Evidence of the overuse of groundwater has become more apparent in recent years with the increase in residents wells pumping short and the decreasing levels of county lakes, including White Bear Lake. This will be discussed further in Chapter 4.

Another factor that affects groundwater supply is the weather. The highest demand on aquifers often comes during drought conditions. Droughts pose a serious threat to groundwater supplies due to the compounded effects of increased water use for lawn sprinkling and crop irrigation, and decrease in replenishment or recharge of aquifers. In the Twin Cities Metropolitan Area, summer water usage is 2.6 times the water usage in the winter (per DNR 2007 cited from Water Sustainability Framework, Domestic Use Technical Work Team Report). To develop long- term stability of aquifer levels, water use habits must change, as must the misconception that groundwater reserves are infinite.

Groundwater supply is also impacted by contamination. The county has known groundwater contamination from perfluorochemicals, volatile organic compounds, and nitrates. These threaten the available clean water needed for drinking. Additionally there are emerging contaminants that are currently being identified and analyzed by MDH. These contaminants will be discussed further in Chapters 5 through 7.

**Groundwater Appropriation**

To a great extent groundwater supply can be managed through appropriation permits. The DNR is the only state agency that permits appropriations of groundwater but watershed districts also have the authority to appropriate groundwater.

*Department of Natural Resources*

The Department of Natural Resources regulates the appropriation of groundwater under Minnesota Rules Chapter 6115 and Minnesota Statute 103G. The DNR also monitors groundwater levels and has an extensive observation well network in the county, see ***Figure 22***. A DNR permit is needed to appropriate groundwater for any domestic use serving 25 or more persons or for any use exceeding 10,000 gallons per day or 1,000,000 gallons in a year.

Minnesota law sets general priorities for water appropriations in the State as outlined from highest to lowest:

- first priority, domestic water supply, excluding industrial and commercial uses of municipal water supply, and use for power production that meets the contingency planning provisions;
- second priority, a use of water that involves consumption of less than 10,000 gallons of water per day;

- third priority, agricultural irrigation, and processing of agricultural products involving consumption in excess of 10,000 gallons per day;
- fourth priority, power production in excess of the use provided for in the contingency plan;
- fifth priority, uses, other than agricultural irrigation, processing of agricultural products, and power production, involving consumption in excess of 10,000 gallons per day; and
- sixth priority, nonessential uses.

Additionally, Minnesota Statute 103G.271 restricts the use of the Mt. Simon-Hinckley aquifer in a metropolitan county. Use of the Mt. Simon will only be permitted if the appropriation is for drinking water, there are no feasible alternatives, and a conservation plan is developed. The intent is to protect this resource for high priority water use.

This statute also prohibits the DNR from issuing a water use permit to increase the volume of appropriations from any groundwater source for a once-through heating/cooling system using in excess of 5,000,000 gallons annually. Existing systems must be terminated by the end of their design-life or no later than December 31, 2010.

The commissioner of the DNR also has statutory authority (Minnesota Statute 103G.287, subd. 4) to designate groundwater management areas (GWMA). These areas are designated to limit total annual water appropriations and uses to ensure sustainable use of groundwater that protects ecosystems, water quality, and the ability of future generations to meet their own needs. A GWMA is being developed for the north and east Twin Cities metropolitan area and is discussed further in Chapter 4.

*Watershed Districts*

Watershed Districts are also charged with providing for the protection of groundwater and regulating its use to preserve it for beneficial purposes, as defined in Minnesota Statute 103D.201 Subd.2 (14). Watershed Districts have the authority to regulate groundwater use and appropriations under Minnesota Statute 103D.335 Subd. 10 if the powers are incorporated into the Watershed District's plan, as defined in Minnesota Statute 103D.341 Subd. 1. In December 2004 the Washington County Water Consortium developed a report titled, "Incorporating Groundwater Protection into Watershed District Rules." This report recommended that watershed districts use their authority to regulate groundwater use for wells that pump between 1,000 to 10,000 gallons per day or between 100,000 to 1,000,000 gallons per year (wells not regulated by the DNR). Currently none of the watershed districts in the county use the authority to regulate groundwater that is granted to them under state statute.

**Water Supply Planning and Conservation Efforts**

Water supply planning and conservation are other methods to control water supply. There are many agencies currently working on water supply planning and many water conservation initiatives are currently in progress.

*University of Minnesota*

The 2009 Minnesota Legislature commissioned the University of Minnesota to develop the Minnesota Water Sustainability Framework. The framework is a comprehensive report designed to protect and preserve Minnesota's lakes, rivers, and groundwater into the future. It makes recommendations to the State of Minnesota on actions to fund to work toward this goal. To read click on Minnesota Water Sustainability Framework.

*Metropolitan Council*

The Metropolitan Council engages in water planning for the metropolitan area. In March 2010 they published the Metropolitan Area Master Water Supply Plan. The plan lays out an adaptive approach to water supply management and is an important tool for guiding long-term water supply planning at the local and regional level. The plan includes information to help LGUs plan for future development based on water needs, including the water availability analysis, the water conservation toolbox, and the Twin Cities Metropolitan Groundwater Flow Model. To read the plan, use the water conservation toolbox or the model go to Metropolitan Council Water Supply Planning.

*Public Water Suppliers*

Public water suppliers (PWSs) serving more than 1,000 people must develop a water supply plan and submit it to the DNR for approval per MN Statute 103G.291. The plan must address projected demands, adequacy of the water supply system, existing and future water sources, natural resource impacts, emergency preparedness, water conservation, supply and demand reduction measures, and allocation priorities. Additionally, PWSs serving more than 1,000 people must encourage water conservation by employing water use demand reduction measures that reduce water use, water losses, peak water demands, and nonessential water uses before requesting an increase in the authorized volume of appropriation.

*Local Government Units*

Water use in growing communities often escalates as homeowners and businesses establish new landscaping. To address these issues, communities throughout the county have identified a number of tools for conserving water. These include sprinkling ordinances, summer surcharges, showerhead and toilet replacement programs, joint energy/water audits, aggressive leak detection programs, and water meter upgrades.

Communities and businesses in the county are working to create opportunities for water reuse, such as collecting rain water runoff from the roof of a building and using it for lawn irrigation. There is currently a conflict in the plumbing code that makes it difficult to store rain water 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 stakeholders 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. The strategies in this chapter work toward this goal.

## 3.1 POLICY

The county will partner in a coordinated effort to develop sustainable groundwater management that balances the discharge from the water supply with sufficient amounts of quality recharge, ensuring sufficient supplies of county groundwater are available.

## 3.2 STRATEGIES

1. Develop a county wide groundwater information database, informed by the work of the DNR and the Metropolitan Council, which the county and LGUs can use to determine:

   a. A water budget that includes surface water and groundwater interaction, an assessment of the geologic conditions, land use, and groundwater contamination and climate change trends and impacts.
   b. How groundwater in the county interacts regionally.
   c. Alternative drinking supplies such as deeper wells, surface water supply, or interconnections. This work will build off of Public Water Supply plans required by MN Statute 103G.291.
   d. The impact of high capacity wells and make recommendations on how to alleviate that impact.

2. Using the information from the groundwater information database, develop a tiered approach alert system for aquifer levels.

3. Analyze the DNR observation well data to determine which wells closely follow patterns of precipitation, high capacity pumping, or a combination of both.

4. Develop an annual forum for the DNR and the Metropolitan Council to share and update the Washington County Water Consortium with groundwater supply information. This information will be used to develop implementation actions for the Groundwater Plan Work Plans.

5. Develop a county wide water conservation plan in partnership with LGUs and state agencies, informed by Strategy 1 above, that:

   a. Researches and makes recommendations on best practices regarding conservation methods such as tiered water rate structures, two meter systems with one meter tracking irrigation use only, the effectiveness and distribution of rain sensors, conducting joint energy/water audits, showerhead and toilet replacement programs, and water leak detection projects.
   b. Evaluates the conflict between the building code and the efforts to reuse non-potable water. Including implementation items to educate and collaborate with building officials on the best methods to resolve these conflicts.
   c. Collaborate with state permitting agencies to require beneficial use of

remediated groundwater and not allow direct discharge of treated groundwater to a surface water.

d. Develops pilot projects for research and education on how water reuse can be accomplished safely and affordably.

e. Evaluates existing educational efforts and makes recommendations on what is most effective for citizens, land owners, public officials, LGUs, and building officials, focused on water conservation.

f. Develops a reuse incentive program.

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# 4. GROUNDWATER AND SURFACE WATER INTERACTION

Lakes, wetlands, and streams are frequently surface exposures of the water table intersecting the land surface. Both groundwater quantity and quality have an impact on surface water quantity and quality. The reverse is also true in that surface water quantity and quality can impact groundwater. Understanding the degree to which surface water level fluctuations affect groundwater level fluctuations and vice versa is extremely important in understanding the water balance. In Washington County, lakes and wetlands can function both as groundwater recharge or groundwater discharge zones and in most cases, streams and rivers function as groundwater discharge zones. Chapter 2 provides detailed descriptions of groundwater and surface water features in the county. Since adoption of the last Plan, two studies have been completed on groundwater and surface water management for the Northern and Southern halves of the county. Information from these studies is referenced in the groundwater resource overview, as well as in this section.

Both groundwater quantity and quality have an impact on surface water quantity and quality.

Surface water is managed and regulated by State agencies, watershed organizations, and local governments. When the 2003 county groundwater plan was written water management organizations and local governments didn't usually factor groundwater provisions into their plans, policies, and rules. This is no longer the case. Currently all of the WMOs in the county discuss groundwater in their plans by referencing the county groundwater plan and most discuss groundwater and surface water interaction. Additionally most of the local governments have also included information on groundwater in their local water management plans. Awareness on the importance of including groundwater as part of managing surface water came about mostly due to the Northern and Southern Washington County groundwater and surface water interaction studies that were supported by the county and watersheds. These studies provided valuable information on county water resources. Future efforts should build off of these studies and focus on further researching the level of connection between surface water and groundwater, identifying groundwater recharge and discharge zones, and developing policies and rules to protect and holistically manage water resources.

There are many factors that affect the balance of groundwater and surface water interaction. In Chapter 3 population growth was discussed as a factor for groundwater supply. Population growth also affects groundwater and surface water interaction because the increased impervious surface from the associated development reduces the surface area for aquifer recharge. Infiltration of rain water is the main method to recharge or increase the amount of groundwater in aquifers. Development not only decreases the amount of area available for recharge it also compacts pervious surfaces that are left and that decreases the volume of rain that can infiltrate to the aquifers.

Additionally, there is growing concern that the rapid increase in pumping from aquifers in the county over the past several decades is having an impact on surface water features and presents a challenge to long-term water supply stability. A 2013 study by the 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. A follow up study by the USGS was started in July 2013 to answer with more specificity the connection between groundwater use and lake levels throughout the north and east metro. The USGS study is expected to be complete by 2015.

Several efforts are underway to address long-term issues related to current reliance on groundwater and the current expectations that all future water needs in the county will be met with groundwater. In the fall of 2013 the Metropolitan Council began a series of studies and evaluations looking at options to support higher water levels in White Bear and other lakes. The study will look at the feasibility of using treated wastewater (from groundwater) to recharge aquifers in the north metro, rather than discharging treated water to the Mississippi. The Metropolitan Council will be completing work on advancing conservation efforts and conducting pilot studies to evaluate the impact conservation practices can have on water use.

In the north and east metro DNR has years of monitoring data, and as noted a growing concern over longterm growth of groundwater use, and the implications for water supply and impacts to surface water features. In response to the DNR studies, work by the USGS and others, and a specific request from the White Bear Lake Conservation District in April 2013, the DNR determined to move forward with the state's first Groundwater Management Area (GWMA) in the north and east metro. The GWMA tool is meant to support the DNRs responsibility to manage Minnesota's water resources now and for future generations. The new aspect of this tool is that it allows DNR to take into unt cumulative impacts from multiple appropriations (many wells taking groundwater from the same aquifers) and may include establishing limits to total annual appropriations within a management area. This is the first time DNR will use a designated Groundwater Management Area to address cumulative impacts of water use to help manage water resources over the long-term. DNR intends to include a sufficient area of hydrogeologically related water users to ensure a comprehensive analysis of pumping related issues and the GWMA may include a large percentage, possibly all, of Washington County. The designated area and plan will be developed with input from the county, local governments, the Metropolitan Council, state and federal agencies and local residents.

Another effort to minimize the impact of development on infiltration was put forth in Minnesota Statutes 2009, section 115.03, subdivision 5c to "develop performance standards, design standards or other tools to enable and promote the implementation of low impact development and other stormwater management techniques." This effort is called Minimum Impact Design Standards (MIDS) and focuses on mimicking natural hydrology in development to reduce surface water pollution and recharge aquifers.

Having reliable mapping data about geology and groundwater resources in the county is essential to understanding the groundwater and surface water interaction and for making planning and land management decisions. The county geologic atlas serves this purpose and will be updated over the course of this plan. The Minnesota Geologic Survey updates Part A of the atlas, which is the geology information. The update will be available in 2015. The DNR updates Part B of the atlas, which is the groundwater pollution and sensitivity. The Part B update should be available by 2017.

It is also important to have data on the chemical composition of groundwater as found in the 2012 study by Robert Tipping titled Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, Minnesota: A Chemical and Hydrostratigraphic Approach. This study found that by mapping the distribution of certain chemical types, such as chloride, determinations can be made on the presence of recent waters in an aquifer and groundwater pathways, both horizontal and vertical. This information assists groundwater planners and managers to map and evaluate how groundwater conditions change with time and land use.  For example, this data could be used to determine the effect of high capacity pumping on groundwater flow paths and to what degree high capacity pumping drives contaminants deeper by greatly increasing the rate of vertical movement along fractures or multiple aquifer wells.

Strategies around groundwater and surface water interaction focus primarily on collecting and analyzing data to better understand the regional infiltration rate in the county, encouraging use of recharge areas and infiltration methods for surface runoff, and education around the connection between our surface and groundwater.

## 4.1 POLICY

The county will partner in a coordinated effort to increase the understanding of groundwater and surface water interaction in the county and use this information to make informed groundwater management decisions.

## 4.2 STRATEGIES

1. Promote and encourage research related to better understanding the regional infiltration system and the specific relationships between groundwater aquifers and surface water bodies. This includes an understanding of the impact that groundwater withdrawal has on surface water bodies that are dependent on groundwater discharge.

2. Stay engaged in the DNR's process of developing a groundwater management area for the north and east metro to ensure the counties needs are represented in the process.

3. Support the completion and rollout of the County Geologic Atlas Part A and the Hydrogeologic Atlas Part B.

4. Build on previous groundwater and surface water studies, along with other available data, to inventory and rank groundwater recharge areas (including wetlands, lakes, streams, and fields) in the county. Include contamination potential, and distance to bedrock as part of the ranking criteria.

5. Develop, through the Washington County Water Consortium, a county-wide groundwater monitoring plan and a data tracking and mapping system in coordination with watershed management organizations (WMOs).

6. Collaborate with LGUs and WMOs to identify and preserve regional recharge areas. Encourage WMOs and LGUs to incorporate protection of recharge areas into plan updates.

7. Develop and implement an expanded education program for citizens and public officials on the interaction between groundwater and surface water, the value of and need to protect groundwater recharge areas and wetlands; and implementation of best management practices and low-impact development and redevelopment strategies to protect groundwater resources.

8. Encourage the development of design standards for low impact storm water management tools, including infiltration, that evaluate proposed locations of practices, specifically:

    a. Collaborate with MDH and Metropolitan Council to develop guidelines on placement of infiltration BMPs in wellhead and source water protection areas, on hazardous waste generator sites, and in areas of known contamination. The criteria for these guidelines will be based on factors such as hydrogeology, aquifer vulnerability, evaluation of the soil and groundwater at the site for existing contamination, and contamination potential based on proposed land use.

b. Once guidelines are developed, work with LGUs and WMOs to develop a map showing areas where it is not recommended to infiltrate.

c. Develop educational materials and an outreach plan for LGUs, WMOs, Hazardous Waste Generators, and others on proper placement of infiltration BMPs in accordance with the guidelines and map.

9. Encourage the use of low impact storm water management tools, including infiltration, in areas where practices can be safely placed in accordance with Strategy 4.2.8.

10. Collaborate with LGU's, state agencies, and MGS to collect and map baseline data of the recommended chemicals in groundwater to evaluate how groundwater conditions change with time and land use changes.

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# 5. SOURCE WATER AND WELLHEAD PROTECTION


Groundwater protection is designed to prevent rather than remediate contamination of groundwater.

Source water protection is the concept of managing land use in critical zones of groundwater recharge to reduce the risk of contaminating water supplies. Source water protection is designed to prevent rather than remediate contamination of groundwater.

In response to the amended Federal Safe Drinking Water Act of 1988, the Minnesota Legislature passed the Groundwater Protection Act of 1989 directing the MDH to develop a wellhead protection program. Minnesota's Wellhead Protection Rules (4717.700 and 4720.5100 to 4720.5590) set the technical and administrative requirements of the Wellhead Protection Program.

Minnesota Wellhead Protection Rules apply only to public water supply wells. The definition of a public water supply well is "a well that provides drinking water for human use to 15 or more service connections or to 25 or more persons for at least 60 days a year." This includes schools, office buildings, restaurants, public buildings, and municipal water supply systems.

Under the Wellhead Protection Program, all PWSs are required to manage an inner-wellhead management zone (a 200-foot radius surrounding a public water supply) by:

- maintaining the isolation distances for newly installed potential sources of contamination as defined in the State Well and Boring Code (Minnesota Rule Chapter 4725);
- conducting a vulnerability assessment of the well and the wellhead protection area;
- conducting an inventory of potential sources of contamination within the wellhead protection area based on the vulnerability assessment;
- developing a plan to manage and monitor existing and proposed potential sources of contamination; and
- establishing a contingency strategy for an alternative water supply should the water supply be disrupted by contamination or mechanical failure.

In addition to the inner-wellhead management zone requirements, PWSs serving municipalities, subdivisions, manufactured home parks, and facilities such as nursing homes, schools, factories, and hospitals must prepare a wellhead protection plan. The major components of a plan 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.

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 general drinking water quality (nitrate and coliform bacteria). The county program also offers other testing options for private well owners such as lead and arsenic. Private well owners need to be well informed and diligent in caring for their drinking water.

In the county, where groundwater is the sole source of drinking water, source water protection is especially important. ***Figure 23*** shows the location of private wells in the county, pulled from the County Well Index. Many wellhead protection areas in the county cross local governmental boundaries (see ***Figure 24***). Strong state, county, and local government coordination will be essential to carry out an effective Source Water Protection Program.

**Well Management**

The MDH licenses well contractors, administers the permitting process for constructing wells and sealing abandoned wells, and inspects wells in Washington County. The Minnesota Well Code became effective in 1974. In some cases, past (pre-well code era) construction may have contributed to groundwater contamination. Improperly constructed and abandoned unsealed wells can act as direct conduits for surface contaminants to enter shallow groundwater and deeper bedrock aquifers.

Local geologic conditions may require special well construction methods. For example, the State Well Code prohibits completion of new wells in fractured bedrock aquifers that are not covered by at least 50 feet of glacial deposits within a one mile radius of the well site. The MDH also regulates well construction in regions of known contamination. These regions are designated Special Well and Boring Construction Areas (SWBCA). Special well construction practices may be imposed to prevent human exposure to harmful contaminants in these areas. These efforts are also geared to promote well construction techniques that minimize the risk of cross-contaminating aquifers during and after well construction. Four SWBCA exist in the county (***Figure 24***). They include the Lake Elmo/Oakdale site that is an expansion of the existing Washington County Landfill site (Lake Jane), Lakeland/Lakeland Shores site, St. Paul Park and Newport site, and the Baytown/West Lakeland Townships site. For information on each site see Chapter 6.

**Abandoned Wells**

Abandoned wells are wells that are no longer in use. State Law requires well owners to either repair abandoned wells and place them in service, or have them permanently sealed by a licensed well contractor. Abandoned wells are a threat to groundwater quality. Abandoned wells are common in both developed, older residential areas that are presently served by public water supplies and in older rural homesteads. Abandoned well identification and sealing efforts will help prevent contamination of groundwater. The County launched an abandoned well sealing cost share program in the mid-2000s, and plans to continue efforts as funds are available.

## 5.1 POLICY

The county will partner with state agencies and local governments to protect groundwater and public health for private well owners and PWSs through coordinated source water protection and wellhead protection efforts.

## 5.2 STRATEGIES

1. The county will assist in the development and implementation of source water protection and wellhead protection activities. When requested the county will facilitate wellhead protection steering committees when protection areas cross jurisdictional boundaries.

2. Develop a forum for PWSs to meet annually to share information and hear updates from MDH. The information from these meetings will be used to develop implementation actions for the Groundwater Plan Work Plans.

3. Work with PWSs and WMOs to strengthen education efforts, and develop and distribute materials needed to inform home owners on where they get their water from, what source water protection is, and the efforts they can make to ensure they don't contaminate their drinking water.

4. As appropriate, the county may consider Source Water Protection Areas and Drinking Water Supply Management Areas when making land use decisions, and encourage LGUs to do so as well.

5. The county will continue a well sealing program for residents who wish to voluntarily seal wells. This includes:

   a. Seeking outside funds to expand well sealing opportunities.
   b. Expanding education and outreach regarding the need to seal abandoned wells.
   c. Placing a higher priority on identifying and sealing unused wells in Source Water Protection Areas, Drinking Water Supply Management Areas, and areas of known contamination. Wells that penetrate to the same aquifer used by a public water supply system should be sealed first.
   d. Developing a pilot project to identify abandoned wells in a small geographic area. Then evaluate the process to determine the feasibility of expanding the inventory.

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# 6. EXISTING VOLATILE ORGANIC COMPOUND (VOC) AND PERFLUOROCHEMICAL (PFC) CONTAMINATION

Washington County contains several locations that are contaminated with VOCs and PFCs.

Washington County contains several locations that are contaminated with volatile organic or inorganic compounds and perfluorochemicals. These chemicals leached into groundwater from legal and illegal waste disposal, underground tanks, and spills.

**VOCs**

VOCs are carbon-containing compounds that evaporate easily from water into air at normal air temperatures. This is why the distinctive odor of gasoline and many solvents can easily be detected. 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.

There are four identified locations in the county that are contaminated with VOCs at a level that poses a public health risk. MDH declared Special Well and Boring Construction Areas (SWBCA), sometimes called well advisories. 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. Washington County has four SWBCAs (***Figure 25***) and additional locations with PFC contamination that aren't designated SWCAs.

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

*Lake Elmo/Oakdale*

The Lake Elmo/Oakdale SWCA was established due to VOC & PFC contamination at the Washington County Landfill near Lake Jane in Lake Elmo and the Oakdale Disposal site.

Initial VOC contamination was found at the Washington County Landfill in 1981, and an official SWBCA was established in 1993. In 1996, the site entered the MPCA-administered Closed Landfill Program and the MPCA has taken additional steps to improve the landfill cover and the groundwater remediation system. Additionally, municipal water service, provided by the Oakdale municipal system, was extended into the SWBCA in 1986, and private wells were sealed.

In 2003 PFC contamination was found at both disposal sites and in 2004 they were detected in Oakdale's municipal water supply. The Lake Elmo/Oakdale SWBCA was revised in 2007 to include PFCs. Oakdale's municipal water supply is treated by Granular Activated Carbon (GAC) filters and residents on private wells in the SWBCA are also using GAC filters.

*Lakeland/Lakeland Shores*

On December 16, 1987 the MDH issued a SWBCA for portions of Lakeland and Lakeland Shores. Groundwater quality monitoring of over 360 private wells indicated the presence of a variety of VOCs. Solvents and petroleum products were found in 193 wells and in 86 wells the levels of one or more of the VOCs exceeded the levels that are considered safe to drink. Residents in these homes are connected to the Lakeland municipal water system. At least two sources and plumes are suspected as the source of contamination, with the northerly plume containing fluorocarbons (freon) and petroleum products, and the southerly plume containing solvents.

*Baytown/West Lakeland Townships*

On May 6, 1988, the MDH issued a SWBCA for parts of Baytown Township, West Lakeland Township, and the city of Bayport in response to the discovery of VOC contaminants in several private wells in the area. The primary contaminant present in the groundwater within the SWBCA is trichloroethylene (TCE). TCE was most commonly used as a degreasing agent for washing metal parts and also as a dry-cleaning solvent. Exposure to high levels of TCE in drinking water can damage the liver, kidneys, immune system, and nervous system. Exposure to low levels of TCE over a long period of time, may be linked to an increased risk of several types of cancer. TCE may also harm a developing fetus if consumed in high concentrations by an expectant mother. The TCE Health Risk Level (HRL) established by MDH is 5 (μ g/L). In May of 2013, MDH issued a new Health Based Value (HBV) for TCE at 0.4 (μ g/L). An HBV level is not regulatory in nature (it must go through a longer rulemaking process at the state level to become an HRL), but can be used as a good indication of the health risk associated with a chemical and is what the state will use moving forward regarding all decisions to protect public health.

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. The MPCA took remedial action at this site with a hydraulic barrier. The barrier includes four extraction wells to collect and capture the contamination before it migrates off of the property. The extracted water is then treated by air stripping to remove the TCE from the water. The water is then discharged back to the soil using horizontal wells approximately 25 feet underground.

