South Washington Watershed District

Monitoring Plan

8/25/2009

SWWD Monitoring Plan

1: Introduction

Water quality and quantity monitoring has been an on-going effort for the SWWD since 1996. The District will continue this initiative and partner with suitable entities to maintain the automated monitoring stations. Monitoring and data analysis relating to surface water flows, key infiltration areas, groundwater, lake levels and precipitation are expected to remain part of the District's overall initiative. This Plan details the District's ongoing programs. Monitoring conducted for short-term assessments or in support of District projects will be detailed in Appendices at the end of this document.

SWWD has contracted with the Washington Conservation District (WCD) to conduct all monitoring programs since 2000. To date, WCD provides SWWD with data and annual summaries as well as the results of more detailed statistical analysis that is performed in odd years. The most recent statistical analyses were conducted by WCD in 2007. Statistical results and interpretation can be found in the SWWD 2007 Monitoring Summary, which is available on the SWWD website or by contacting either the SWWD or WCD. Beginning with data from the 2009 monitoring season, annual data analyses and reporting will be completed by SWWD staff. The annual monitoring report will be presented to the SWWD Board of Managers by the end of April each year.

SWWD maintains a record of updated standard operating procedures for all monitoring programs. They can be obtained by contacting SWWD staff.

2: Surface Water Monitoring

2.1: Regional Assessment

2.1.1: Rationale

One of the objectives of the SWWD is to establish a framework for characterizing and managing water resources at a regional level rather than solely at a site-specific level. To optimize monitoring efforts for regional assessment, the District has designated key locations at critical crossings and checkpoints throughout the watershed as regional assessment locations (Chapter 6, Section 8 of the SWWD 2007 WMP, Houston Engineering). Locations were chosen to characterize water quality and quantity entering or leaving a region. Data collected at these locations through the District's surface water monitoring programs will be used to identify trends in regional water quality and quantity as well as potential areas for concern, develop and verify regional models, set benchmarks for regional water quality, evaluate effectiveness of ordinances resulting from the SWWD WMP, evaluate regional affects of proposed development projects, and predict and evaluate the success of BMP and resource conservation projects.

All regional assessment locations are part of the District's permanent monitoring program and will be operated until deemed unnecessary by analysis and modeling, unless otherwise noted below (Section 2.1.3.1). A map of current regional assessment locations is in Section 5.

2.1.2: Monitoring Procedures

Regional assessment monitoring stations are automated to the greatest extent feasible and operated by the WCD. Regional assessment monitoring sites are equipped with an area-velocity probe (stage and flow), rain gauge (where rainfall is monitored), and an ISCO 24 bottle automated water quality sampler. Monitoring equipment is operated by a 12V deep cycle battery. Where possible, stations are also equipped with a 20 watt solar panel to keep the battery charged. Two sites, MS1 and MS2, were also equipped with backup self powered water level loggers (for flow monitoring) which allows for data collection when primary equipment is not recording or malfunctions.

Stage, velocity, and discharge measurements are taken every 15 minutes at all regional assessment locations. Where monitored, continuous rainfall data is also collected. Field stage measurements are taken at all sites and stage to discharge relationships are developed, if possible. When the area-velocity probe at a site is covered with debris or is otherwise giving erroneous velocity readings, data is generated using the stage to discharge relationship. Stage to discharge relationships are also used to interpolate missing data.

Flow weighted storm event composite samples, storm event grab samples, snowmelt grab samples, baseflow composite samples and baseflow grab samples are collected throughout the monitoring season which typically runs from the beginning of April to the beginning of November. Additionally, *E. coli* bacteria grab samples are collected at all locations. All water quality samples are analyzed at the Metropolitan Council Environmental Services Lab in St. Paul.

Additional information about specific methods or equipment can be obtained by contacting staff at SWWD or WCD.