The plume of TCE contamination is approximately 5 miles long and 2 miles wide, extending from northeast Lake Elmo to the St. Croix River. Groundwater movement is generally to the east, toward the St. Croix River, but is complicated due to the fracture flow in the Prairie du Chien aquifer, and other hydrogeologic conditions.

TCE has been detected in glacial sediments in northeast Lake Elmo, at the Lake Elmo Airport, and in Bayport. A public water supply is only available in portions of the cities of Bayport and Lake Elmo. The remainder of the SWBCA is served by private wells.

Baytown Township enacted an ordinance on September 8, 2003, pertaining to water testing and installation, testing, and maintenance of whole-house granular activated carbon (GAC) filters. West Lakeland Township enacted a similar ordinance on March 1, 2004. The ordinances require residents to install an approved GAC filter when TCE or carbon tetrachloride is detected in a well at concentrations exceeding exposure limits. All filter installation, testing, and maintenance costs are the responsibility of the well owner. The ordinances also require periodic testing and reporting of results.

Some requirements of the ordinances do not apply if the MPCA is monitoring and maintaining a whole house GAC filter for the well owner. Currently, the MPCA will install, maintain, and test a whole house GAC filter for an existing well within the SWBCA that exceeds the interim exposure limit of 0.4 µg/L TCE, only if the well is located on property approved for development on or before April 9, 2002.

Additionally Minnesota Statutes, section 103I.236, passed during the 2003 legislative session, requires a seller of real property in Washington County not served by a municipal water system or that has an unsealed well, to state in writing to the buyer, whether, to the seller's knowledge, the property is located within a SWBCA.

*St. Paul Park/Newport*
On November 10, 1997 the MDH issued a SWBCA for portions of St. Paul Park and Newport. Groundwater in the SWBCA has been contaminated as a result 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.

Contamination is found in the Prairie du Chien bedrock and at lower levels in the Jordan aquifer. The contaminants of concern are petroleum products, several VOCs, and pentachlorophenol (PCP). Currently residents in these areas are on municipal water.

**PFCs**
PFCs are a family of manmade chemicals that have been used for decades to make products that resist heat, oil, stains, grease, and water. PFC containing wastes were 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. PFCs were released from the sites, resulting in contamination of groundwater and nearby drinking water wells (***Figure 26***).

In the county the drinking water sources of nine communities have been impacted by PFCs in the groundwater. Listed below are the four sources of the PFC contamination that have been identified in the county. For more information on each follow the links:

- MDH Hazardous Sites in MN - Washington County Landfill
- MDH Hazardous Sites in MN - 3M Oakdale Site
- MDH Hazardous Sites in MN - 3M Woodbury Site
- MDH Hazardous Sites in MN - 3M Cottage Grove Site Facility and PFCs

Many studies and reports have been completed by the MDH with regard to PFCs.

*Point of Use Water Treatment Systems for PFC Removal*
MDH contracted for an independent study of water treatment systems to provide residents with information about how to reduce or remove PFCs from water. To view the report go to MDH Water Treatment Study.

*The East Metro PFC Biomonitoring Project and Follow-up Project*
The East Metro PFC Biomonitoring Pilot Project was one of the first biomonitoring projects directed by the legislature in 2007. This biomonitoring project was conducted to measure PFCs in the blood of East Metro residents known to have been exposed to PFCs through drinking water. Participants included 196 adults who lived in Oakdale, Lake Elmo, and Cottage Grove. The MDH Public Health Laboratory tested participants'

blood for PFOA, PFOS, PFBA, PFBS, PFHxS, PFPeA, and PFHxA.
Three PFCs (PFOA, PFOS, and PFHxS) were found in the blood of all participants. Levels of each were somewhat higher than those found in the general US population, but comparable or lower than levels found in other studies of communities exposed to PFCs in drinking water. Two PFCs (PFBA and PFBS) were found in a smaller proportion of participants, and two (PFHxA and PFPeA) were not found in any participants. For people on private wells, PFOA and PFOS levels in drinking water were related to levels in blood.

The results from this project (and all biomonitoring projects in the state) were analyzed by the MDH Environmental Health Tracking and Biomonitoring Advisory Panel. Based on recommendations from the panel, MDH was tasked with conducting a follow-up study of these participants to determine how PFC levels in their blood has changed over a two-year time period. One of the follow-up project's goals was to find out whether efforts to reduce drinking water exposure to PFCs had been successful in reducing PFC blood levels in the population. Another goal was to learn more about how people are exposed to PFCs.

Participants included 164 adults who agreed to give a second blood sample in 2010. The MDH Public Health Laboratory analyzed blood samples for the same 7 PFCs measured in 2008. Three PFCs (PFOA, PFOS, and PFHxS) were found in the blood of all participants. Levels of these PFCs have declined since 2008 in most participants. On average, individual levels of PFOS went down by 26%, PFOA by 21%, and PFHxS by 13%. 2010 levels were still somewhat higher than the most recent information available for the general U.S. population.

The other 4 PFCs were less frequently detected: PFBA in 34 people (21%), PFBS in 7 people (5%), and PFPeA in 1 person. PFHxA was not detected in any samples. This was similar to 2008, though PFBA was detected in a greater percentage of participants (25%) in 2008.

Because these declines are similar to other exposed communities, results show that efforts made to reduce drinking water exposure to PFCs in the East Metro were successful. Over time it is expected that levels will continue to go down to general U.S. population levels.To view the reports produced from these studies go to East Metro Biomonitoring Study.

*PFCs in Class B Firefighting Foam*
Another source of PFCs researched by the MDH and the MPCA is municipal, refinery, and airport fire training facilities where special PFC bearing fire-fighting foams were reportedly used. The view the report of their findings go to: Perfluorochemicals in Class B Firefighting Foam.

*PFCs in Homes and Gardens Study*
In addition to drinking PFC containing water, it is possible people may be exposed to PFCs from other sources, such as eating vegetables from a garden or bare soil in a yard that was watered with PFC containing water. To determine the risk of exposure to PFCs from these sources this study looks at whether soil, home-grown produce, and house dust in Oakdale, Lake Elmo, and Cottage Grove contain PFCs that people could come in contact with. To follow this study go to PFCs in Homes and Gardens Study.

## 6.1 POLICY

The county will work with state agencies and local governments to track existing contamination plumes, increase resident's awareness of existing groundwater contamination, and continue to educate residents on the steps they can take to ensure their drinking water is safe.

## 6.1 STRATEGIES

1. The county will continue to work with MDH and Baytown and West Lakeland Townships (as requested by the townships) with testing private homes for VOC's in accordance with their ordinances.

2. The county will assist MDH and LGUs as requested with education and outreach related to groundwater contamination, including bio-exposure and accumulation as with PFC's.

3. Develop an intergovernmental communication plan for Conditional Use Permits and other development projects that may impact or be impacted by existing groundwater contamination.

4. The County Epidemiologist will continue to represent Washington County residents by serving on the MDH Environmental Health Tracking and Biomonitoring Advisory Panel.

5. The county will support continued legislative advocacy for the MDH Environmental Health Tracking and Biomonitoring Program.

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# 7. NUTRIENTS, PESTICIDES, & ROAD SALT

Agriculture and turf management are county wide activities.

This chapter addresses impacts to groundwater quality from agricultural practices, turf management, and animal waste disposal. If not handled appropriately chemicals used for turf management and agricultural practices along with animal wastes can leach through the soil and contaminate groundwater. They can also run off of the land into surface water bodies causing them to be listed as impaired. ***Figure 5*** shows surface water bodies that are on the MPCA impaired waters list. For these reasons proper application of agricultural and turf management chemicals and proper handling of animal wastes are essential to protecting groundwater quality.

Agriculture and turf management are county-wide activities. Fertilizer and pesticide applications are widely used to grow crops and manage turf. Many of the users include the county in maintenance of its properties, commercial businesses, golf courses, horse farms, orchards, and hobby farms, along with three currently state permitted feedlots. Fertilizers, pesticides, and animal waste by-products have been shown to degrade the quality of groundwater. Contamination risks are magnified in southern Washington County where thin permeable soils lie above shallow bedrock aquifers. County residents on private well water are responsible for testing 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 general drinking water quality (nitrate and coliform bacteria).

***Fertilizer Use***

A common component of fertilizers, nitrate, is the most common groundwater contaminant in Washington County. Nitrate easily dissolves in water and moves readily through soil and into regional aquifers. Nitrate levels can also be elevated from failing septic systems, discussed in chapter 9.

In Washington County, the average nitrate level is 2.05 milligrams per liter (mg/l) based on over 14,000 well water tests conducted between 1978 and 2013. Nitrate levels are highest in the southern Washington County communities of Cottage Grove, Denmark Township, and Grey Cloud Island. In the southern portion of the county, the bedrock is close to the surface, covered by a thin layer of glacial material offering limited protection to the nitrate-sensitive aquifers below. Historical data collected by PHE and supported by a MPCA study indicate 16 percent of the private wells tested in the Cottage Grove area exceed the State Health Risk Limit for nitrate of 10.0 mg/l.

The primary health concern associated with exposure to nitrate is methemoglobinemia, commonly known as "blue baby syndrome". This condition occurs when nitrate is 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.

***Pesticide Use***

Very few groundwater samples have been collected for pesticide analysis in Washington County. A 2000 MPCA study completed in the Cottage Grove area tested 79 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.

***Road Salt Storage and Use***

Salts, such as 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 water 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 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.

In 2008 the St. Anthony Falls Laboratory of the University of Minnesota conducted a series of research papers, funded by the Local Road Research Board, on the use of road salt and its effect on lakes, streams, and aquifers in Minnesota. The third report is titled "Potential for Groundwater Contamination by Road Salt in Minnesota" November 2008. A few findings from this report are increased chloride levels in groundwater wells in close proximity to road networks, chloride concentration in some urban wells has increased by 15%, and the MPCA has found higher chloride concentrations in shallower monitoring wells than in deeper wells. To read this report go to: Potential for Groundwater Contamination by Road Salt in Minnesota.

The MPCA is running the Metropolitan Area Chloride Project that researches the effect of road salt on our lakes and streams and the infiltration of salt laden water getting into aquifers. For more information visit: Metropolitan Area Chloride Project: Road Salt and Water Quality.

***Animal Waste***

Animal manure, when used properly, provides essential nutrients, organic matter, and moisture to crop-land. 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. 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. Manure management and operation practices for feedlots, and horse and hobby farms, and geologic conditions are all factors that potentially affect groundwater quality.

The Minnesota Pollution Control Agency 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 three feedlots in the county.

The Washington County Zoning Ordinance regulates land use in unincorporated townships. The Zoning Ordinance contains provisions for managing manure and feedlots. Provisions of the Ordinance call for "the adoption of all Minnesota Pollution Control Agency minimum requirements, the prohibition of new feedlots within 1000 feet of any lake or pond or within 300 feet of a river or stream, and require all new feedlots to have a permit from the Minnesota Pollution Control Agency." The Washington Conservation District provides technical assistance and consultation to animal feedlot operators.

## 7.1 POLICY

The county will partner with state agencies, local governments, and stakeholders in a balanced approach to implement best management practices that reduce groundwater contamination from nutrients, pesticides, and road salt.

## 7.2 GENERAL NUTRIENT STRATEGIES

1. Re-evaluate the Cottage Grove Nitrate Study and expand to Afton, Grey Cloud Island, Denmark Township, and other communities as needed.

2. Map well testing data from the county testing program, including data from community and county nitrate clinics.

3. Continue to operate and promote a resident private well testing program.

4. Develop education materials that direct private well owners where to access drinking water testing for pesticides. Investigate options to offer pesticide testing of groundwater to private well owners.

5. Develop a program that identifies long term monitoring stations for nitrates and pesticides. Analyze data for trends in levels of these contaminants.

6. Identify available partnerships and funding opportunities to address Agricultural Nutrient Management.

    a. Watershed District/WMO programs
    b. USDA NRCS programs
    c. SWCD State Cost Share Programs
    d. NPEAP engineering assistance programs for feedlot design
    e. MDA loan program

## 7.3 URBAN NUTRIENTS STRATEGIES

1. Develop and implement an education program directed at homeowners outlining proper use and disposal of lawn and garden chemicals, salt usage and storage, and management of pet waste. This education should include:

    a. Information on their location in relation to the groundwater sensitivity maps and wellhead protection areas.
    b. Which BMPs to use for what practice (such as soil testing before application of fertilizers) and how they will minimize their effect on groundwater.

2. Develop an outreach plan to educate lawn care companies, golf courses, kennel operations, and county and LGU public works departments on how to use BMPs to minimize the effects on groundwater caused by the use and storage of fertilizers, pesticides, and road salt, while properly maintaining

their properties. This education should include information on the property location in relation to the groundwater sensitivity maps and wellhead protection areas.

## 7.4 AGRICULTURE NUTRIENTS - ANIMAL WASTE MANAGEMENT

1. Complete an inventory of existing animal holding facilities, including horse farms, in the county.

    a. Inventory everything from small farms, including horse farms, to large-scale operations based on animal units. Include an update to the existing feedlot inventory (current information from 1995). Gather existing information from other groups such as the Minnesota Pollution Control Agency and the Minnesota Department of Agriculture.
    b. Evaluate the risk to groundwater that existing feedlots and animal holding facilities may have at their specific location, using tools such as the groundwater sensitivity map. This information will be used to develop and implement targeted BMP plans to protect groundwater.
    c. Investigate if and how communities in the county govern animal waste management, and work with LGUs and WMOs using this information, to develop recommendations to other communities on effective rules and methods for animal waste management.

2. Promote implementation of on-the-ground BMPs to contain and/or treat runoff from animal feeding and holding areas.

    a. Determine areas in need of upgraded facilities and promote assistance programs to ensure installation of facilities.
    b. Promote and encourage the completion of nutrient management plans.
    c. Promote coordination with NRCS to promote other USDA programs that may assist in addressing animal waste runoff.
    d. Target educational efforts in sensitive areas identified in number 7.4.1 above.

3. Develop an educational plan to promote programs and assistance related to management of animal feeding and holding facilities and the impact they can have on water resources. This program should also include information on new research types of BMPs and how they should be used.

## 7.5 AGRICULTURE NUTRIENTS - NON-ANIMAL WASTE MANAGEMENT

1. Complete an inventory of active agricultural areas in the county, including orchards, nurseries, and vineyards.

    a. Update the existing row crop and agricultural inventory (currently based on 2007 MLCCS information). Inventory everything from small farms to large-scale operations.
    b. Evaluate the risk to groundwater that actively farmed areas may have at their specific location, using tools such as the groundwater sensitivity map. This information will be used to develop and implement targeted BMP plans to protect groundwater.

2. Complete an inventory of abandoned and unused agricultural operations in the county and identify any clean up needs. Compare these areas to areas sensitive to groundwater contamination to determine risk level and to target BMP efforts.

3. Promote implementation of BMPs to contain and/or treat agricultural runoff.

    a. Prioritize where BMPs are most needed, such as wellhead protection areas, ravines, or waterways.
    b. Promote conservation tillage and cover crop practices.
    c. Promote and encourage the development of nutrient management plans for active farmland, including orchards, nurseries, and vineyards.
    d. Promote coordination with SWCDs, USDA NRCS, and others to increase on the ground implementation efforts and funding to landowners.

4. Develop an educational program regarding:

    a. Programs and assistance related to agricultural nutrient management and the impact it has on groundwater.
    b. Types of BMPs such as different fertilizers, application rates, timing, and cover crops.

# 8. EMERGING CONTAMINANTS

Emerging contaminants include pharmaceuticals, pesticides, personal care products, and others.

Emerging contaminants are substances that have been released to, found in, or have the potential to enter groundwater or surface water and don't 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, fire retardants, and other items that are washed down drains and not able to be processed by municipal wastewater treatment plants or septic systems. Perfluorochemicals are known as an emerging contaminant but due to their presence in county groundwater they are discussed in Chapter 6. Other common examples of emerging contaminants are:

- Triclosan, a chemical compound used in antibacterial products like soap and hand sanitizer.
- Acetaminophen, a medication widely used to reduce fever and pain. It is used in many brands of non-prescription medications. It is also combined with other drugs in some prescription pain medications.
- Tonalide, a musky fragrance used in cosmetics and personal care products such as shampoo and lotion. It is also used in cleaning products such as soap and laundry detergent.

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 MPCA partners with MDH and implements the Ambient Groundwater Monitoring Program to monitor groundwater for emerging contaminants (***Figure 27***).

For more information and to view the findings on specific contaminants please visit: MDH Contaminants of Emerging Concern Program.

For information on monitoring for these contaminants please visit: MPCA Ambient Groundwater Monitoring Program.


## 8.1 POLICY

The county will work with MDH, MPCA, local governments, and stakeholders to educate residents on the impact emerging contaminants have on groundwater and how to protect additional groundwater contamination from emerging contaminants.

## 8.1 STRATEGIES

1. Track and monitor emerging contaminants research at both the state and federal levels. This includes the MDH Contaminants of Emerging Concern program (the nomination and evaluation of new contaminants), the U.S. Environmental Protection Agency guidance, and Drug Enforcement Agency changes to drug disposal. The county will also promote state agency monitoring for emerging contaminants, including coordination with state agency staff on identifying areas or wells for emerging contaminants monitoring.

2. Develop and promote education and outreach related to emerging contaminants, for the general public, elected officials, and PWSs. Continue to promote the county's unused medication drop box. The county may seek financial assistance from state and/or federal resources for emerging contaminants outreach activities.

# 9. SEPTIC SYSTEMS

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

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 MUSA and waste water treatment plants (WWTP), briefly described in Chapter 1. In lower density, rural settings, where the MUSA does not extend, homes and businesses must rely on SSTS, commonly called septic systems, to treat waste. A properly designed, installed, and functioning SSTS effectively treats septage and decreases introduction of bacteria, viruses, and other disease causing organisms into groundwater. As an added benefit SSTS also take groundwater pumped for human uses and recharge it directly to the local water table.

While SSTS can be an efficient means of treating waste in rural areas, failing or poorly maintained SSTS have the potential to contaminate groundwater and surface water for a number of contaminants, including nitrates, coliform bacteria (E Coli), and phosphorus. A failing system does not have the required three feet of separation from the water table, bedrock, or some other limiting feature, and is therefore not adequately treating waste. As a result, wastewater that flows from these failing systems is untreated septic tank effluent. A 2004 MPCA report found one home with a faulty SSTS can easily contribute more bacteria than a WWTP treating water from thousands of homes.

**SSTS in Washington County**

SSTS are widely used throughout the county, with approximately 80% of the geographical area in the county served by this type of waste treatment (***Figure 28***). This equates to over 16,000 systems as of 2013, which serves approximately 48,000 residents, and treats an average of 3.6 million gallons of waste water a day. This is equivalent to the amount of waste water treated by the St Croix Valley Wastewater Treatment Plant (WWTP) that serves the communities of Stillwater, Oak Park Heights, and Bayport. The resulting pollution from that particular WWTP is managed and regulated from just a few discharge points. In contrast, for communities served by SSTS there are thousands of individual discharge points that have the potential to contribute pollution; resulting in contamination of surrounding soils and groundwater. Just as this WWTP must be managed and maintained to prevent surface water contamination, the thousands of 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 3 and 4) 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."

**SSTS Ordinance and Local Enforcement**

Minnesota Statutes 7080 through 7083, enforced by the MPCA, addresses statewide rules for SSTS, guidelines for licensing of SSTS professionals, and a local framework for regulation. Every county must have a SSTS ordinance that is at least as strict as the rules set by the MPCA. Washington County's septic ordinance was first adopted in 1972, was most recently revised in 2009, and will be undergoing another revision by 2014. The county PHE department administers the SSTS program in unincorporated areas of the County and portions of the County delegated through contracts with incorporated cities (seventeen communities as of 2013). The communities of Stillwater and Dellwood have adopted and enforce their own ordinances. The SSTS Ordinances in cities must be as restrictive as the county SSTS Ordinance.

The county SSTS Ordinance and local SSTS Ordinances regulate the location, design, installation, use, and maintenance of SSTS. Additionally the county inspects and requires replacement of systems when they are failing. To help ensure that failing SSTS are identified and replaced, the 2009 revised ordinance requires SSTS inspection at a point of sale.

Replacement of a failing system can be a costly endeavor, roughly $8,000-20,000 depending on the system. As a result, the strategies below discuss options for financial assistance to residents who are required to replace their systems. There is also an opportunity to improve surface water quality in some areas of the county, since failing SSTS have been identified as a potential load contribution in phosphorus TMDLs.

The current county SSTS program also requires regular maintenance of existing systems, since regular maintenance and inspection of a SSTS can extend the life of a system. Residents receive a reminder every three years to pump their septic system, and pumping records must be filed with the county by licensed SSTS pumpers.

## 9.1 POLICY

The county will partner with state agencies, local governments, and stakeholders to protect groundwater from contamination that is caused from failing SSTS.

## 9.2 STRATEGIES

1. Develop a county wide assessment that utilizes geologic data, nitrate testing/mapping, housing stock data, and a community approach to determine risk levels of existing systems throughout the county, and identify possible areas of concern for failing systems.
   Use assessment data to:

   a. Set up targeted inventory in areas of concern for failing SSTS.
   b. Inform decisions regarding placement of SSTS, type of SSTS to be installed, or other alternatives (hookup to city sewer).
   c. Develop materials that describe the necessity to analyze the cumulative affect of SSTS community wide versus for each individual home. Use these materials to educate and inform public officials, contractors, and SSTS owners.

2. Strengthen education efforts and develop materials to inform home owners on the impact a failing SSTS can have on groundwater and surface water resources. Include education on proper use and maintenance of SSTS to ensure functionality of the system.

3. Define a method and develop materials to educate realtors and title companies on SSTS rules and requirements during property transfers.

4. Define a method to verify SSTS compliance inspections occur during property transfers.

5. Research and develop financing options, including the possibility of a cost share, grant, or loan program for SSTS system replacement.

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# 10. LAND SPREADING FOR BENEFICIAL USE

Beneficial use of solid waste is a sustainability practice where an "Industrial By-Product" (IBP) (classified in State Rule as a solid waste 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) is spread on agricultural fields to alter soil for crop production. 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.

Solid waste land application is a highly regulated state program. Minnesota Administrative Rules 7035.2860, Beneficial Use of Solid Waste, sets the rules by which solid waste can be land spread. Additionally the county licenses solid waste applicators under its Solid Waste Management Ordinance #114. This program annually reviews and writes license conditions for the products the applicator submits analyticals for and intends to apply. The most common IBP that is spread on county fields is lime sludge, although other products are allowed on a case by case basis. Also the county conducts individual site inspections prior to an IBP application. IBPs cannot be applied without soil tests demonstrating the need for the product, and analysis of the product 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. To view the ordinance: Washington County Solid Waste Management Ordinance #114.

The current county ordinance doesn't address land spreading of septage.

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 doesn't address land spreading of septage so therefore it is regulated under the EPA Regulations 40 CFR Part 503.

The county is beginning the process of updating the septic ordinance and will be addressing the allowance of land spreading of septage in the county. Raw septage carries pathogens and emerging contaminants, which are a public health concern. The county should consider not allowing land spreading due to the presence of emerging contaminants and the sensitivity of water resources in the county. This plan recommends that if land spreading of septage is allowed in the county the septic ordinance be updated to include a strong regulatory component to these activities that includes requirements about distance and slope to surface water bodies, wetlands, and other groundwater dependent natural resources, that considers the geology and infiltration rates, has requirements based on the distance to the water table, and requires the land spreaders to monitor surface and groundwater to ensure public health and safety.

## 10.1 POLICY

The county will partner with state agencies, local governments, and stakeholders to ensure sufficient regulation and oversight are in place to protect public health, safety, and groundwater from potential contamination by land spreading activities.

## 10.2 STRATEGIES

1. For the land application of lime sludge and other wastes as approved by the state and county, the county encourages watershed management organizations to identify sensitive water features and appropriate setbacks for those features, and provide such information to the county for consideration in the approval process for land application. The county also encourages watershed management organizations to work directly with businesses that land apply, to make sure sensitive water features are protected.

2. This plan recommends the county prohibit the land spreading of septage until such time that sufficient research and best management practices have been established by either the EPA or the MPCA to ensure that public health and safety are not compromised.

3. If the county decides to allow land application of septic waste this plan recommends the county develop and implement a rigorous regulatory program to ensure the process is done safely and protective of county surface and groundwater. Include in the regulatory program the requirement to notify WMOs, WCD, and LGUs so that citizen inquiries can be addressed. Also require the land spreader monitor any impacts to surface and groundwater.

4. Develop and implement an educational program for citizens regarding land spreading of septage.

# 11. HAZARDOUS WASTE

Improperly handled hazardous waste has contaminated groundwater in localized areas of Washington County.

Improperly handled hazardous waste has contaminated groundwater in localized areas of Washington 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 (***Figure 24***). In these areas, special well construction practices are in effect to protect the public from contaminated groundwater (see Chapter 8). In addition, there are nine active State or Federally designated soil and groundwater contamination areas, termed Superfund Sites, located in the county (***Figure 29***).

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.

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 Waste Management Master Plan 2012-2030 (Master Plan) 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. The Master Plan also contains provisions focused on modifying industrial processes to reduce or eliminate the use of toxic and hazardous materials. To view the plan click the link: Washington County Waste Management Master Plan 2012 - 2030.

***Washington County Hazardous Waste Management***
Washington County's PHE has been implementing a hazardous waste licensing and inspection program for over three decades. Currently, Washington County's Environmental Protection Team licenses and inspects approximately 480 hazardous waste generators, four hazardous waste facilities, and administers a household hazardous waste (HHW) collection program at the county Environmental Center. All hazardous waste generators are required to obtain permission from the County for each waste they generate and to annually report the volumes of wastes produced. The Environmental Protection Team, in coordination with the Washington County Attorney's Office, investigates complaints regarding the mismanagement of hazardous wastes and investigates occurrences of abandoned wastes.

The HHW program provides a separate collection system for residents to dispose of common products such as paints, solvents, and petroleum wastes. In 2009, Washington County opened a new HHW collection facility, the Washington County Environmental Center in the City of Woodbury. In addition to providing the permanent facility, satellite collection events are offered throughout the county several times each year. The HHW 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 PHE 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.

The county also has an usused medication drop box program. This program provides a method for the safe disposal of medication and keeps these contaminants out of our groundwater. Strategy 8.2.2 includes continued promotion of the county's unused medication drop box program. For information specific to the program go to: Washington County - Take it to the Box - Medication Disposal.

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: MPCA - Underground Storage Tank (UST) Systems

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, cracking, weld and valve failures, spills during transfers, and occasionally tank rupture. 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, or surface water and creating hazards to aquatic life and 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) are regulated by permits negotiated with MPCA. The goal of regulating AST systems is to prevent spills and leaks by providing storage tank owners with various safeguard options. More information on the MPCA Regulatory Program for AST systems is available at: MPCA - Aboveground Storage Tank (AST) Systems

***Transportation of Hazardous Waste and Hazardous Waste Spills***

Hazardous wastes are transported throughout Washington 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 MN Chapter 115E, Oil and Hazardous Substance Discharge Preparedness. This requires hazardous waste transporters to prepare and train to respond to petroleum and chemical spills. Pipelines, trucking, and railroad businesses that transport more than 100,000 gallons of hazardous waste per month are mandated to develop spill prevention and preparedness plans.

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. All spills that have the potential to impact the environment must be reported to the State of Minnesota Office of Public Safety (Minnesota State Duty Officer) within 24 hours. The MPCA oversees the initial response and cleanup of non-agricultural spills and the MDA oversees the clean-up of agricultural chemical spills.

***Pipelines***

Eight companies operate pipelines in Washington County. Products carried in local pipelines include natural gas, fuel oil, crude oil, gasoline, and other petroleum products (***Figure 30***). Pipelines cross many parts of Washington County, including areas considered sensitive to groundwater contamination.

The U.S. Department of Transportations, Pipeline and Hazardous Materials Safety Administration regulate pipelines. The MPCA is responsible for responding to pipeline release incidents and local first responders are responsible for public safety. The county does not have direct pipeline regulatory authority, but does have the opportunity to review permit applications and comment on what efforts should be made to protect groundwater. More information is available at: MN Pipeline Information

## 11.1 POLICY

The county will work to reduce the risk of groundwater contamination by ensuring sound management of hazardous waste within the county.

## 11.2 STRATEGIES

1. The county will work to ensure that groundwater protection is an integral part of State, county, and local rules and permitting programs that regulate hazardous waste storage, transportation, disposal, clean up, and emergency response structures.

2. Explore options to encourage BMPs at new and existing salvage yards in the county, to promote proper management of waste and prevent groundwater contamination.

3. Continue to strengthen outreach and education on household hazardous waste disposal options through the use of the county environmental center and other household hazardous waste facilities that are available.

4. Develop education materials and an outreach plan for hazardous waste generators that explains their potential groundwater impact.

   a. Create a hierarchy of education based on toxicity to groundwater.
   b. Education materials should be prioritized by how effective they are at getting the message out to residents.

# 12. MINING

Mining increases potential impacts to groundwater from spilling of chemicals and/or fuel.

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. 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.

Mining may take place below the water table, requiring de-watering efforts. Operations pumping more than 10,000 gallons per day or over 1,000,000 gallons per year must obtain a DNR water appropriation permit. Groundwater drawdown in mining areas has the potential to impact local and regional water quantity.

The Washington County Mining Ordinance regulates the removal of sand, gravel, rock, soil, and other natural deposits in unincorporated townships. The mining ordinance also regulates the production of asphalt and concrete. Incorporated cities with mining activity administer mining ordinances and concrete and asphalt production within their boundaries.

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 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 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 county ordinance also requires the county issue formal permits that include annual inspections, and that each operation undergoes a review process with a public hearing every five years. Currently the county holds 12 active mining permits.

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.

The concerns of increased silica sand mining in the county include greater potential to contaminate groundwater, increased depletion of groundwater due to use by mining operations, noise and light pollution, and potential serious health effects from silica laden dust. This groundwater plan recommends that the county update its mining ordinance to include specific regulations for silica sand mining to protect public health and safety.

## 12.1 POLICY

The county will coordinate with local governments and stakeholders to regulate mining activities and ensure sufficient mining reclamation to protect groundwater and public health and safety.

## 12.2 STRATEGIES

1. The county will continue to review and provide comments on any proposed mining operations within the county, including frac sand mining, in order to protect groundwater. The county will review proposals specifically for:

    a. Proposed mining process and use of chemicals.
    b. Proximity to surface contaminants based on surrounding land uses.
    c. Proximity to groundwater dependent natural resources including horizontal distance and depth.
    d. Distance from the bottom of the excavation to the top of the water table.
    e. The amount of water appropriation requested.
    f. Proposed land use after mining.
    g. Requirements for annual operating permits.
    h. Proposed management of waste water including wash water.

2. The county will review and comment on any proposed ordinance or rule changes from municipalities and other LGUs, with regards to mining operations, in order to protect groundwater.

3. The county will review the current county mining ordinance, in the context of frac sand mining, to ensure protection of groundwater. Suggested changes and/or comments may include requiring additional monitoring, limiting excavation to certain distances from the water table, and further restrictions under certain geologic conditions.

# 13. LANDFILLS

The county has a difficult history with landfills and disposal sites in relationship to groundwater. The formerly known Washington County Landfill and disposal sites in Oakdale, Woodbury, and Cottage Grove are sources of PFC 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 liners weren't required. Another reason is due to the type of geology in the county. The county's geology, especially in the southern part, doesn't have much till before bedrock is exposed and is also riddled with fractured bedrock and areas of karst. All of these characteristics create a situation with great potential for contaminating groundwater.

The county's sensitive geology creates a situation with great potential for contaminating groundwater.

In 2008 the Minnesota Legislature passed a bill calling for a work group to advise them on updating MPCA rules for industrial landfills that address groundwater sensitivity. One of the drivers of this was the history of groundwater contamination in the county along with a proposal by Xcel Energy to develop a new lined landfill in West Lakeland Township that would receive fly ash from coal combustion.

Recommendations put forth to the legislature by this work group that affect groundwater are:

- Permitting of industrial waste landfills should be based on hydrogeology.
- The use of site specific hydrogeologic investigations needs to be done to characterize groundwater at proposed sites instead of a single criteria or test.

The MPCA moved forward with these recommendations and brought together a group of stakeholders who wrote the "Industrial Landfill Guidance" document. This document informed the state legislature and in March 2012 they adopted Minnesota Administrative Rule 7001.3111 "Additional Siting Requirements for Certain Landfills that have not Received a Permit before January 1, 2011." This rule provides criteria that are based on a site's sensitivity to groundwater contamination. These criteria include:

- The applicant must provide a certification for site and groundwater conditions from a professional geologist licensed in Minnesota and a certification for structural conditions from a professional engineer licensed in Minnesota.
- The predicted minimum time of travel of groundwater contaminants from the proposed landfill's base grade to an approvable proposed compliance boundary is at least 100 days.
- Groundwater flow is known in sufficient detail to allow monitoring for potential contaminant releases, and site and groundwater conditions would allow the owner/operator sufficient space and time to implement corrective actions to prevent contaminants released from the landfill from exceeding applicable standards at a compliance boundary.
- No karst exists within 200 feet laterally of the proposed waste fill area.

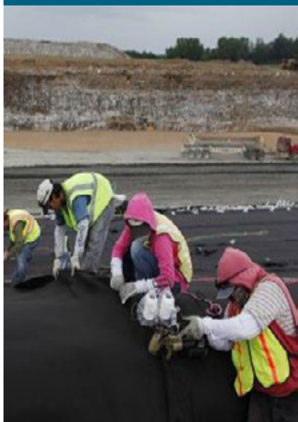
- At sites where carbonate bedrock exists, either more than 50 feet of undisturbed, unconsolidated overburden has been maintained prior to construction so that karst is not likely to develop or the commissioner finds based on the site evaluation that karst is not likely to develop.

These proposed rules support this plans recommendation to not allow siting an industrial landfill in the county in order to protect groundwater.

Mixed municipal solid waste (MSW) is another waste stream where PHE works with stakeholders to protect groundwater. The Washington County Waste Management Master Plan 2012-2030 guides county waste management activities and was developed with guidance from the MPCA Metropolitan Solid Waste Management Policy Plan 2010-2030. 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:

a. Waste reduction and reuse;
b. Waste recycling;
c. Composting of source-separated compostable materials, including, but not limited to yard waste and food waste;
d. Resource recovery through mixed municipal solid waste composting or incineration; and;
e. 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
f. 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.

The groundwater plan supports this integrated management system and encourages the county to go a step further and continue to ensure that landfills are not sited in the county. This recommendation is due to the sensitive geology and the existing contaminated groundwater in the county.



## 13.1 POLICY

The county will partner with state agencies, local governments, and stakeholders to prevent the siting of landfills in the county in an effort to protect groundwater from contamination.

## 13.1 STRATEGIES

1. The county supports Minnesota Rule 7001.3111 "Additional Siting Requirements for Certain Landfills that have not Received a Permit before January 1, 2011."

2. The county will continue to review and provide comments on any proposed landfill operations within the county in order to protect groundwater.

3. The county will review and comment on any proposed statute or rule changes from the state with regards to landfill operations in order to protect groundwater.

4. The County Groundwater Plan supports the work of the Washington County Waste Management Master Plan 2012-2030 to implement activities for an integrated solid waste management system that is protective of groundwater.

5. This plan recommends the county prohibit the siting of landfills in the county to protect groundwater that is vulnerable due to the sensitive geology.

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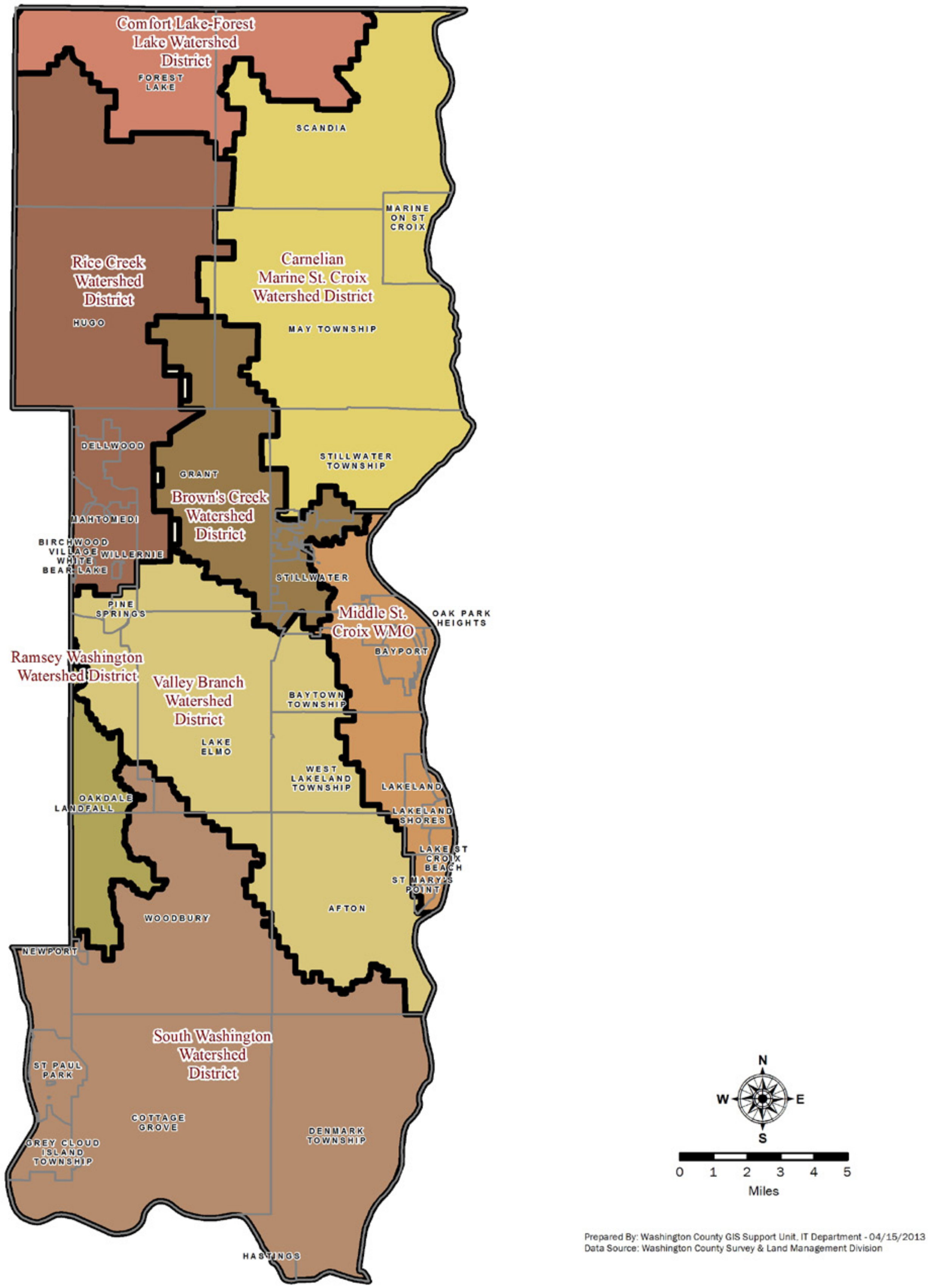
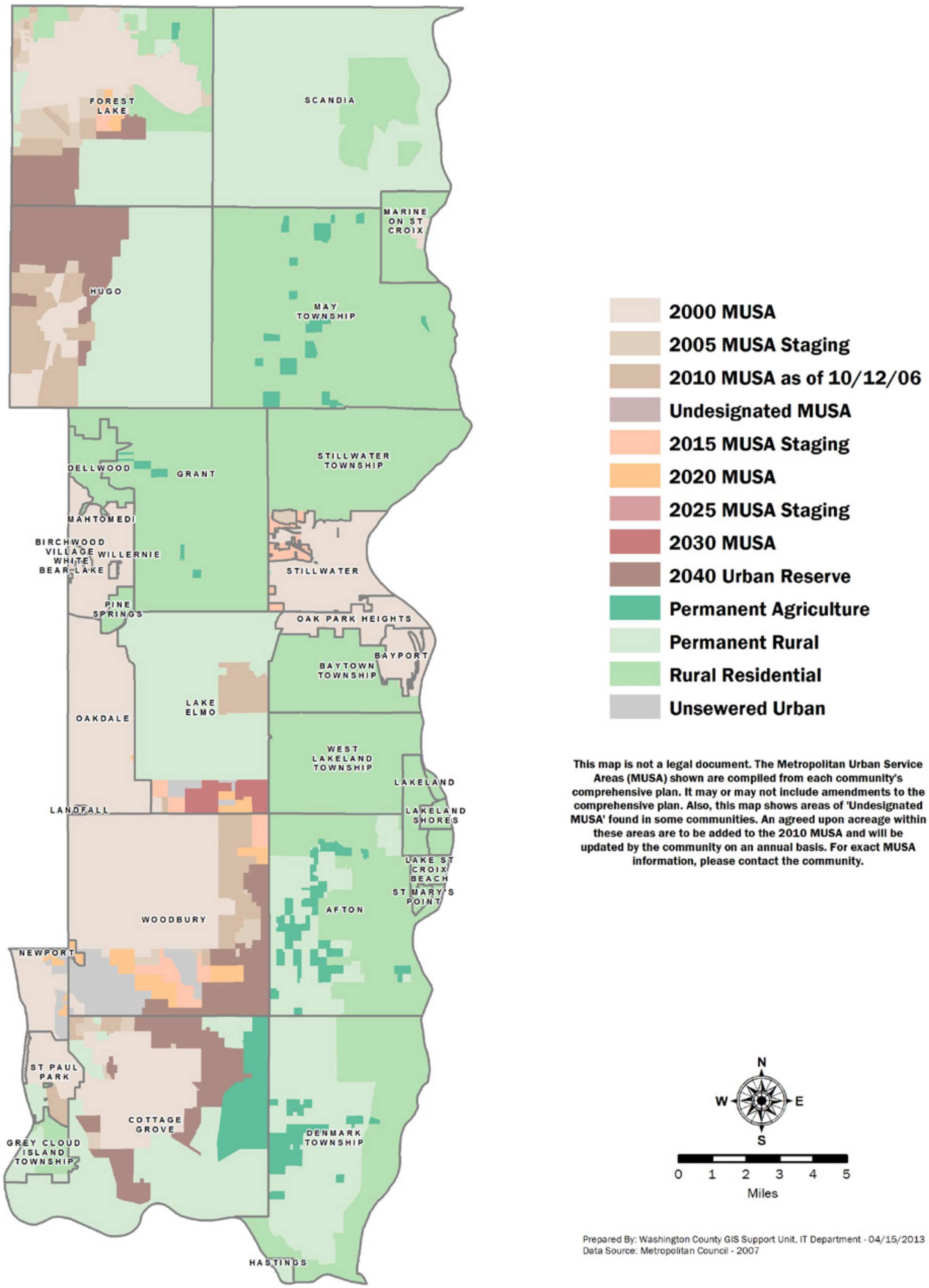
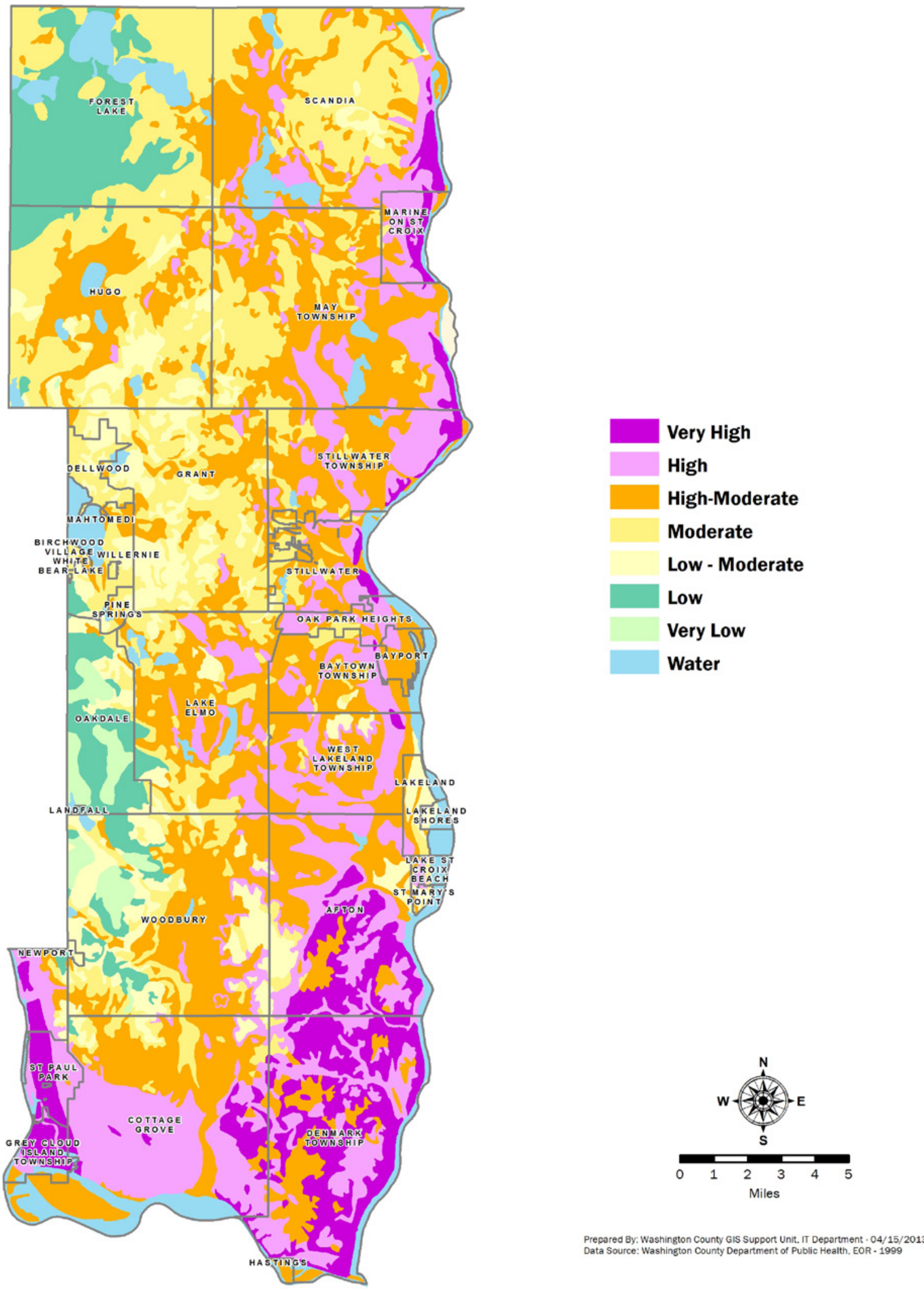
# 14. LIST OF FIGURES


Comfort Lake-Forest Lake Watershed District
FOREST LAKE
SCANDIA
MARINE ON ST CROIX
Rice Creek Watershed District
Carnelian Marine St. Croix Watershed District
HUGO
MAY TOWNSHIP
DELLWOOD
GRANT
STILLWATER TOWNSHIP
Brown's Creek Watershed District
MAHTOMEDI
BIRCHWOOD VILLAGE
WHITE BEAR LAKE
WILLERNIE
STILLWATER
PINE SPRINGS
Middle St. Croix WMO
OAK PARK HEIGHTS
BAYPORT
Ramsey Washington Watershed District
Valley Branch Watershed District
BAYTOWN TOWNSHIP
LAKE ELMO
WEST LAKELAND TOWNSHIP
LAKELAND
OAKDALE
LANDFALL
LAKELAND SHORES
LAKE ST CROIX BEACH
ST MARY'S POINT
AFTON
WOODBURY
NEWPORT
South Washington Watershed District
ST PAUL PARK
COTTAGE GROVE
DENMARK TOWNSHIP
GREY CLOUD ISLAND TOWNSHIP
HASTINGS
N
W
E
S
0 1 2 3 4 5
Miles
Prepared By: Washington County GIS Support Unit, IT Department - 04/15/2013
Data Source: Washington County Survey & Land Management Division

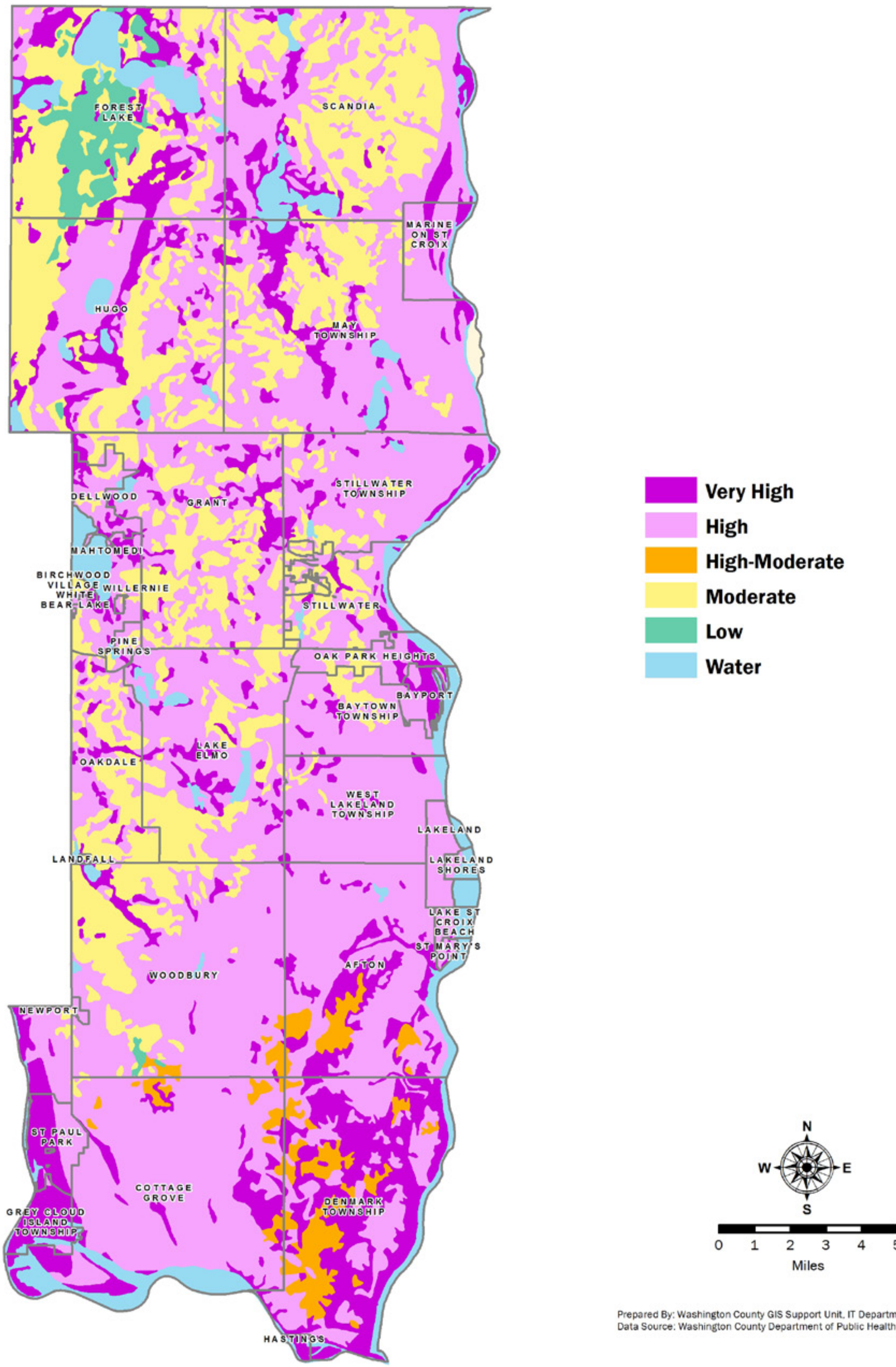
## Figure 2 · Metropolitan Urban Service Area (MUSA)