2.1.3: Regional Assessment Monitoring Locations

2.1.3.1: Current Regional Assessment Locations

100th Street (East of Jamaica Ave S): This site is key to understanding the hydrologic system of both the Central Draw and West Draw watersheds as it is located just downstream of the outflows of both. Monitoring data collected at the 100th Street location helps illustrate any impacts of activity on the quality and quantity of water ultimately draining to the Mississippi River. The 100th Street monitoring site was established in 2000. Parameters monitored include bacteria (since 2001), stage (since 2000), flow (since 2001), heavy metals (since 2001), nutrients (since 2001), and rainfall (since 2002). The site has been operated continuously since establishment. In 2007 this site was relocated just upstream of the original location due to backwater influences from downstream. A new regional monitoring location (Central Ravine) was established at the outlet of the Central Draw watershed in 2009. The 100th Street monitoring site may be phased out and a new site established at the outlet of the West Draw watershed when the West Draw is connected to the Mississippi River drainage.

Bailey Lake Lift station: The Bailey Lake site currently consists of only a water level logger. Water quality grab samples are collected at the lift station during pumping events, which have not occurred since 2005. The site will be completely established after Woodbury has become fully developed and pumping at the Bailey Lake Lift station becomes routine. The station will serves as a regional assessment location for the entire Northern watershed and provides water quality and quantity data for water entering the Central Draw Storage Facility watershed and Central Draw Overflow Corridor. Parameters monitored will include stage, flow, rainfall, nutrients, heavy metals and bacteria. In the interim, data collected at the lift station will help the District determine how much water is leaving the Northern watershed and assess the need for establishing a full regional assessment location.

Central Ravine: The Central Ravine location was established in 2009. Data collected from this location will give a better understanding of the quantity and quality of water leaving the Central Draw watershed and draining to the Mississippi River. Parameters monitored include bacteria, stage, flow, heavy metals, and nutrients. The 100th Street location formerly served as the regional assessment location for the Central Draw watershed. Information about the Central Draw watershed is difficult to discern from data collected at the 100th Street location as it also drains water leaving the West Draw watershed.

MS1 (near I94 and County 13): MS1 is a vital link in understanding the intercommunity flow from Lake Elmo and Oakdale to Woodbury. This data gives a baseline understanding of the initial surface water quality and quantity at the headwaters of the watershed. Comparative studies throughout Woodbury are possible with this key dataset. The MS1 monitoring site was established in 1996. Parameters monitored include bacteria (since 2002), stage, flow, heavy metals, nutrients, and rainfall.

MS2 (N side of Bailey Lake): Water from a large portion of Woodbury, including outflow from Colby Lake, collects at MS2 before flowing into Bailey Lake. Data collected at this location will be used to assess loading rates from the portion of Woodbury that drains into Bailey Lake and develop models that will be used to evaluate effects of proposed development, BMP, and conservation projects. The MS2 monitoring site was established in 1996. Parameters monitored include stage, flow, heavy metals, nutrients, and rainfall.

Newport (Tributary to Mississippi River): This site is on a tributary to the Mississippi River through which stormwater runoff from the City of Newport flows. This station serves as a regional assessment location for the City of Newport and will help develop baseline water quality and quantity data for runoff flowing into the Mississippi River. This site also characterizes stormwater runoff from an urban area following treatment in a stormwater pond. The site was established in 2006. Parameters monitored include bacteria, flow, stage, nutrients, and heavy metals.

Saint Paul Park (Tributary to Mississippi River): The St. Paul Park site monitors stormwater that discharges directly from the city stormsewer system to the Mississippi River by pipe. This regional assessment location will be used to characterize baseline water quality and quantity data for stormwater generated in St. Paul Park and direct loading to the River. The site was established in 2006. Parameters monitored include bacteria, flow, stage, nutrients, and heavy metals.

Wilmes Lake Outlet: The Wilmes Lake Outlet location was established in 2009. Data collected from this location will give a better understanding of the quantity and quality of water leaving the Northern portion of the Northern watershed and flowing toward Colby Lake. Parameters monitored include bacteria, stage, flow, heavy metals, and nutrients.

2.1.3.2: Planned Regional Assessment Locations

70th Street (CD-P85 Overflow Outlet): The 70th Street site will be established when pumping at the Bailey Lake Lift station becomes routine and monitored in tandem with the fully established Bailey Lake lift station site. Data from this location will be used to quantify the effectiveness of the CD-P85 Regional Infiltration Basin at reducing water quantity and improving water quality. Parameters monitored will include stage, flow, rainfall, nutrients, heavy metals, and bacteria.