# Figure 3 · Bedrock Sensitivity

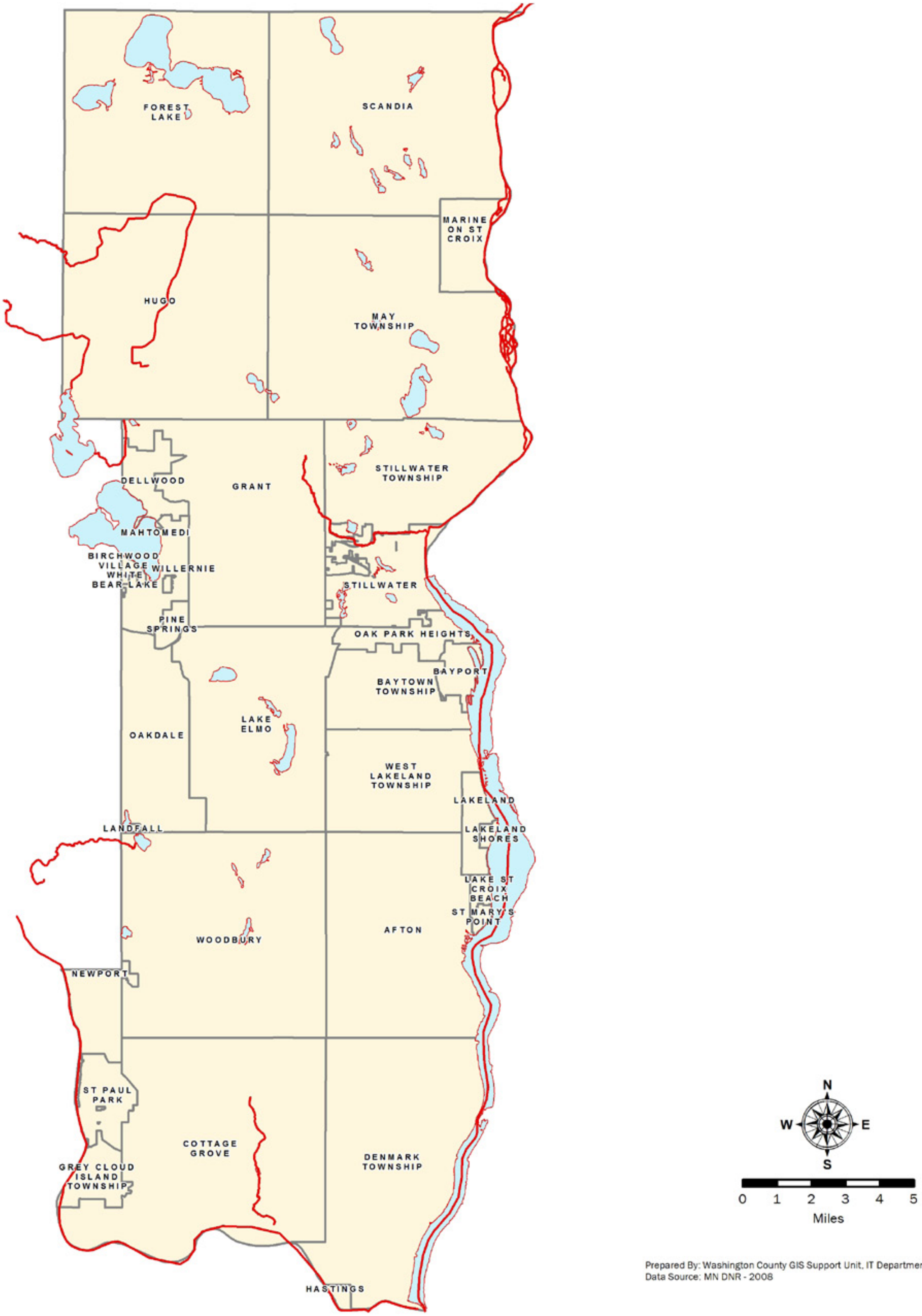


# Figure 4 · Water Table Sensitivity



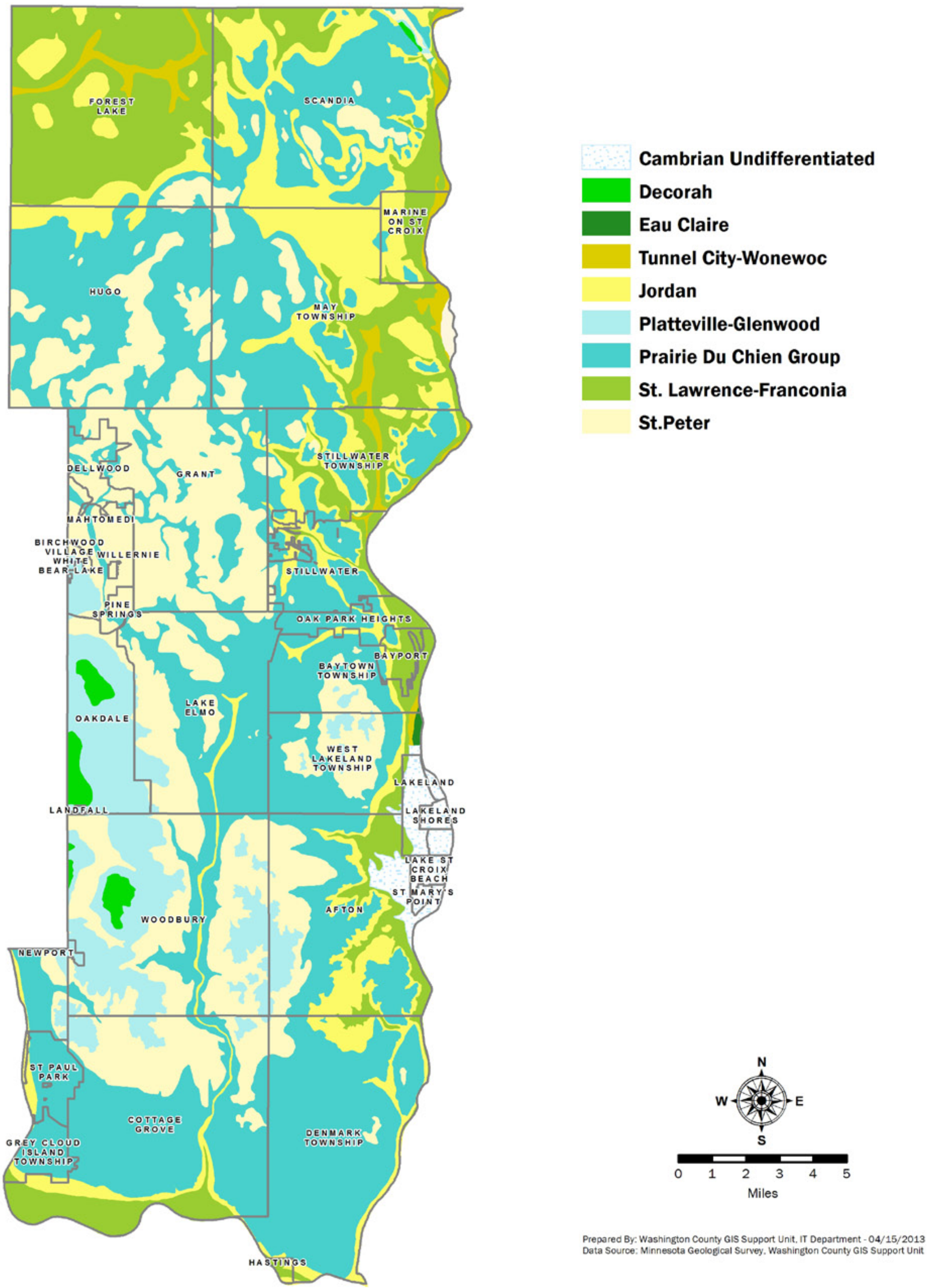

Prepared By: Washington County GIS Support Unit, IT Department - 04/15/2013
Data Source: Washington County Department of Public Health, EOR - 1999

# Figure 5 · Impaired Waterbodies

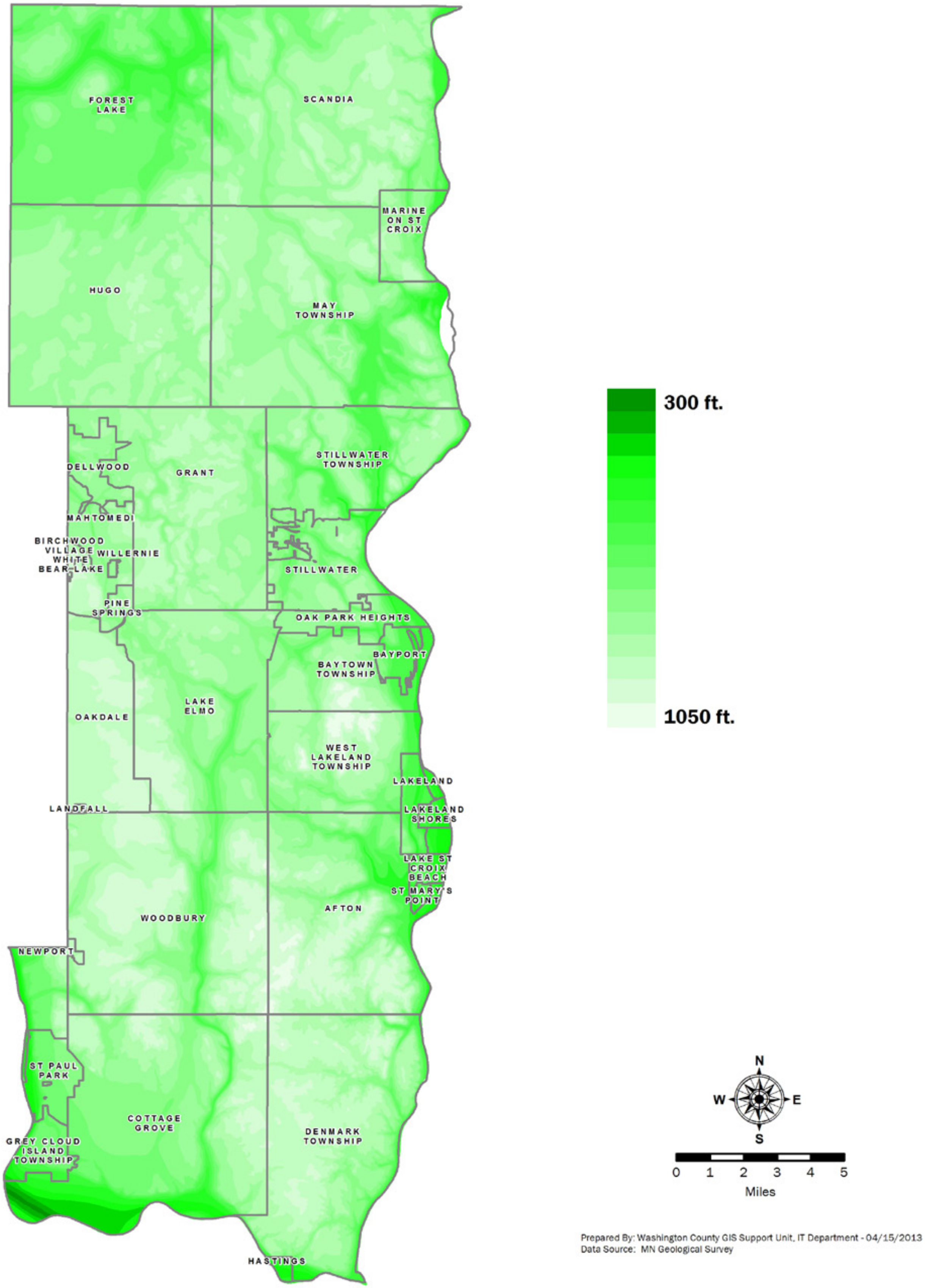



Prepared By: Washington County GIS Support Unit, IT Department - 04/15/2013
Data Source: MN DNR - 2008

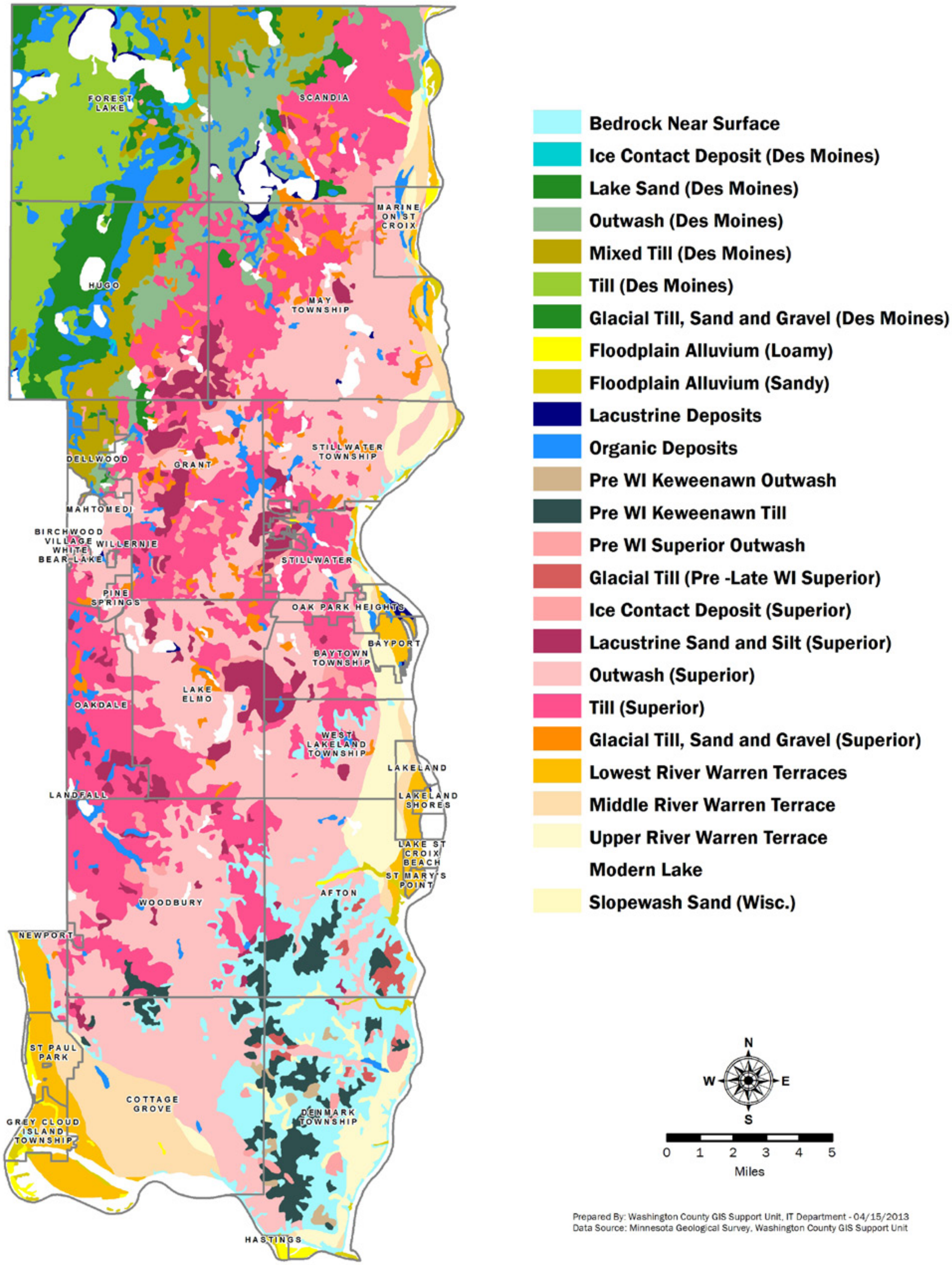
# Figure 6 · Bedrock Geology



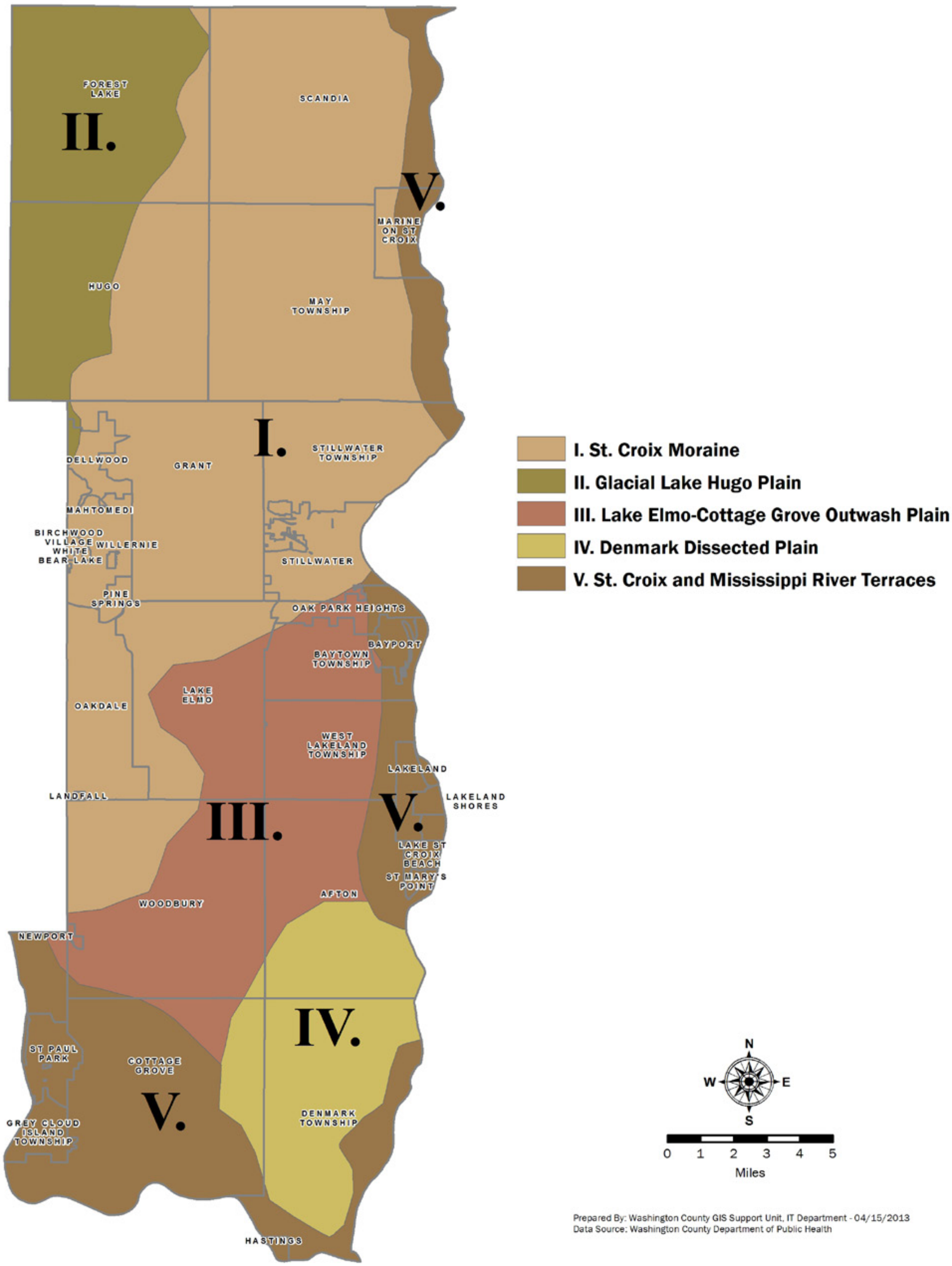
# Figure 7 · Bedrock Topography



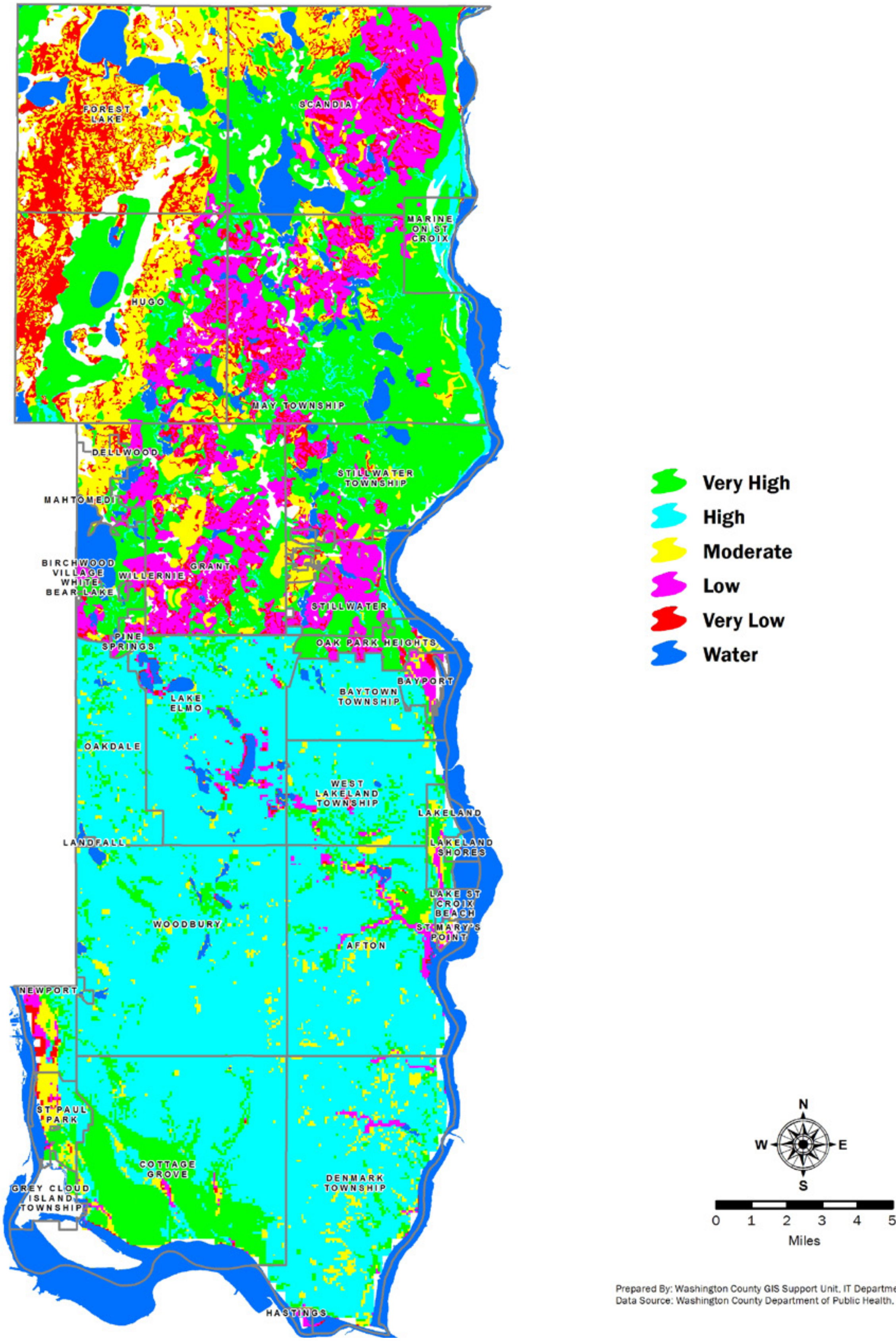
# Figure 8· Quaternary (Surface) Geology