Glendenning Avenue (Cottage Grove): The Glendenning Avenue site will replace the 100th Street site and will be established when the West Draw watershed is connected to drainage to the Mississippi River. Data collected will better illustrate the quality and quantity of water leaving the West Draw watershed. Parameters will include stage, flow, rainfall, nutrients, heavy metals, and bacteria.

Cottage Grove Ravine Park Outlet: Near the end of the Central Draw Overflow Corridor, the Cottage Grove Ravine Park site will be established and monitored in conjunction with the 70th Street (CD-P85 Outlet) and Bailey Lake lift station sites. Data collected will help illustrate changes in water quality and quantity of water flowing through the Central Draw Overflow Corridor and provide detailed water quality and quantity information for water discharged into the Mississippi River. Parameters will include stage, flow, rainfall, nutrients, heavy metals, and bacteria.

O'Conner's Creek (at St. Croix Trail, inlet to O'Conner's Lake): This site will be established in 2010 and will help assess the O'Conner's Creek watershed, which is landlocked. Monitoring at this site is listed as a Priority 1 activity in the LSCWMO WMP.

Trout Brook (at St. Croix Trail): This site will be established in 2010 in order to assess the Trout Brook watershed. The site will be monitored at its entry to Afton State Park.

2.2: Subwatershed Assessment

2.2.1: Rationale

To enhance the SWWD regional assessment framework, the District operates subwatershed assessment sites on a rotating basis. Subwatershed assessment locations are chosen in order to further define and manage water resources within the major regions of the watershed. Data collected at these locations will be used to identify priority subwatersheds within the larger watershed regions of the District as well as to help calibrate regional models and update maximum allowable load levels corresponding to the contributing areas for each location. Subwatershed assessment sites, once established, will be operated for a period of 3-10 years depending on District goals and value of the data being collected. A map of current subwatershed assessment locations is in Section 5.

2.2.2: Monitoring Procedures

Methods will vary depending on SWWD objectives for each location. Subwatershed assessment monitoring stations are and will continue to be automated to the greatest extent feasible and operated by the WCD. Currently, all subwatershed assessment monitoring sites are monitored for flow using a self-powered water level logger. Stage measurements are taken every 15 minutes. Field stage measurements are taken at all sites and stage to discharge rating curves are developed, if possible. Rating curves are used to calculate discharge at the subwatershed assessment locations. If necessary, subwatershed assessment locations can be equipped with sampling equipment to assess nutrient and pollution loading on a subwatershed level. Additional information about specific methods or equipment can be obtained by contacting staff at SWWD or WCD.

2.2.3: Subwatershed Assessment Monitoring Locations

Current subwatershed assessment locations include 80th Street (since 2002; Central Draw watershed), 90th Street (since 2002; Central Draw watershed), Tamarack (since 2001), West Draw 1 (since 2007; West Draw watershed), and West Draw 3 (since 2008; West Draw watershed). Data from all four current subwatershed assessment locations will be used to calibrate SWWD regional hydrologic models.

2.3: Waterbody Assessment

2.3.1: Rationale

The SWWD utilizes two approaches for monitoring of waterbodies throughout the District. First, the District conducts long-term, screening level monitoring of lakes in the form of lake level monitoring and participation in the Metropolitan Council Citizen-Assisted Lake Monitoring Program (CAMP). By collecting long-term, baseline data for area Lakes, the District can identify trends—both positive and negative—and identify targets for in-depth study. Second, the District undertakes in-depth, assessment level monitoring of priority waterbodies, impaired waters, and others targeted for in-depth study.

2.3.2: Screening Level Monitoring Programs

2.3.2.1: Citizen-Assisted Lake Monitoring Program

The SWWD participates in the Metropolitan Council's Citizen-Assisted Lake Monitoring Program (CAMP). Lakes within the District are monitored on an annually rotating basis with the goal of maintaining long-term data records for all lakes in the District. Lakes chosen for monitoring are monitored biweekly from April to October. Monitoring is conducted at the deepest point of each lake and consists of water sample collection and in-field measurements of surface temperature, dissolved oxygen, and transparency. Samples are analyzed for nitrogen, phosphorous, and chlorophyll-a. Hypolimnion water quality samples are collected where appropriate. If possible, volunteers are recruited to conduct monitoring. Lakes without volunteers are monitored by the WCD. Data from the CAMP program is used to detect long-term trends in lake water quality. Additional information about methods or equipment used can be obtained by contacting staff at SWWD or WCD.