# Figure 9· Geomorphic Regions

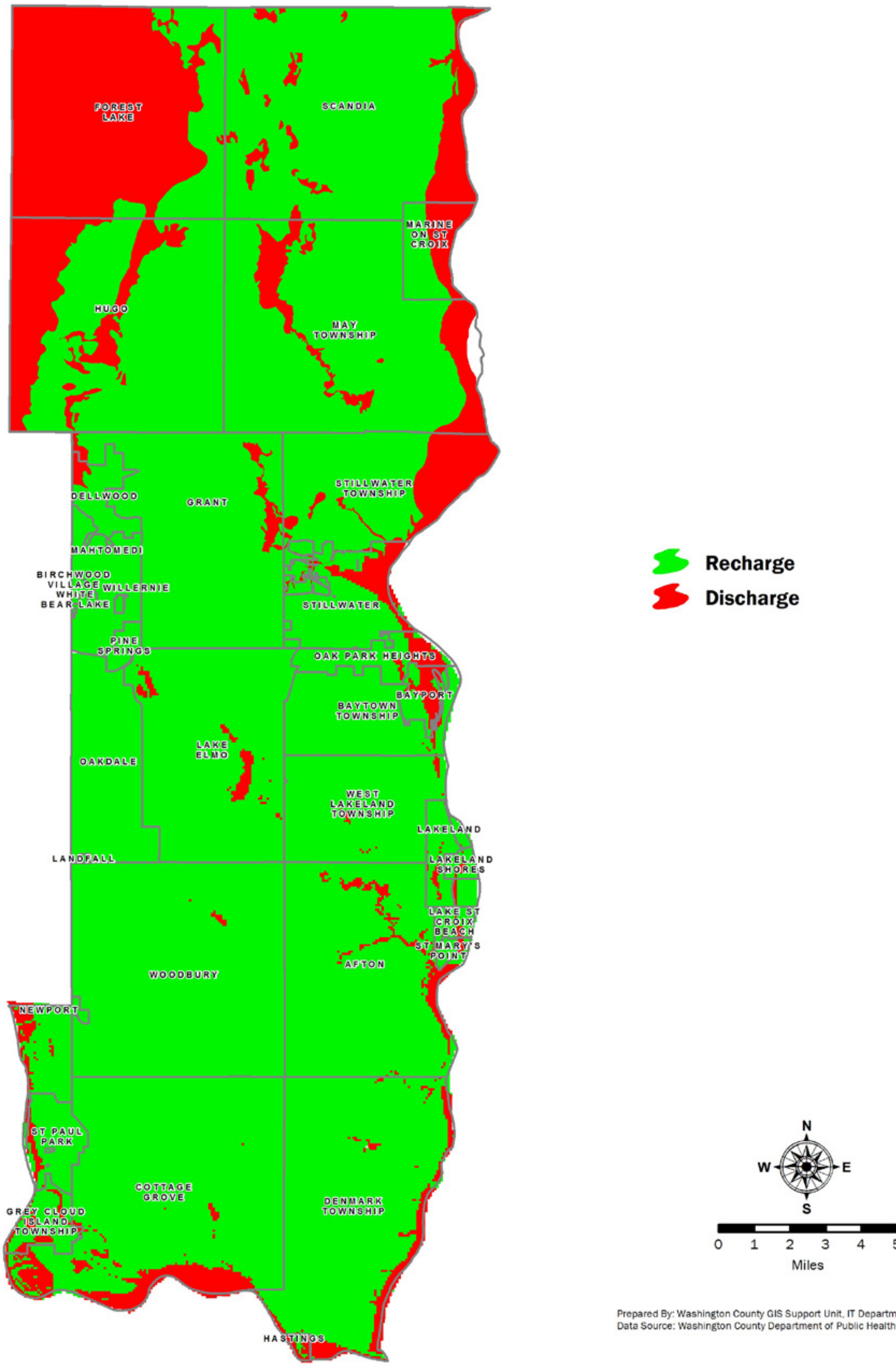


# Figure 10 · Infiltration Potential



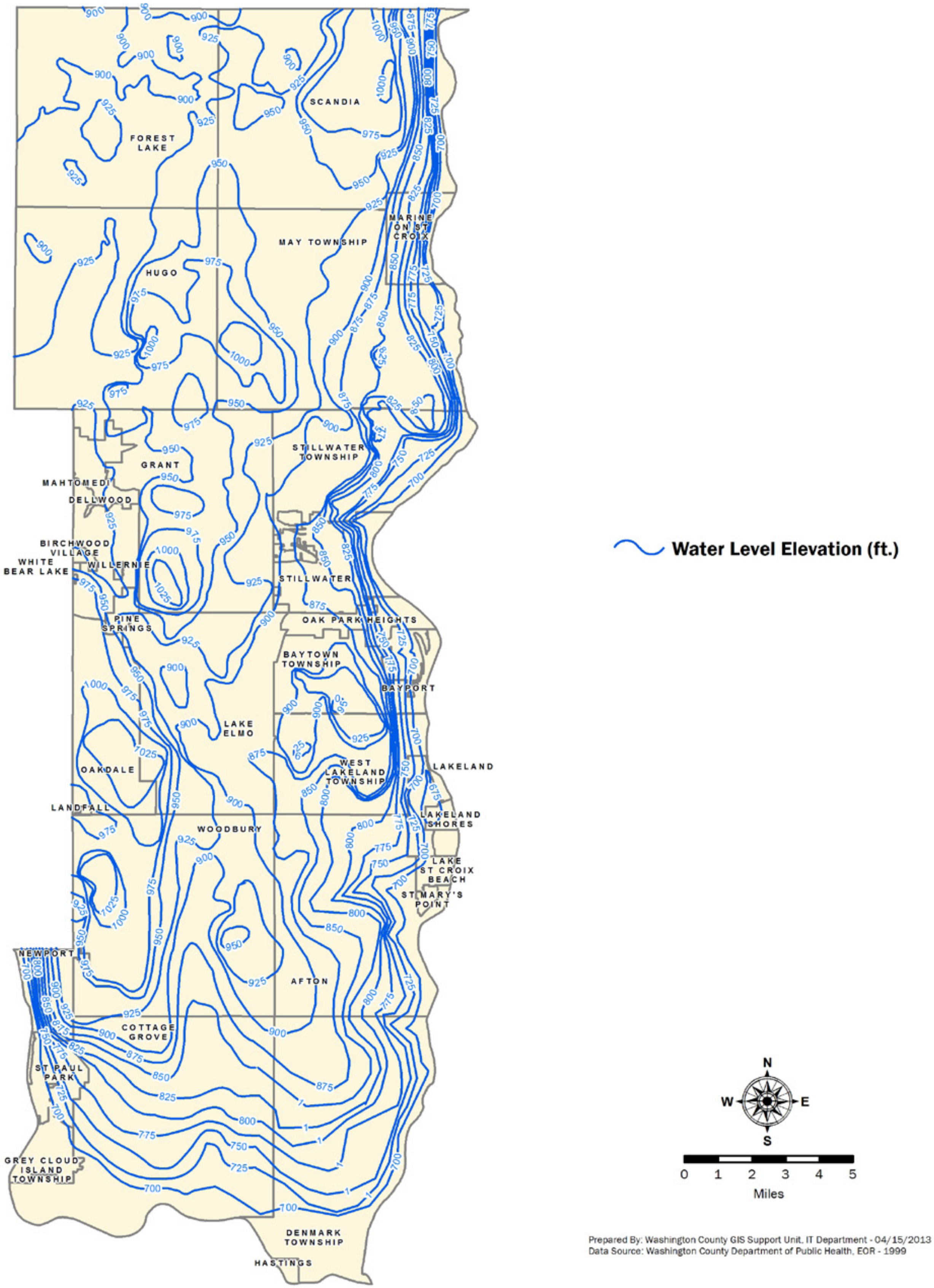

Prepared By: Washington County GIS Support Unit, IT Department - 04/15/2013
Data Source: Washington County Department of Public Health, EOR, BARR

# Figure 11 · Recharge/Discharge Areas



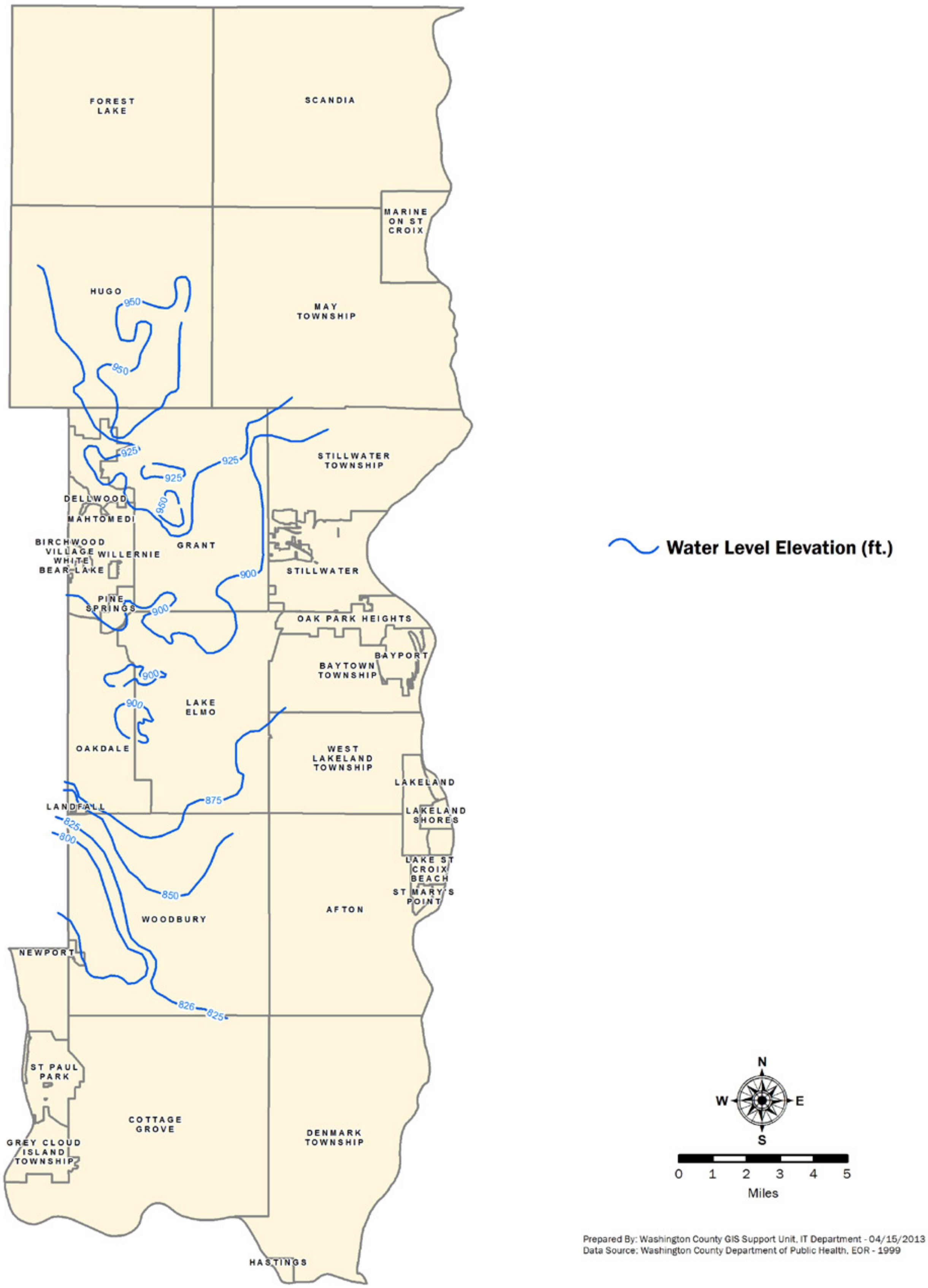

Prepared By: Washington County GIS Support Unit, IT Department - 04/15/2013
Data Source: Washington County Department of Public Health, EOR, BARR

# Figure 12 · Groundwater Flow Water Table Aquifer

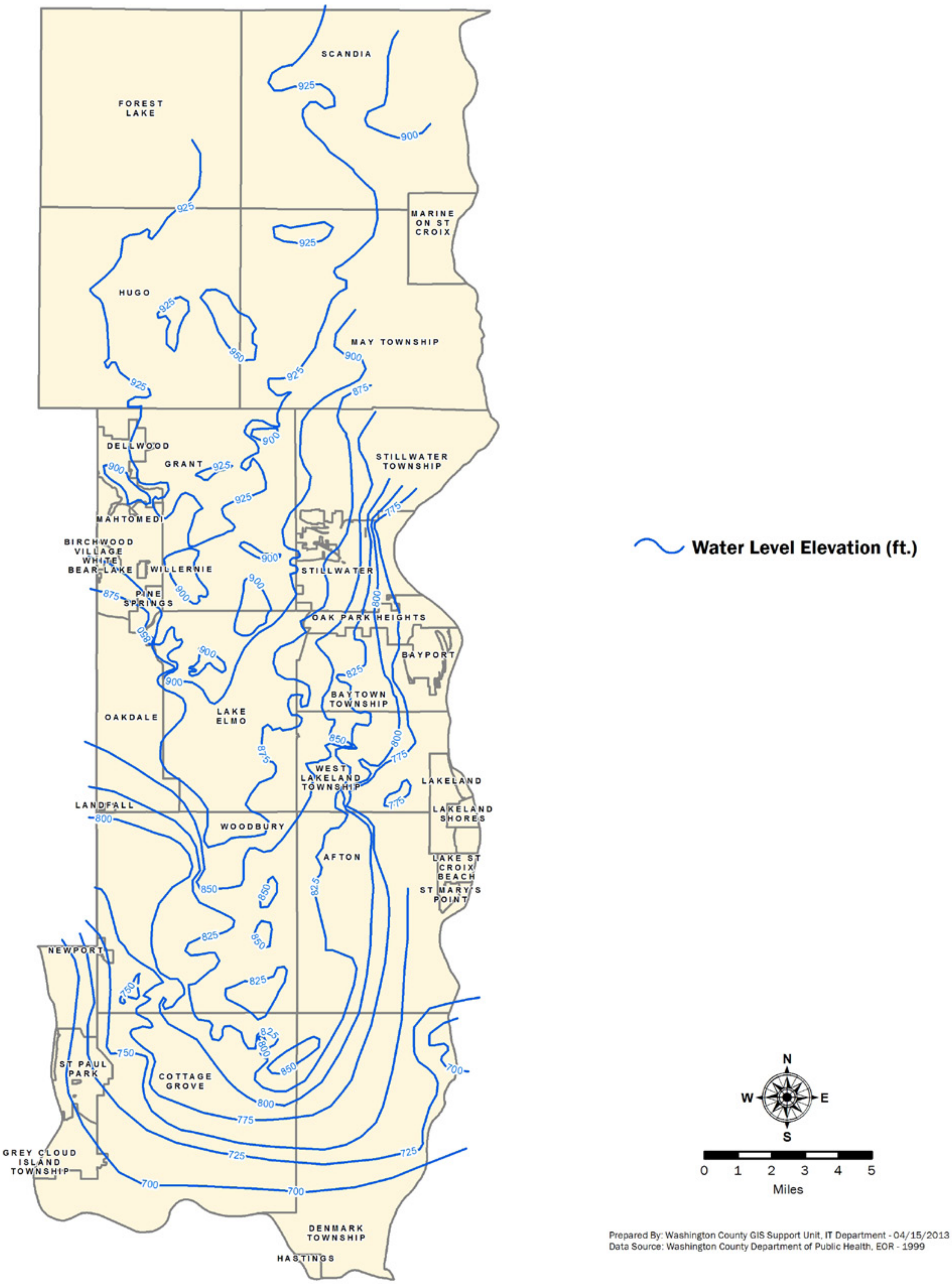



Prepared By: Washington County GIS Support Unit, IT Department - 04/15/2013
Data Source: Washington County Department of Public Health, EOR - 1999

# Figure 13 · Groundwater Flow St. Peter Aquifer

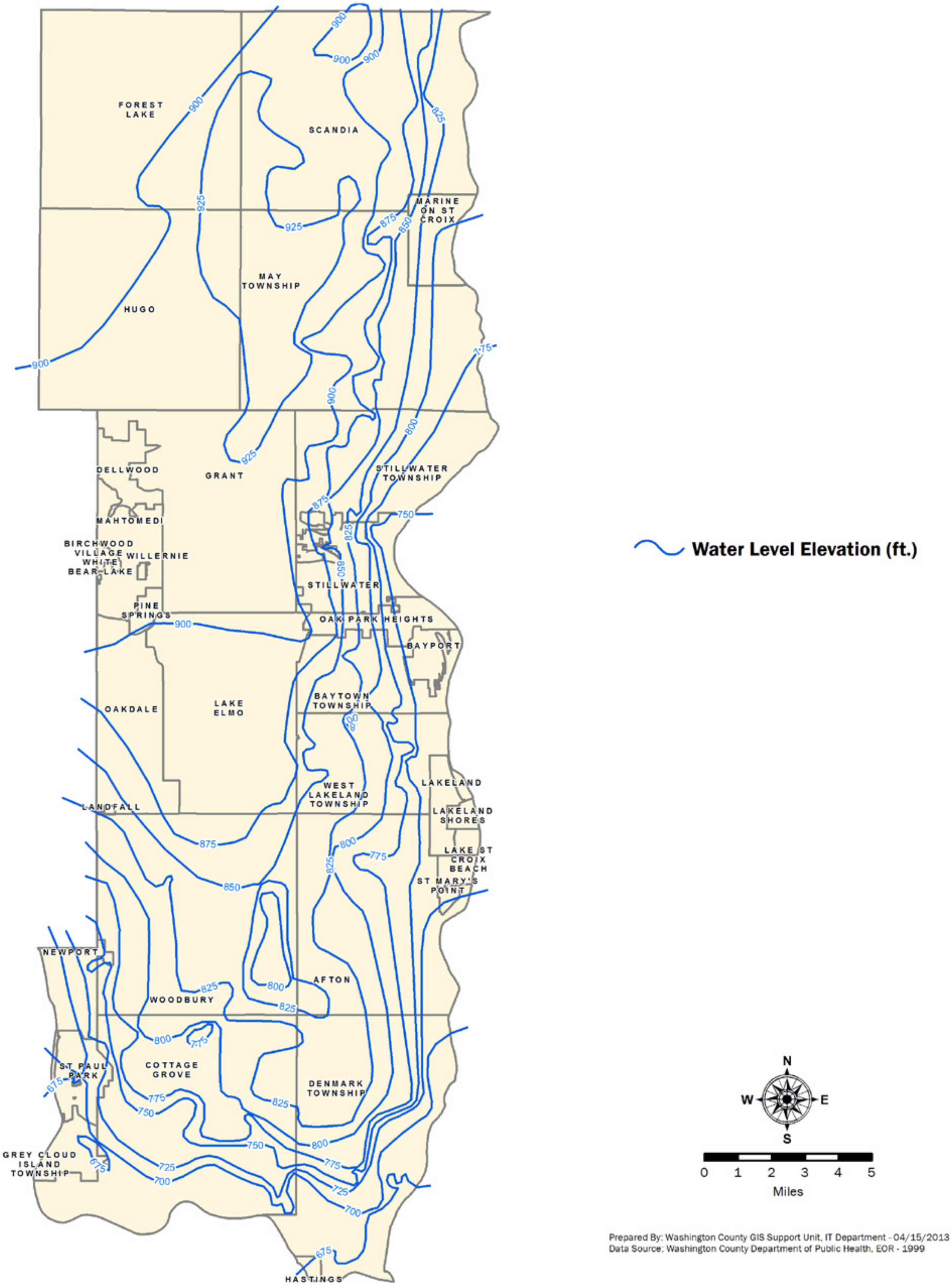


# Figure 14 · Groundwater Flow Prairie du Chien Aquifer

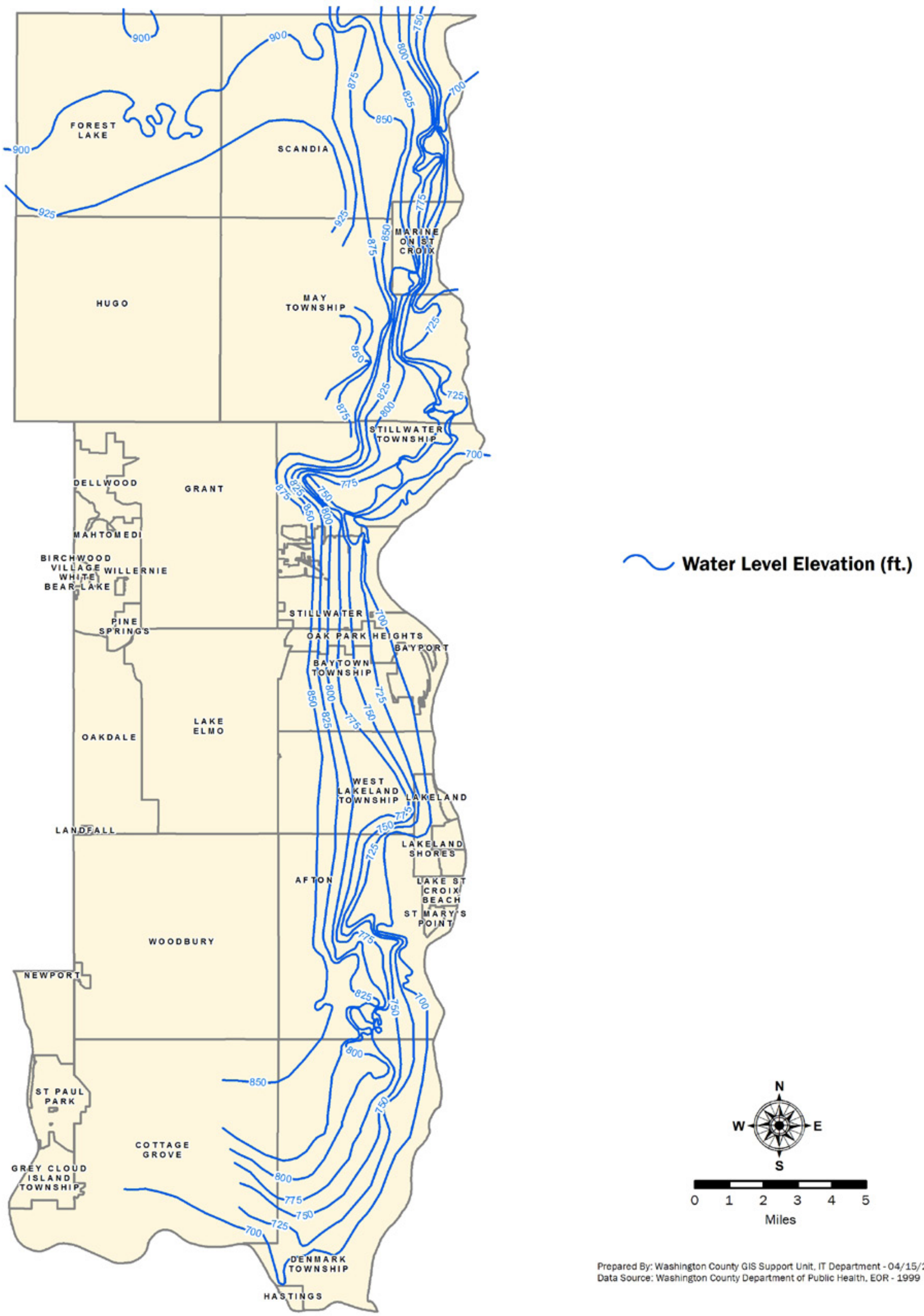



Prepared By: Washington County GIS Support Unit, IT Department - 04/15/2013
Data Source: Washington County Department of Public Health, EOR - 1999

# Figure 15 · Groundwater Flow Jordan Aquifer

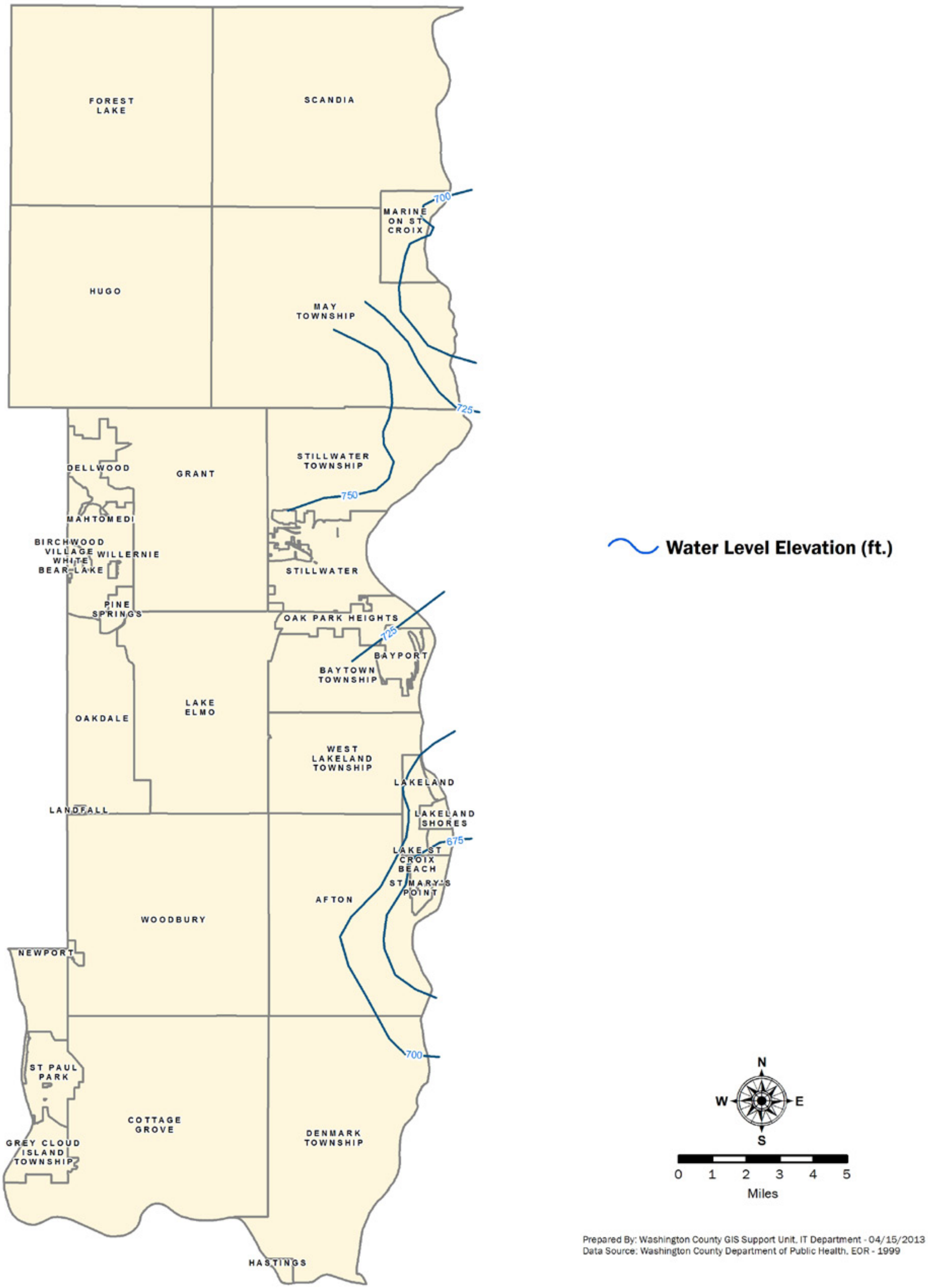


# Figure 16 · Groundwater Flow Tunnel City Group Aquifer

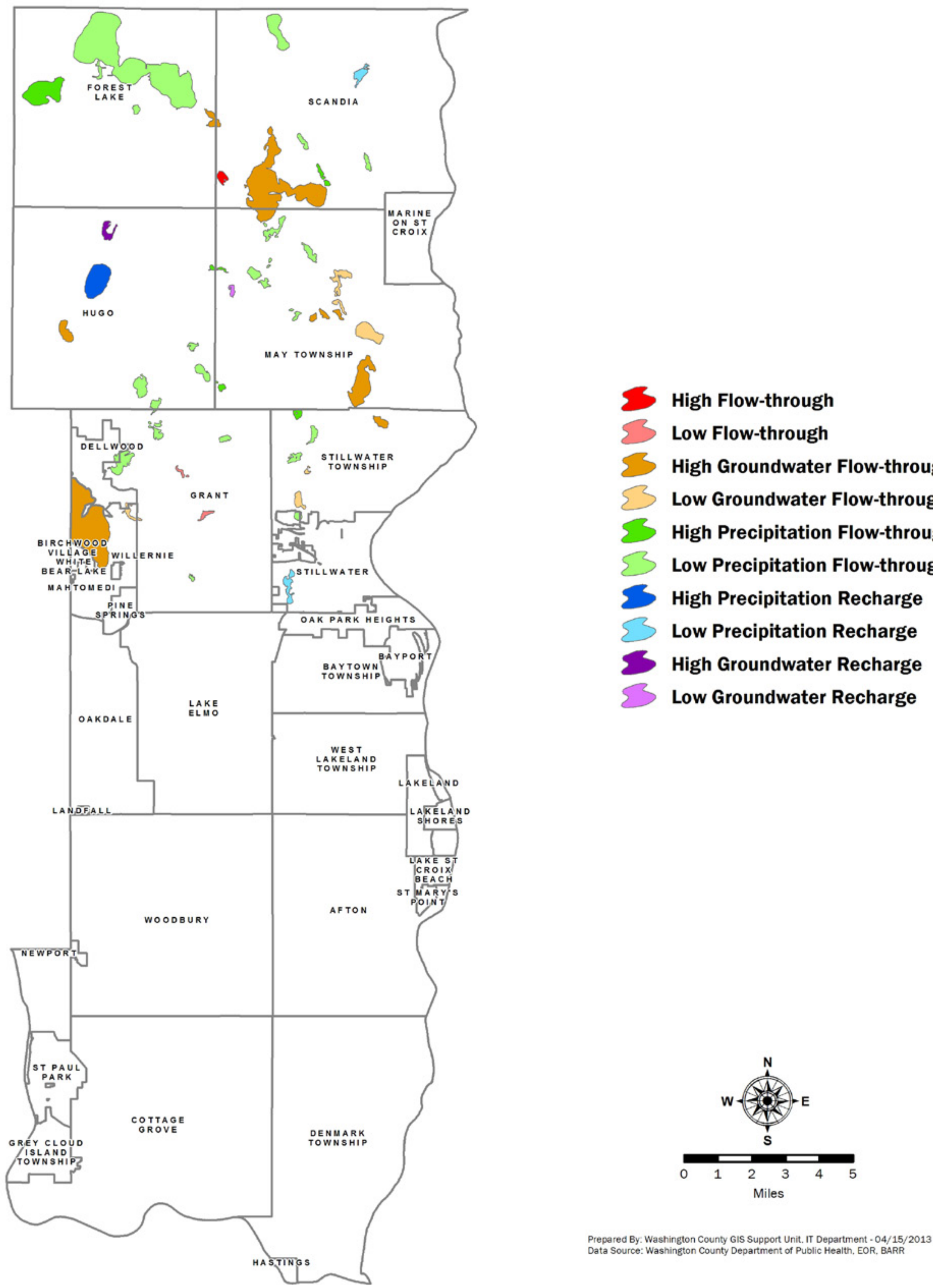



Prepared By: Washington County GIS Support Unit, IT Department - 04/15/2013
Data Source: Washington County Department of Public Health, EOR - 1999

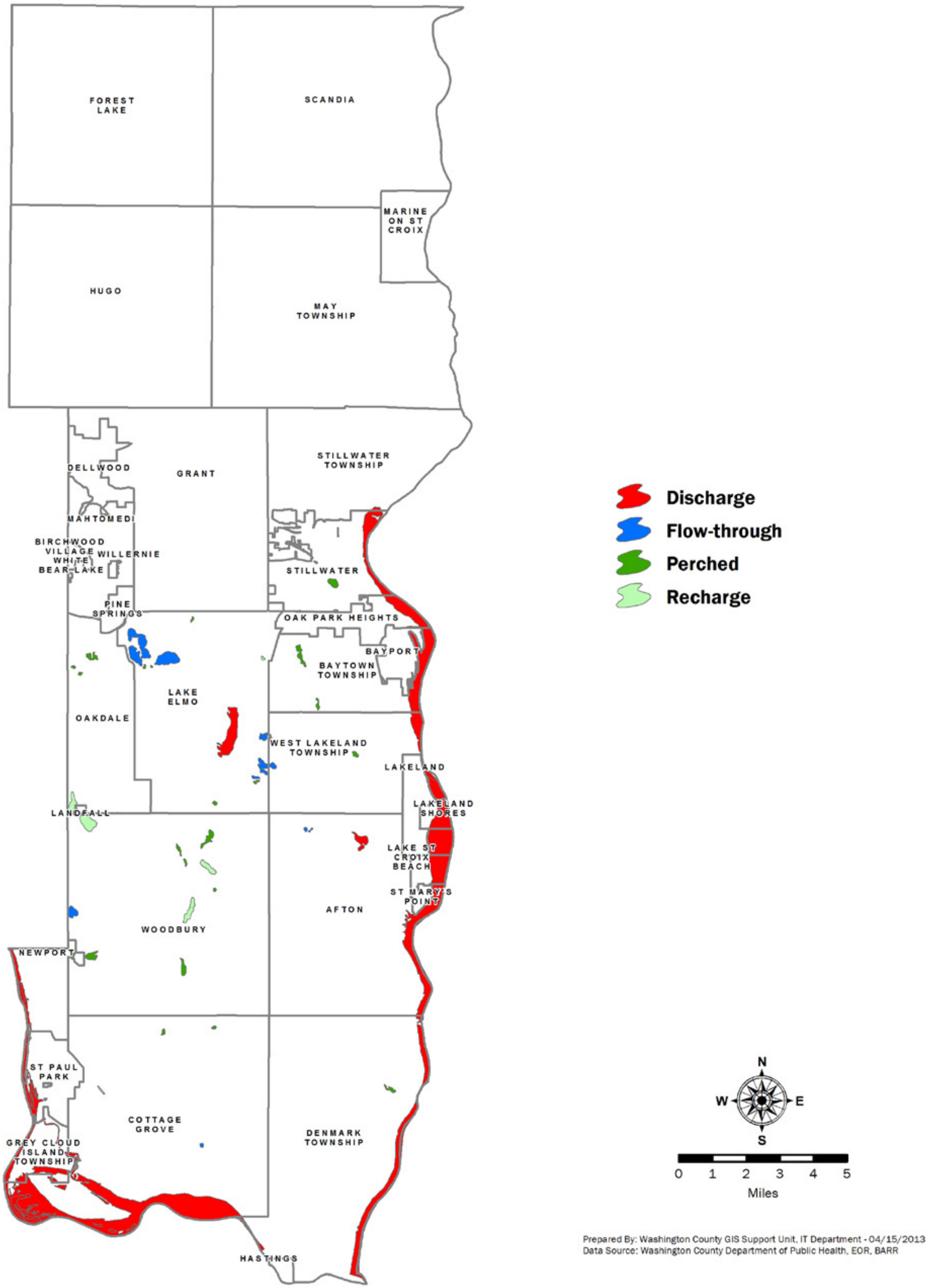
## Figure 17 · Groundwater Flow Wonewoc Sandstone Aquifer



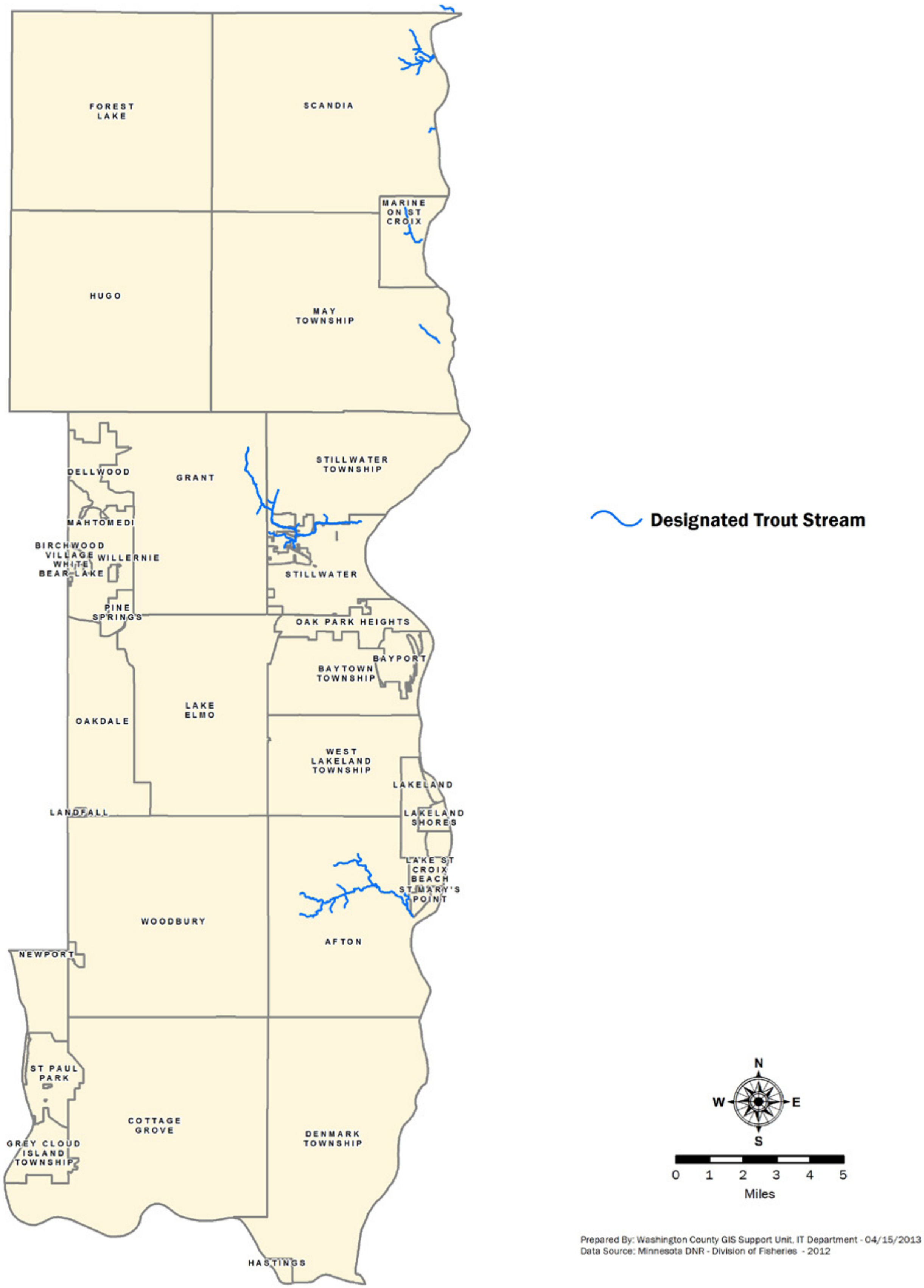
# Figure 18 · Lake Classification - Northern Washington County



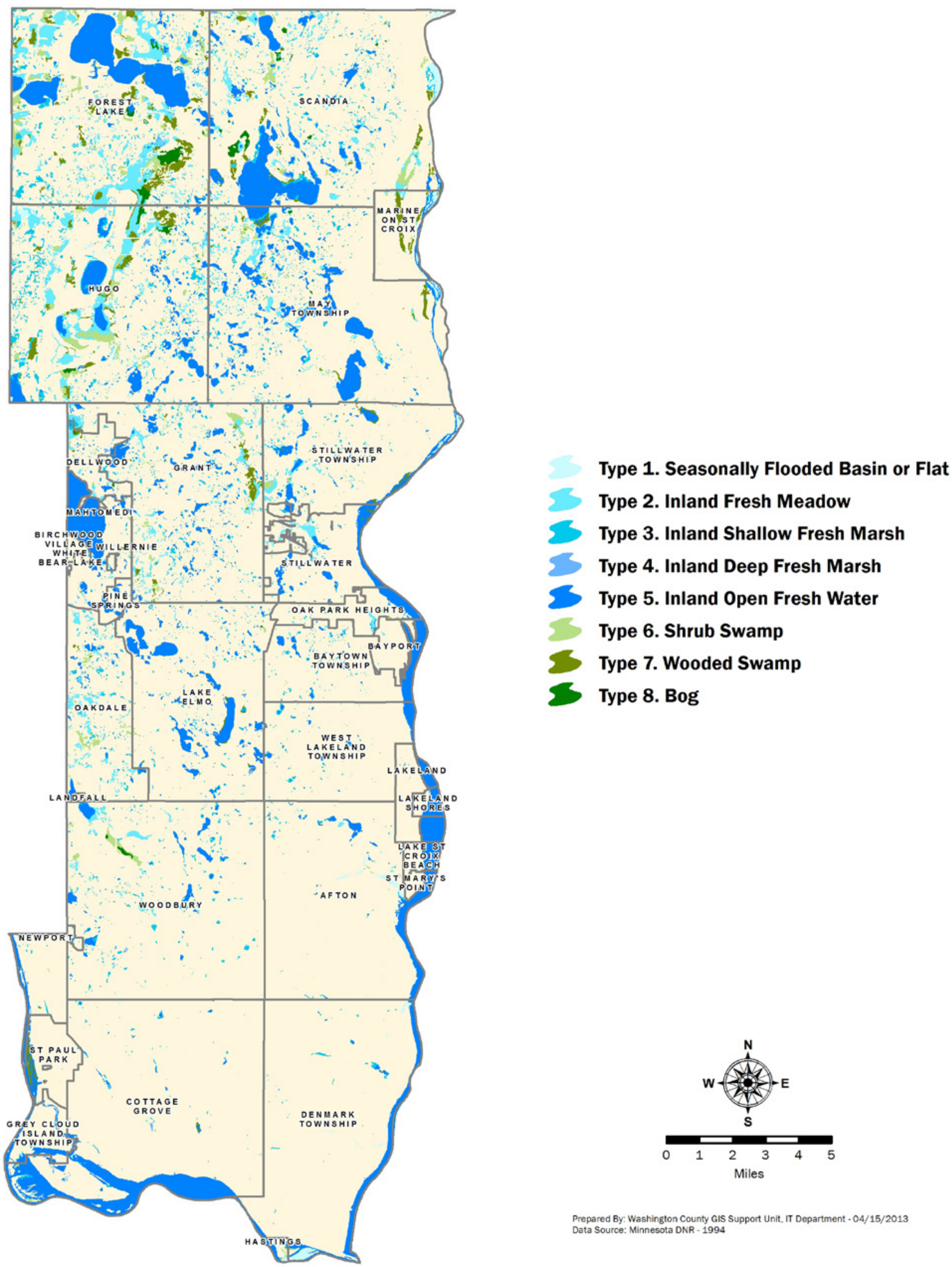
# Figure 19 · Lake Classification - Southern Washington County



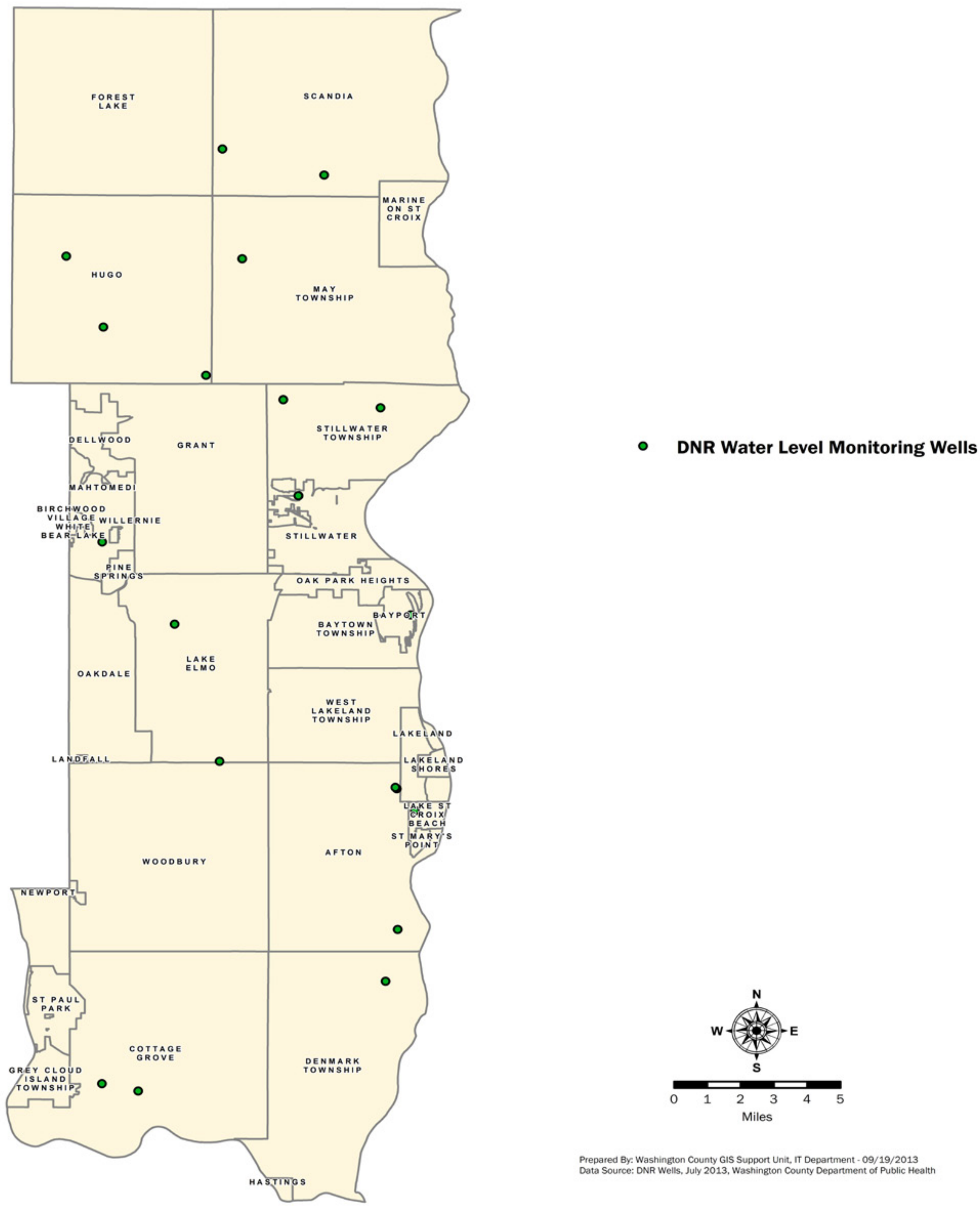
# Figure 20 · Designated Trout Streams



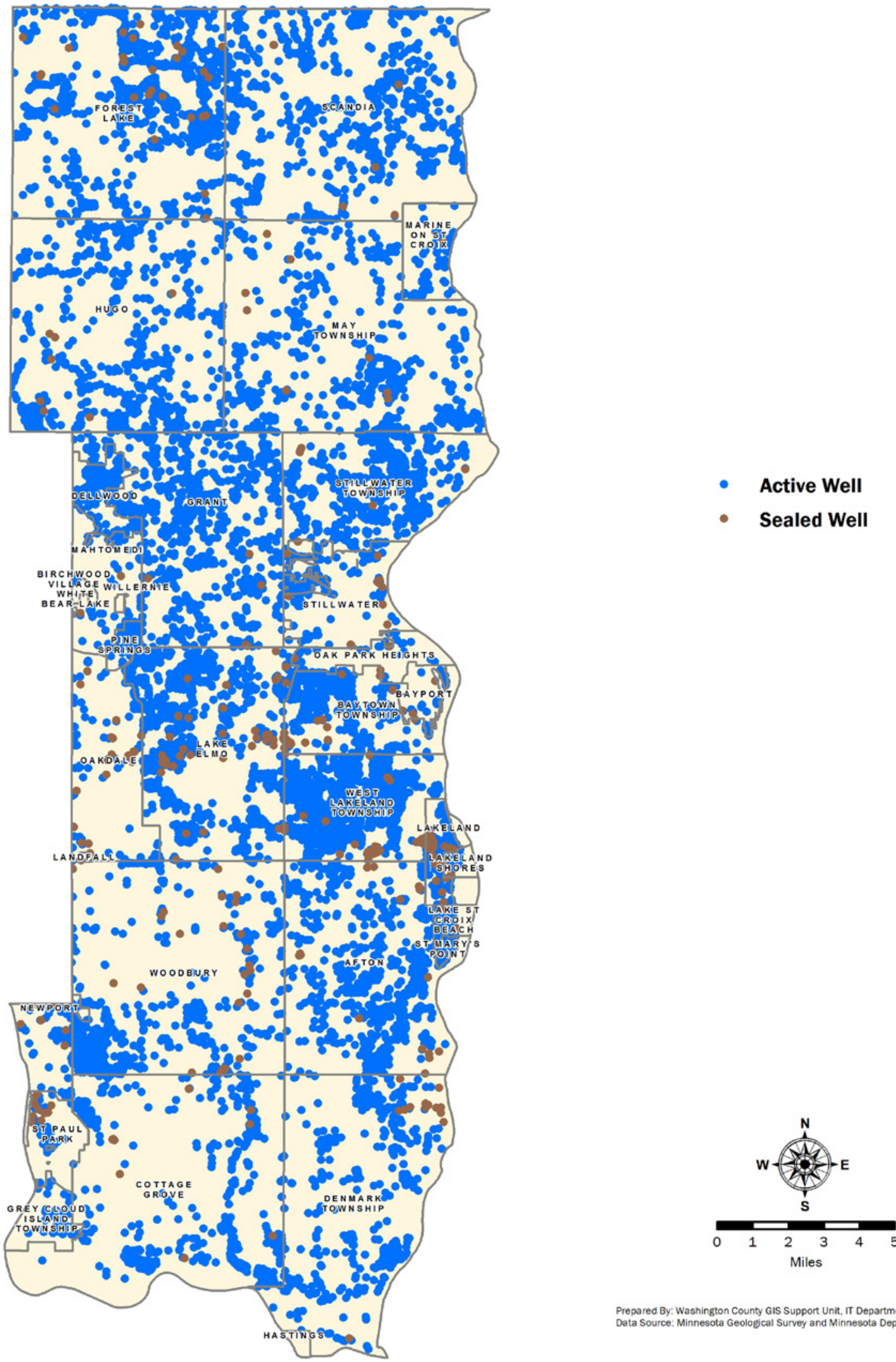
# Figure 21 · National Wetlands Inventory (NWI)