2.3.2.2: Lake Levels

The SWWD currently monitors lake levels on 12 lakes. Lakes are monitored from approximately April to October using staff gauges. Monitoring is conducted by WCD. Data collected is used to illustrate seasonal fluctuations and identify abnormal fluctuations.

2.3.3: In-Depth Assessments

2.3.3.1: Individual Waterbody Assessment

In-depth assessment of individual waterbodies becomes necessary when data from screening level monitoring programs indicates impairment or nutrient loading in excess of SWWD or MN standards. Assessments will generally last 3-5 years and consist of CAMP monitoring (Section 2.3.2.1), and a network of automated water quality and quantity monitoring sites at the waterbody's inlets. Automated stations will be operated using the same equipment and procedures used for regional assessment monitoring locations (Section 2.1.2). Data will be used to identify portions of the watershed leading to the impairment or nutrient loading. After subwatershed loading is characterized and mitigation actions taken, CAMP monitoring will continue and automated monitoring sites will be rotated amongst the lake's inlets so that each is monitored at least once every five years. Inlets will be monitored more frequently if poor water quality or high year to year variability in data persists.

2.3.3.2: BMP and Stormwater Design Assessment

Much of the property in the South Washington watershed is relatively newly developed. As they were built, those developments were subject to runoff peak, runoff volume, and phosphorous loading standards. Developments utilize a variety of stormwater features and BMPs to meet those standards. However, the success of those stormwater features and BMPs at meeting SWWD standards is largely unknown. SWWD will initiate assessments to examine the flow and nutrient reduction capacities of various BMPs. Data will be used to assess reduction in flow rate and volume and phosphorous as well as to better inform engineers and designers of the success of various features and BMPs in south Washington County.

3: Groundwater

3.1: Rationale

Municipalities within the SWWD rely on groundwater to provide potable water, satisfy water demand for commercial and industrial facilities, and irrigation. Additionally, many surface water features have direct interaction with groundwater. Therefore, management of some surface water resources is also dependent on high quality, sustainable levels of groundwater.

Multiple examinations of groundwater resources have been completed in south Washington County. The extensive, multi-phase Infiltration Management Study (EOR, 2001) was initiated by SWWD in 1997 in order to examine the use of infiltration in stormwater management. The study reported that the utilization of "the natural features of this watershed, such as extensive natural detention areas and high infiltration capacities, is a sound and innovative approach to stormwater management that is foresighted and directed toward the future of more natural, less costly solutions." Additional work by

Barr Engineering (2005a and 2005b) led to completion of a groundwater flow model and characterization of infiltration potential throughout the District, noting that the majority of the area served as a recharge area. The SWWD has made it common practice to mitigate for groundwater withdrawals and lost natural groundwater recharge rates by routing water from impervious areas to open areas or infiltration basins. However, the District is also aware that the need to replenish the aquifers must be balanced with the need to prevent potentially degraded water from impacting groundwater quality.

The Cottage Grove Area Nitrate Study (Barr, 2003) found elevated nitrate concentrations in wells throughout the Cottage Grove area. Further, many of those wells were within one mile of a bedrock fault. Investigators concluded that the fault is associated with enhanced recharge through rapid downward percolation of water. Similar faults are located in bedrock throughout south Washington County.

A literature review conducted for the MPCA (Weiss et al. 2008) indicated mixed results when examining groundwater contamination from infiltrated stormwater. Contamination risk is higher for salts and pathogens, while it is generally lower for other pollutants. However, contamination risk largely depends on soil and geologic characteristics. A major consideration is the presence of karst features that can provide rapid and direct conveyance of stormwater to groundwater.