# Figure 22 · DNR Water Level Monitoring Wells

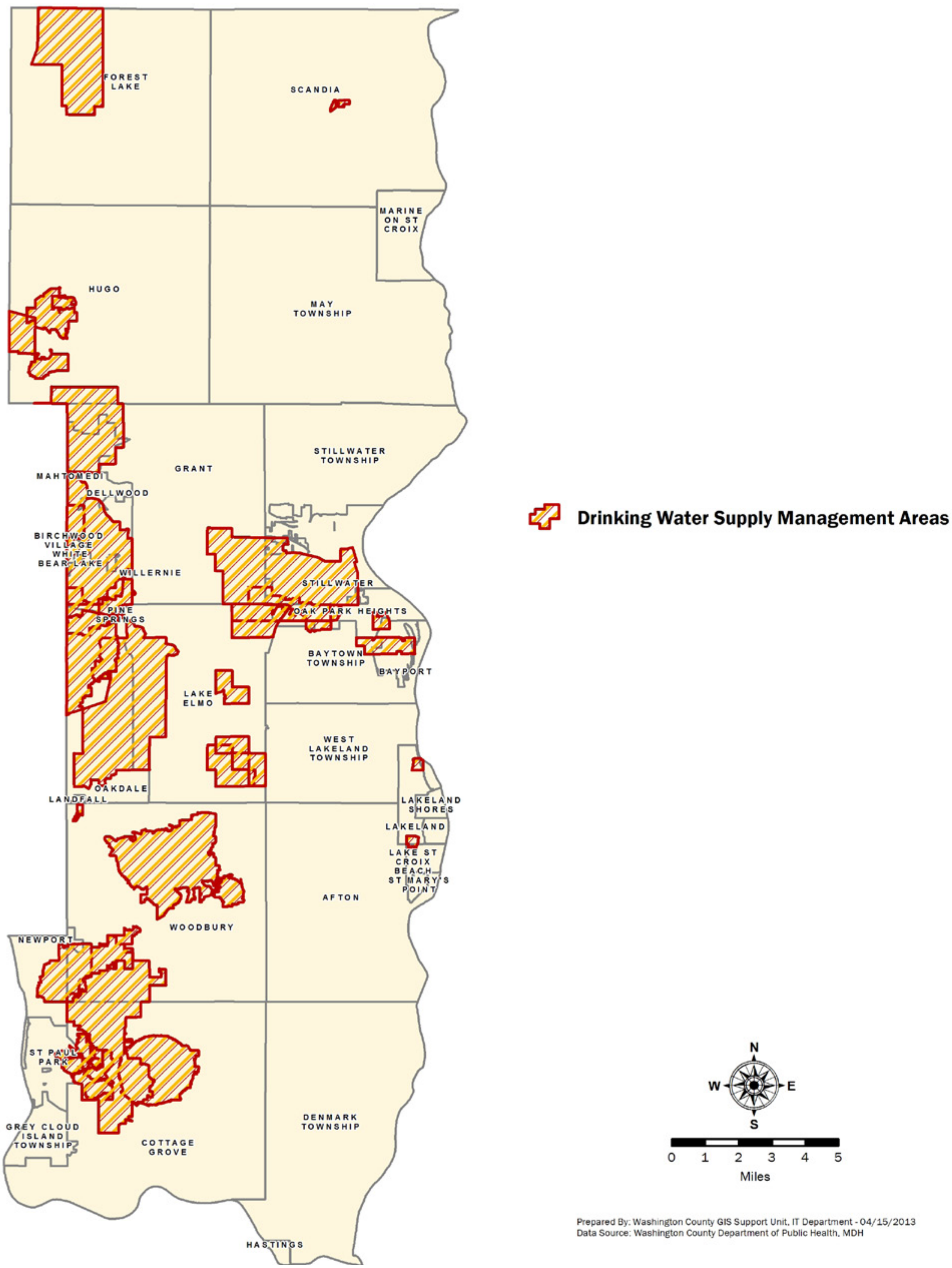


# Figure 23 · County Well Index - Private Well Locations

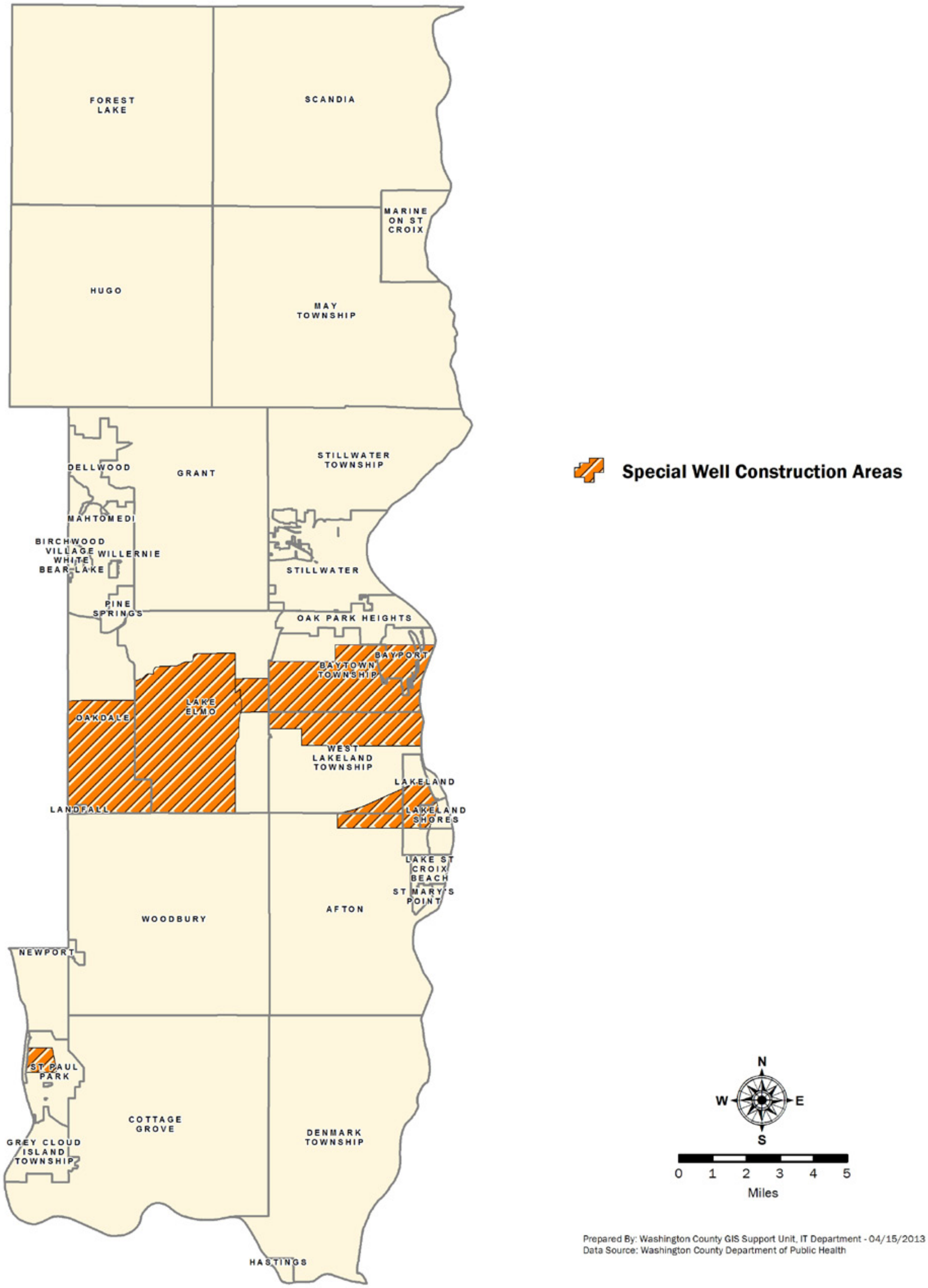



Prepared By: Washington County GIS Support Unit, IT Department - 04/15/2013
Data Source: Minnesota Geological Survey and Minnesota Department of Health

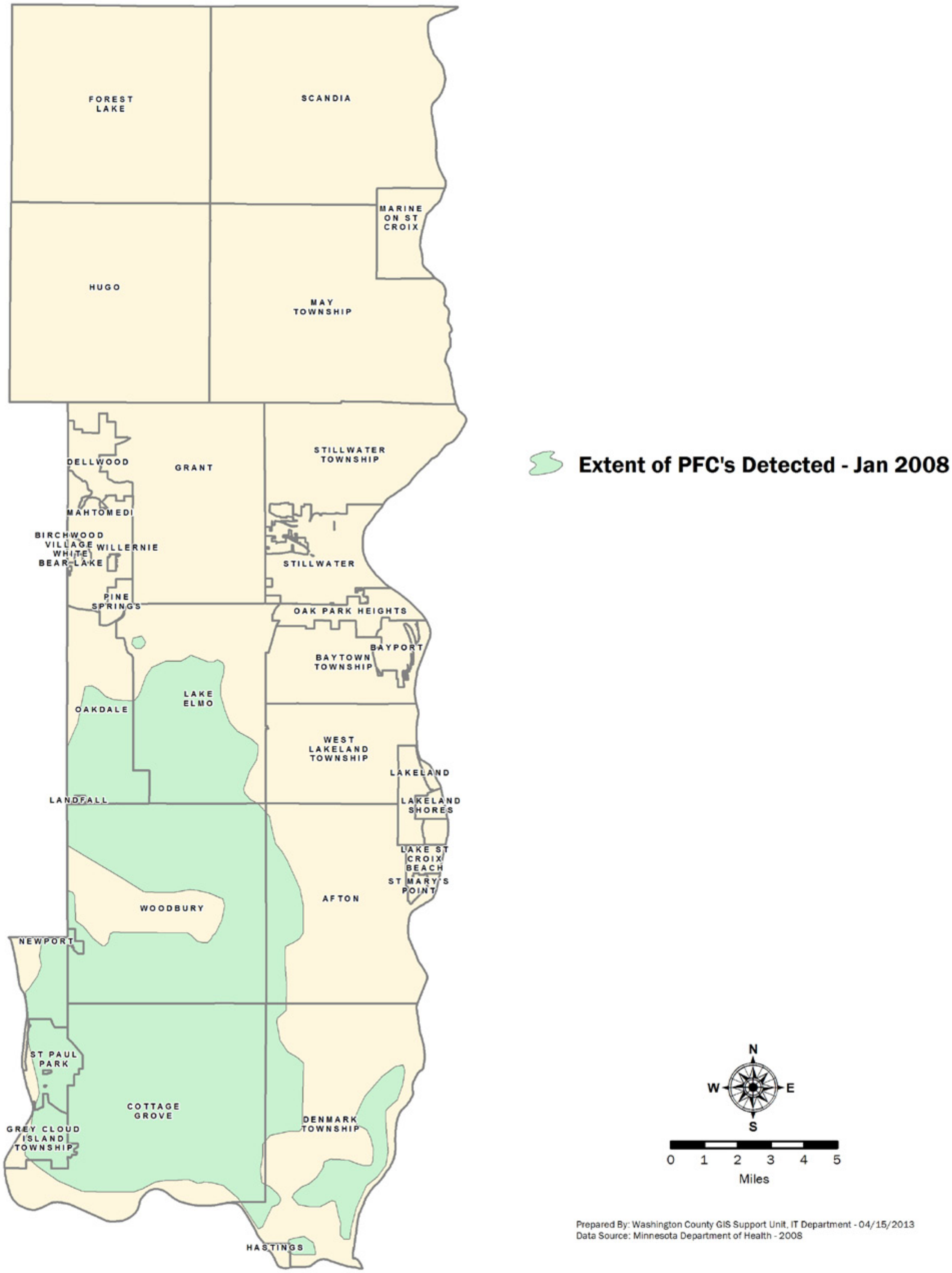
# Figure 24 · Drinking Water Supply Management Areas (DWSMAs)



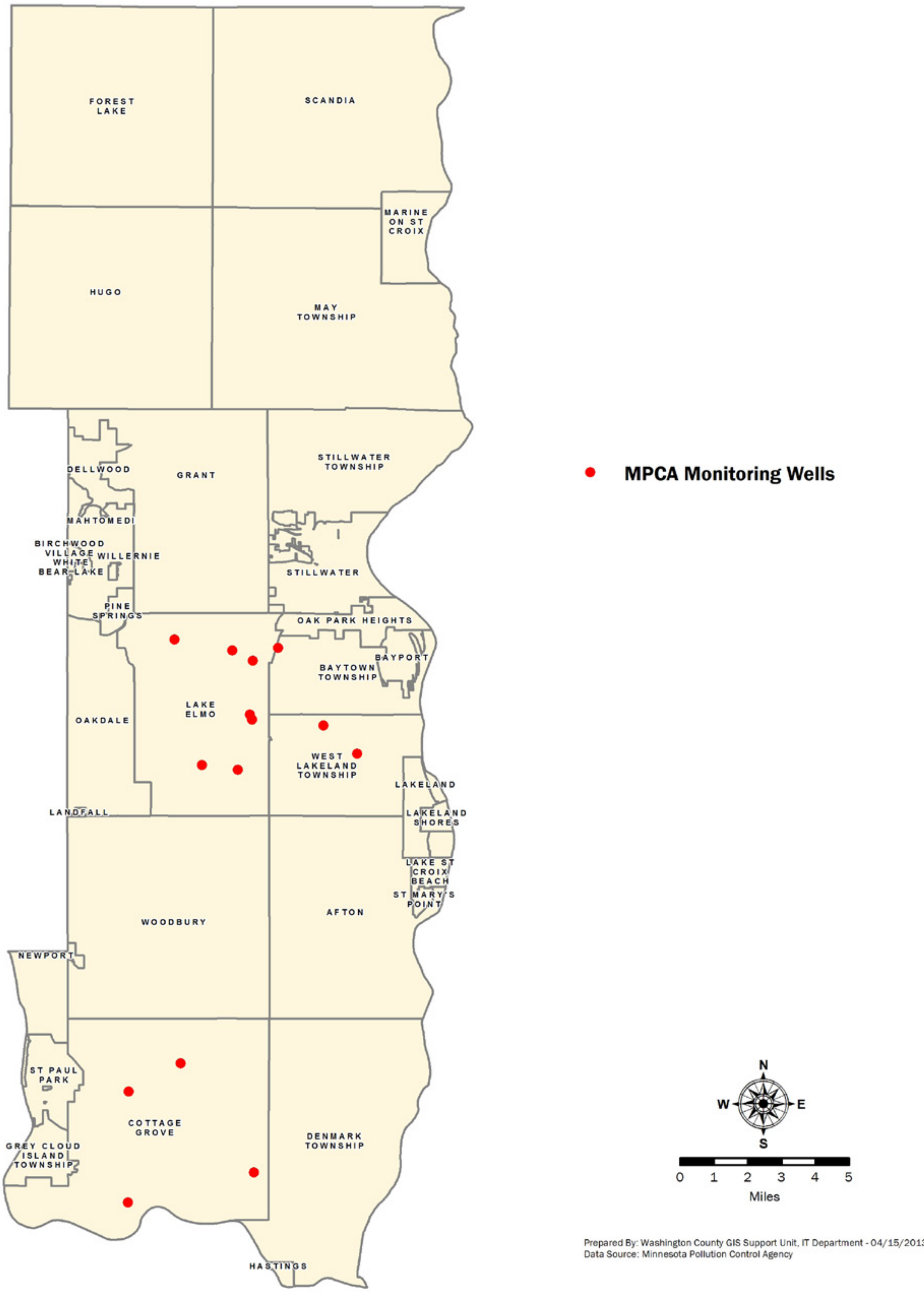
## Figure 25 · Special Well Construction Areas



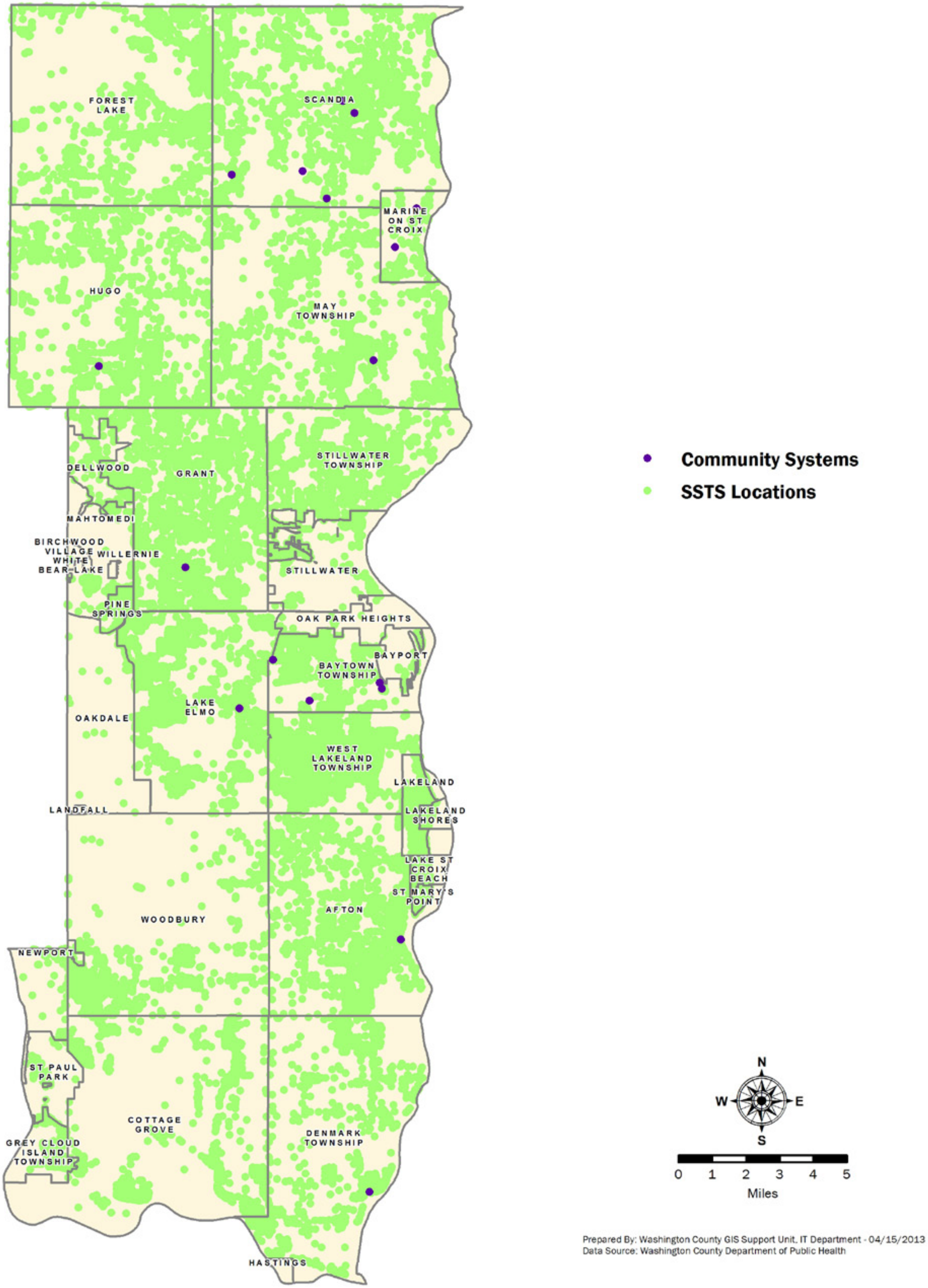
# Figure 26 · Perfluorochemical (PFC) Plume



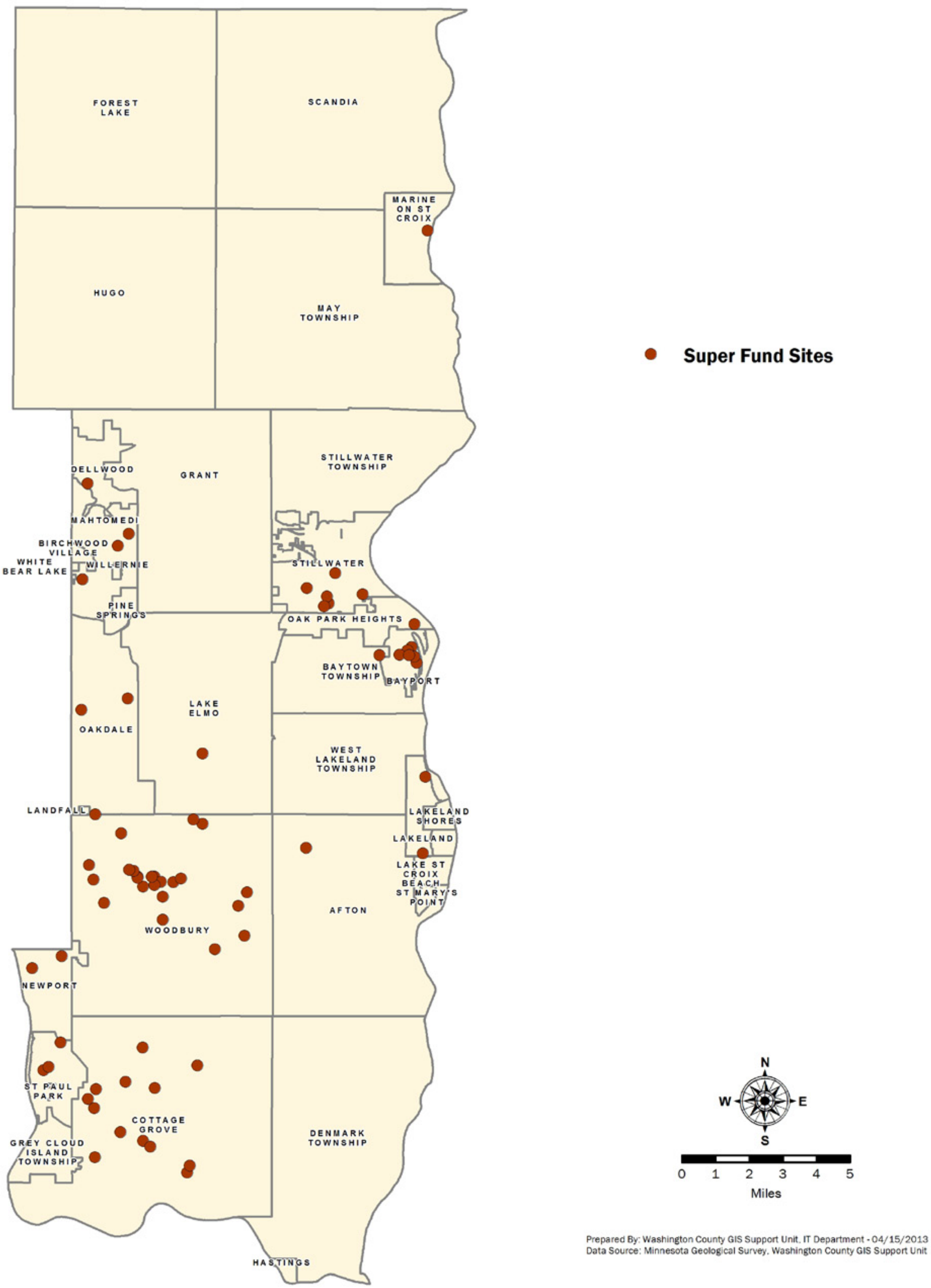
# Figure 27 · MPCA Monitoring Wells



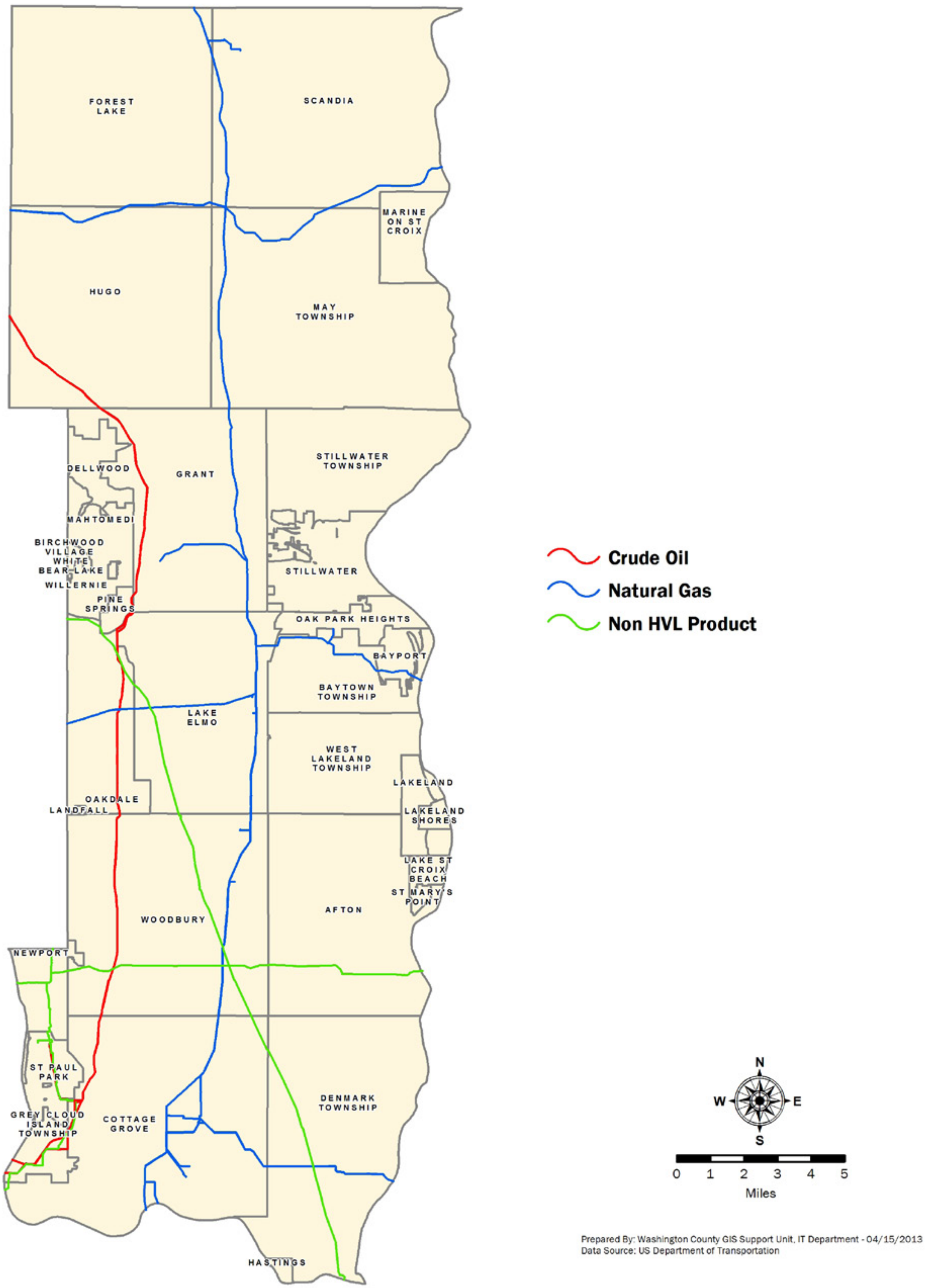
# Figure 28 · SSTS Locations



## Figure 29 · Superfund Sites



# Figure 30 · Pipelines



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# 15. APPENDICES

## APPENDIX A: GROUNDWATER PLAN MEASURES

| POPULATION ACCOUNTABILITY |
|---|
| Quality of Life Result: Clean and sustainable groundwater for all Washington County residents |
| Why is this important?<br><br>Groundwater is one of Washington County's most valuable natural resources. Safe drinking water, healthy lakes and streams, and economic vitality all depend on protecting and conserving this resource. Protecting groundwater resources is one of the most central roles of public health and a fundamental component to a safe and healthy society. |
| How are we doing?<br><br>*Quality*: The county has known areas of groundwater contamination including VOC contamination in eight communities and PFC contamination in four communities. Nitrate levels in the southern region of the county are also elevated. Combined with the threat of emerging contaminants, there is strong evidence that the quality of the county's groundwater is compromised which in turn reduces quantity.<br><br>*Quantity*: Recent history is starting to indicate that the previously held notion that there is an overabundance of groundwater supply is false. Increasingly, residents are being forced to lower their pumps, and for those surface water bodies connected to aquifers, levels are dropping. Both of these circumstances indicate a drop in aquifer levels.<br><br>At the residential level, the county currently monitors data on well water testing and well sealing activities. The rate of water testing has been relatively low due to limited resources available for marketing and education. Well-sealing rates have remained constant over the past few years and increased slightly in 2012 due to available funding. |
| What will it take to do better?<br><br>**Collaboration**: Effective collaboration with key state and local agencies is a cornerstone to the success of the Washington County Groundwater Program. Due to a lack of statutory authority, the county's primary role is to promote and facilitate collaboration around the prevention, treatment and monitoring of groundwater quality and quantity.<br><br>The partners who have a role to play in improving the quality and quantity of the county's groundwater include the following state and local agencies: Department of Natural Resources, Department of Health, Pollution Control Agency, Department of Agriculture, Metropolitan Council, Board of Water and Soil Resources, municipalities, watersheds, and residents. Many of these partners have sometimes conflicting priorities. Our role as the county is to bring them together on common issues and help them recognize their role and stake in the implementation of strategies that address groundwater issues.<br><br>**Education and Outreach:** Focused, coordinated education and outreach to the public about groundwater quality and quantity issues is a key element to groundwater protection.<br><br>**Initiatives:** Initiatives focused on instilling a sense of urgency among residents and LGUs around groundwater quality and quantity are critical to sustaining achievements in disease reduction and increased longevity that we frequently take for granted. |

| Groundwater Supply Performance Measures | | |
|---|---|---|
| | **Quantity** | **Quality** |
| **Effort** | How much did we do (#)?<br><br>**Customers**:<br># of local government units<br><br>**Activities**:<br># of water bodies identified and maintained in a groundwater information database<br># of # of local government units invited to attend annual forum | How well did we do it (%)?<br><br>% of water bodies in database with known surface water and groundwater interaction<br>% of local government representation at open forum |
| **Effect** | Is anyone better off (#)/(%)?<br><br>#/% of local government units that update ordinances to reflect best practices<br>$ per capita water use for municipal systems | |

**Headline Performance Measures & Data Development Agenda**

% of local government units that update ordinances to reflect best practices
$ per capita water use for municipal systems
% of water bodies in database with known surface water and groundwater interaction
% of local government representation at open forum

| Groundwater/Surface Water Interaction Performance Measures | | |
|---|---|---|
| | **Quantity** | **Quality** |
| **Effort** | How much did we do (#)?<br><br>**Customers:**<br># of local government units<br># watershed management organizations<br><br>**Activities**:<br># of recharge areas identified, inventoried and ranked<br># of best management practice guidelines developed | How well did we do it (%)?<br><br>% of county with recharge areas identified<br>% of watershed management organizations and local government units that incorporate protection of recharge into plan updates |
| **Effect** | Is anyone better off (#)/(%)?<br><br>#/% of regional recharge areas established<br>#/% of watershed management organizations and local government units that implement best management practices and low-impact development and redevelopment strategies | |

**Headline Performance Measures & Data Development Agenda**

% of regional recharge areas established
% of watershed management organizations and local government units that implement best management practices and low-impact development and redevelopment strategies
% of county with recharge areas identified

<table>
<tr><th colspan="3">Source Water & Well Head Protection Performance Measures</th></tr>
<tr><th></th><th>Quantity</th><th>Quality</th></tr>
<tr><td>Effort</td><td><u>How much did we do (#)?</u><br><br>Customers:<br># of local government units<br># of public water suppliers<br># of homeowners with private wells<br><br>Activities:<br># of abandoned wells identified<br># of outside funding opportunities identified for abandoned well sealing<br># of local government units invited to attend annual forum</td><td><u>How well did we do it (%)?</u><br><br>% of wells identified in high priority areas<br>% of funds available for abandoned well sealing<br>% of local government unit representation at forum</td></tr>
<tr><td>Effect</td><td colspan="2"><u>Is anyone better off (#)/(%)?</u><br><br>#/% of total abandoned wells sealed<br>#/% of abandoned wells sealed in high priority areas<br>#/% of Wellhead Protection Plans undated to reflect collaborative strategies on water supply issues</td></tr>
</table>

<table>
<tr><td><u>Headline Performance Measures</u><br><br>% of total abandoned wells sealed<br>% of abandoned wells sealed in high priority areas</td></tr>
<tr><td><u>Secondary Measures</u><br><br># of abandoned wells identified<br># of total abandoned wells sealed<br># of abandoned wells sealed in high priority areas</td></tr>
<tr><td><u>Data Development Agenda</u><br><br>% of Wellhead Protection Plans undated to reflect collaborative strategies on water supply issues</td></tr>
</table>

| Groundwater Contamination Performance Measures<br>*Existing VOC and PFC Contamination* | | |
|---|---|---|
| | **Quantity** | **Quality** |
| **Effort** | How much did we do (#)?<br><br>**Customers**:<br># of local government units<br># of public water suppliers<br># of residents<br><br>**Activities**:<br>*Existing VOC and PFC Contamination*<br># of homeowners identified<br># of homeowners contacted | How well did we do it (%)?<br><br>*Existing VOC and PFC Contamination*<br>% of homeowners contacted that test water supply |
| **Effect** | Is anyone better off (#)/(%)?<br><br>#/% of customers implementing best management practices in areas of known contamination | |

| **Headline Performance Measures & Data Development Agenda** |
|---|
| % of customers implementing best management practices in areas of known contamination |
| **Secondary Measures** |
| % of homeowners that test water supply |

| Groundwater Contamination Performance Measures<br>*Nutrients - General* | | |
|---|---|---|
| | **Quantity** | **Quality** |
| **Effort** | How much did we do (#)?<br><br>**Customers**:<br># of local government units<br># of public water suppliers<br># of residents<br><br>**Activities**:<br>*Nutrients – General*<br># of studies conducted in high-risk communities<br># of well testing data mapped<br># of long-term monitoring stations for nitrates and pesticides identified | How well did we do it (%)?<br><br>*Nutrients – General*<br>% of studies completed for high-risk communities<br>% of county that is mapped<br>% of samples collected<br>% of long-term stations for nitrates and pesticides monitored |
| **Effect** | Is anyone better off (#)/(%)?<br><br>#/% of customers implementing best management practices in areas of known contamination | |

| **Headline Performance Measures & Data Development Agenda** |
|---|
| % of customers implementing best management practices in areas of known contamination |
| **Secondary Measures** |
| # of studies conducted in high-risk communities<br># of long-term monitoring stations for nitrates and pesticides identified |

| Groundwater Contamination Performance Measures<br>*Nutrients - Urban* | | |
|---|---|---|
| | **Quantity** | **Quality** |
| **Effort** | How much did we do (#)?<br><br>**Customers**:<br># of public water suppliers<br># of businesses<br># of residents<br><br>**Activities**:<br>*Nutrients – Urban*<br># of highly sensitive areas identified | How well did we do it (%)?<br><br>*Nutrients – Urban*<br>% of highly sensitive areas that receive outreach and education |
| **Effect** | Is anyone better off (#)/(%)?<br><br>#/% of customers that adopt or implement best management practices | |

## Headline Performance Measures & Data Development Agenda

% of customers that adopt or implement new practices

<table>
<tr><th colspan="3">Groundwater Contamination Performance Measures<br>Nutrients - Agricultural</th></tr>
<tr><td></td><td>Quantity</td><td>Quality</td></tr>
<tr><td>Effort</td><td><u>How much did we do (#)?</u><br><br>Customers:<br># of animal holding facilities<br># of crop farmers<br><br>Activities:<br>Nutrients - Agriculture General/Animal Waste/Non-Animal Waste<br># of customers identified</td><td><u>How well did we do it (%)?</u><br><br>Nutrients – Urban/Agriculture General/Animal Waste/Non-Animal Waste<br>% of customers that receive outreach education</td></tr>
<tr><td>Effect</td><td colspan="2"><u>Is anyone better off (#)/(%)?</u><br><br>#/% of customers that adopt or implement best management practices</td></tr>
</table>

## Headline Performance Measures & Data Development Agenda

% of customers that adopt or implement new practices

| Groundwater Contamination Performance Measures<br>*Emerging Contaminants* | | |
|---|---|---|
| | **Quantity** | **Quality** |
| **Effort** | How much did we do (#)?<br><br>**Customers**:<br># of local government units<br># of public water suppliers<br># of residents<br><br>**Activities**:<br>*Emerging Contaminants*<br># of areas or wells identified | How well did we do it (%)?<br><br>*Emerging Contaminants*<br>% of areas or wells identified that are monitored<br>% of areas or wells with known contamination and risk levels |
| **Effect** | Is anyone better off (#)/(%)?<br><br>#/% of areas or wells with identified risk levels that implement best management practices<br>#/% of areas or wells with identified risk levels that implement remediation strategies | |

## Headline Performance Measures & Data Development Agenda

% of areas or wells with identified risk levels that implement best management practices
% of areas or wells with identified risk levels that implement remediation strategies

| Septic Systems Performance Measures | | |
|---|---|---|
| | **Quantity** | **Quality** |
| **Effort** | How much did we do (#)?<br><br>**Customers**:<br># of homeowners with a septic system<br># realtors and title companies<br><br>**Activities**:<br># compliance inspections completed<br># of areas of concern for failing systems identified<br># of trainings offered to realtors and title companies | How well did we do it (%)?<br><br>% of compliance inspections completed during the time of a property transfer<br>% of areas of concern with known risk level<br>% of realtor and title company attendees that are satisfied with training and plan to share information |
| **Effect** | Is anyone better off (#)/(%)?<br><br>#/% of failing systems replaced<br>#/% of attendees representing realtors and title companies who have increased knowledge of the impact a failing system can have on groundwater and surface water resources | |

| **Headline Performance Measures** |
|---|
| % of failing systems replaced |
| **Secondary Measures** |
| # compliance inspections completed<br># of failing systems replaced |
| **Data Development Agenda** |

<table>
<tr><th colspan="3">Hazardous Waste Performance Measures</th></tr>
<tr><td></td><td>Quantity</td><td>Quality</td></tr>
<tr><td>Effort</td><td><u>How much did we do (#)?</u><br><br>Customer:<br># of hazardous waste generators<br># of residents<br><br>Activities:<br># of salvage yards identified<br># of types of materials collected at WCEC and remote events</td><td><u>How well did we do it (%)?</u><br><br>% of salvage yards inspected<br>% of residential participants at the county environmental center and collection events</td></tr>
<tr><td>Effect</td><td colspan="2"><u>Is anyone better off (#)/(%)?</u><br><br>#/% of salvage yards implementing best management practices<br>#/% of residential household hazardous waste collected</td></tr>
</table>

<table>
<tr><td><u>Headline Performance Measures & Data Development Agenda</u><br><br>% of salvage yards implementing best management practices<br>% of residential household hazardous waste collected</td></tr>
<tr><td><u>Secondary Measures</u><br><br># of types of materials collected at WCEC and remote events<br>% of residential participants at the county environmental center and collection events<br>#/% of residential household hazardous waste collected</td></tr>
</table>

# APPENDIX B: HISTORY

**1992 Draft Washington County Comprehensive Groundwater Plan**
In 1990, Washington County began developing a groundwater plan and in November of 1992 released a draft Comprehensive Groundwater Management Plan. The 1992 Draft Plan was not guided through the final review and approval process and, therefore, was not finalized and implemented.

**2003-2013 Washington County Groundwater Plan**
In January 2001 the Washington County Board of Commissioners re-activated the Washington County GWAC for the purpose of guiding and advising County staff in reviewing and re-drafting the 1992 draft Plan (as required by Minnesota Statute 103B.255). The county also established a Technical Advisory Committee (TAC) that included staff from the DNR, MPCA, MDH, MDA, Metropolitan Council, WCD, U of M, local governments, and WMO's. County staff led these groups in the development and final adoption of this plan in 2003.

**2014-2024 Washington County Groundwater Plan**
In June of 2012 Washington County kicked off the process of updating the 2003 plan. Again a GWAC and TAC aided in the process of identifying the necessary issues that should be addressed between 2014 and 2024. To determine the strategies in the plan work groups were formed consisting of the technical experts and specific partners needed to carry out the work in each issue area into the future. The work of these groups and county staff is reflected in Chapters 1 to 13 of this plan.

**103B.255 Groundwater plans.**

Subdivision 1. **Authority.** A metropolitan county may prepare and adopt groundwater plans in accordance with this section.

Subd. 2. **Responsible units.** The county may prepare and adopt the plan or, upon request of a soil and water conservation district, the county may delegate to the soil and water conservation district the preparation and adoption of all or part of a plan and the performance of other county responsibilities regarding the plan under this section and section 103B.231.

Subd. 3. **Local coordination.** To assure the coordination of efforts of all units of government during the preparation and implementation of watershed and groundwater plans, the county shall conduct meetings with local units of government and watershed management organizations and may enter into agreements with local units of government and watershed management organizations establishing the responsibilities during the preparation and implementation of the water plans.

Subd. 4. **Assistance.** The county may contract with the Minnesota Geological Survey, the United States Geological Survey, a soil and water conservation district, or other public or private agencies or persons for services in performing the county's responsibilities regarding the plan under this section and section 103B.231. Counties may enter into agreements with other counties or local units of government under section 471.59 for the performance of these responsibilities. To assist in the development of the groundwater plan, the county shall seek the advice of the advisory committee, the Minnesota geological survey, the departments of health and natural resources, the pollution control agency, and other appropriate local, state, and federal agencies.

Subd. 5. **Advisory committees.**

(a) The county shall name an advisory committee of 15 members. The committee must include representatives of various interests, including construction, agriculture, hydrogeology, and well drilling. At least four members of the committee must be from the public at large, with no direct pecuniary interest in any project involving groundwater protection. At least seven members must be appointed from watershed management organizations, statutory and home rule charter cities and towns, and these local government representatives must be geographically distributed so that at least one is appointed from each county commissioner district.

(b) The county shall consult the advisory committee on the development, content, and implementation of the plan, including the relationship of the groundwater plan and existing watershed and local water management plans, the effect of the groundwater plan on the other plans, and the allocation of costs and governmental authority and responsibilities during implementation.

Subd. 6. **General standards.**

(a) The groundwater plan must specify the period covered by the plan and must extend at least five years, but no more than ten years, from the date the board approves the plan. The plan must contain the elements required by subdivision 7. Each element must be set out in the degree of detail and prescription necessary to accomplish the purposes of sections 103B.205

to 103B.255, considering the character of existing and anticipated physical and hydrogeologic conditions, land use, and development and the severity of existing and anticipated groundwater management problems in the county.

(b) To the fullest extent possible, in a manner consistent with groundwater protection, a county shall make maximum use of existing and available data and studies in preparing the groundwater plan and incorporate into its groundwater plan relevant data from existing plans and the relevant studies and provisions of existing plans adopted by watershed management organizations having jurisdiction wholly or partly within the county.

Subd. 7. **Contents.** A groundwater plan must:

1. cover the entire area within the county;
2. describe existing and expected changes to the physical environment, land use, and development in the county;
3. summarize available information about the groundwater and related resources in the county, including existing and potential distribution, availability, quality, and use;
4. state the goals, objectives, scope, and priorities of groundwater protection in the county;
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;
6. describe relationships and possible conflicts between the groundwater plan and the plans of other counties, local government units, and watershed management organiza¬tions in the affected groundwater system;
7. set forth standards, guidelines, and official controls for implementation of the plan by watershed management organizations and local units of government; and
8. include procedures and timelines for amending the groundwater plan.

Subd. 8. **Review of the draft plan.**

(a) Upon completion of the groundwater plan but before final adoption by the county, the county shall submit the draft plan for a 60-day review and comment period to adjoining counties, the Metropolitan Council, the State review agencies, the Board of Water and Soil Resources, each soil and water conservation district, town, statutory and home rule charter city, and Watershed Management Organization having territory within the county. The county also shall submit the plan to any other county or watershed management organization or district in the affected groundwater system that could affect or be affected by implementation of the plan. Any political subdivision or watershed management organization that expects that substantial amendment of its plans would be necessary in order to bring them into conformance with the county groundwater plan shall describe as specifically as possible, within its comments, the amendments that it expects would be necessary and the cost of amendment and implementation. Reviewing entities have 60 days to review and comment. Differences among local governmental agencies regarding the plan must be mediated. Notwithstanding sections 103D.401, 103D.405, and 473.165, the council shall review the plan in the same manner and with the same authority and effect as provided in section 473.175 for review of the comprehensive plans of local government units. The council shall comment on the apparent conformity with metropolitan system plans of any anticipated amendments to watershed plans and local comprehensive plans. The council shall advise the Board of Water and Soil Resources on whether the plan conforms with the management objectives stated in the council's water resources plan and shall recommend changes in the plan that would satisfy the council's plan.

(b) The county must respond in writing to any concerns expressed by the reviewing agencies within 30 days of receipt thereof.

(c) The county shall hold a public hearing on the draft plan no sooner than 30 days and no later than 45 days after the 60-day review period of the draft plan.

Subd. 9. **Review by metropolitan council and state agencies.** After completion of the review under subdivision 8, the draft plan, any amendments thereto, all written comments received on the plan, a record of the public hearing, and a summary of changes incorporated as part of the review process must be submitted to the Metropolitan Council, the State review agencies, and the Board of Water and Soil Resources for final review. The State review agencies shall review and comment on the consistency of the plan with State Laws and Rules relating to water and related land resources. The State review agencies shall forward their comments to the board within 45 days after they receive the final review draft of the plan. A State review agency may request and receive up to a 30-day extension of this review period from the board.

Subd. 10. **Approval by board.** After completion of the review under subdivision 9, the Board of Water and Soil resources shall review the plan as provided in section 103D.401. The Board shall review the plan for conformance with the requirements of sections 103B.205 to 103B.255, and chapter 103D. The Board may not prescribe a plan but may disapprove all or parts of a plan which it determines is not in conformance with the requirements of sections 103B.205 to 103B.255, and chapter 103D.

Subd. 11. **Adoption and implementation.** The county shall adopt and implement its groundwater plan within 120 days after approval of the plan by the Board of Water and Soil resources.

Subd. 12. **Amendments.** To the extent and in the manner required by the adopted plan, all amendments to the adopted plan must be submitted to the towns, cities, counties, the Metropolitan Council, the State review agencies, and the Board of Water and Soil Resources for review in accordance with the provisions of subdivisions 8 to 10.

Subd. 13. **Property tax levies.** 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 of administering and implementing priority programs identified in the county's groundwater plan.

HIST: 1990 c 391 art 2 s 16; 1992 c 511 art 2 s 3; 1995 c 184 s 18-23

The Groundwater Plan is intended to extend through the year 2024. The Plan is intended to be updated at least every ten years.

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 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, Watershed Districts, Watershed Management Organizations, 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 the 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 the BWSR has decided whether the amendment is in accordance with provisions of section 103B.255, subdivisions 8, 9, and 10. If the 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.

**ANALYSIS OF POTENTIAL CONFLICTS**

At this time, there are no known conflicts between the Groundwater Plan and other Washington County, local government, Watershed District, Watershed Management Organization, or neighboring county plans. Comments received from these agencies indicated the Washington County Groundwater Plan conforms and supports existing Water Management Plan. If conflicts should arise in the future, they may be addressed by the following informal or formal conflict resolution processes.

**INFORMAL CONFLICT RESOLUTION**

The County or other local units of government may request a meeting with the Chair of the BWSR to informally resolve disputes before initiating a contested case procedure as covered under Minnesota Statutes 103B.345. An informal hearing can be called to:

- Determine the meaning of any provision of Minnesota Statutes Chapter 103B;
- Resolve conflicts between any two ground water protection plans or a ground¬water protection plan and a surface water management plan or comprehen¬sive water plan; or
- Settle any other dispute relating to the Groundwater Plan.

The informal resolution process is as follows:

1. A meeting with the Chair of the BWSR may be requested in writing by any of the involved parties.
2. The nature of the provision of omission causing the conflict must be described, whether it is in the Groundwater Plan, or other control. All parties in the conflict must be identified.
3. The Chair shall acknowledge the request in writing, and request a meeting of all parties. If request for a meeting does not satisfy the parties, or if there is no response from one of the parties, the Chair shall make a reasonable effort to obtain the information needed for resolution in another manner.
4. The Chair shall establish the meeting time and place, and inform all parties in writing. A local unit of government may be represented by any person or persons of its choosing, subject to control of the Chair. The Chair may consider any relevant and reasonable evidence or argument by local unit of government in reaching a resolution.
5. The decision of the Chair may be announced at the meeting, or made later. In any case, the decision shall be submitted in writing to all parties, and will be effective 60 days following the decision of the Chair.

6. A petition may be filed within that time pursuant to Minnesota Statutes, Section 103B.345, subdivision 3, for a contested case hearing under that section.

**FORMAL CONFLICT RESOLUTION**

A county or other local government may petition for a contested case hearing if:

- The interpretation and implementation of a groundwater protection plan is challenged by a local unit of government aggrieved by the plan;
- If two or more counties or local governmental units disagree about the apportionment of the costs of a project implemented in a groundwater protection plan; or
- If a county and other local unit of government disagree about a change in local surface or groundwater and related land resources plan or official control recommended by the County under MN Statute 103B.

The process for a formal resolution of a conflict is as follows:

1. A petition must be filed within 60 days after the date of adoption of approval or the disputed ordinance, or the date a local unit of government receives a recommendation of the County Board under MN Statute Section 103B.325.
2. The petition must be made in writing, addressed to the BWSR, and include the following: the names, phone numbers, and addresses of the parties or their representatives involved in the petition; a request for a hearing; a statement of the allegations or issues to be determined by the hearing; and proof of service of a copy of the petition on all others involved in local units of government.
3. The petition is considered filed with the BWSR when it is received by the Board. The BWSR shall acknowledge receipt of the petition in writing.
4. If the aggrieved county or other local unit of government files a petition for a hearing, a hearing must be conducted by the State Office of Administrative Hearings under the contested case procedure of Minnesota Statues Chapter 14 within 60 days of the request. The subject of the hearing may not extend to questions concerning the need of a groundwater protection plan. In the report of the administrative law judge, the fees of the Office of Administrative Hearings and transcript fees must be equally apportioned among the parties to the proceeding. Within 60 days after receiving the report of the administrative law judge, BWSR must make a final decision on the issue. All parties will be informed of the decision in writing.
5. A decision of the board may by appealed to the Court of Appeals in a manner provided by Sections 14.63 to 14.69.