Currently, the District operates a groundwater level monitoring network and will transition to a regional assessment program beginning in 2010. Data from these programs as will provide information about the sustainability of high quality groundwater resources as well as help identify direction for future action.

3.2: Groundwater Monitoring Program

3.2.1: Current Monitoring Program

The SWWD maintains a network of 6 groundwater observation wells (obwells) in the Central Draw Storage Facility (CDSF) watershed, where groundwater levels are measured. Five of the wells are screened in the water table aquifer whereas 1 is screened in the Prairie du Chien. Readings are collected by the Washington Conservation District 12 times per year using a manual tapedown method. Data from these obwells is used to assess groundwater supply patterns and the influence of nearby regional infiltration basins. A map of current obwell locations is in Section 5. Detailed information about methods and equipment used can be obtained by contacting SWWD or WCD staff. The current program will transition into the regional groundwater assessment network (section 3.2.2).

3.2.2: Regional Assessment Program

Beginning in 2010, the District will enhance its current water level monitoring program into a regional assessment program analogous to that for surface water. The focus of the program will be detecting effects of stormwater infiltration as the watershed continues to develop. Regional groundwater assessment locations will be equipped to collect both groundwater quantity and quality data. In the first year, SWWD will continue to monitor groundwater levels and will partner with WCD and the Minnesota Department of Health (MDH) to collect quarterly groundwater samples from existing obwells near the

CD-P85 and CD-P86 infiltration basins. Samples will be collected following MPCA's *Sampling Procedures for Ground Water Monitoring Wells* and analyzed at a local MDH lab for chloride, bromide, total nitrate + nitrite, total phosphorus, E. coli, and metals. Quarterly surface water samples will also be collected from the bottom of the water column in Bailey Lake, up-gradient of the obwells, for comparison. Following each of the first three years, sampling frequency and parameters will be re-assessed.

When program guidelines are fully established, SWWD will work with MDH and/or a Technical Advisory Committee to identify new sites for expansion of the program leveraging existing groundwater models to optimize placement and existing wells where possible to minimize cost. As part of the process, SWWD will work with partners to refine existing models using SWWD data. All new regional assessment sites will be equipped with automated water level loggers. Existing sites will retrofitted with automated water level loggers as necessary. Data from the regional assessment network will be used to identify trends, assess the sustainability of groundwater resources, and refine and calibrate the South Washington groundwater model.

SWWD will investigate trends of degrading groundwater quality or increased fluctuation of groundwater levels using groundwater models developed for south Washington County to target likely causes. The SWWD will then undertake in-field, in-depth assessment to verify sources and target mitigation strategies.

3.3: Groundwater Surface Water Interactions

Many surface water resources throughout the District are directly impacted by groundwater influences. SWWD will use its monitoring programs to support efforts to further define groundwater surface water interactions and develop groundwater models in south Washington County. Results of those efforts will be used in directing management strategies.

In many areas of the District, infiltrating water remains in the shallow soil profile. However, in other areas, sinkholes and karst features allow a large portion of infiltrated water to recharge deep groundwater. These features are a particular concern throughout the District's regional infiltration basins (CD-P85 and CD-P86) and planned Central Draw Overflow, which when finished will provide drainage for overflow from the infiltration basins to the Mississippi River. Much of the water that will leave the Northern watershed and enter the regional infiltration basins will be stormwater from rare storm events with potentially high loads of nutrients and pollutants. It is therefore a priority of the District to identify and inventory sinkholes and karst features throughout the infiltration basins and Central Draw Overflow as well as the rest of the District. The District will pursue an identification/inventory project, which will help identify potential hazards to deep groundwater. When completed, the information generated will be used to target and protect areas that should be isolated from stormwater runoff and assess the need for water quality monitoring of deep groundwater resources.

4: References

Barr Engineering Company. 2003. Cottage Grove Area Nitrate Study.

Barr Engineering Company. 2005a. Intercommunity Groundwater Protection: Sustaining Growth and Natural Resources in the Woodbury/Afton Area.

Barr Engineering Company. 2005b. Integrating Groundwater & Surface Water Management; Southern Washington County.

Emmons & Olivier Resources. 2001. South Washington Watershed District Infiltration Management Study.

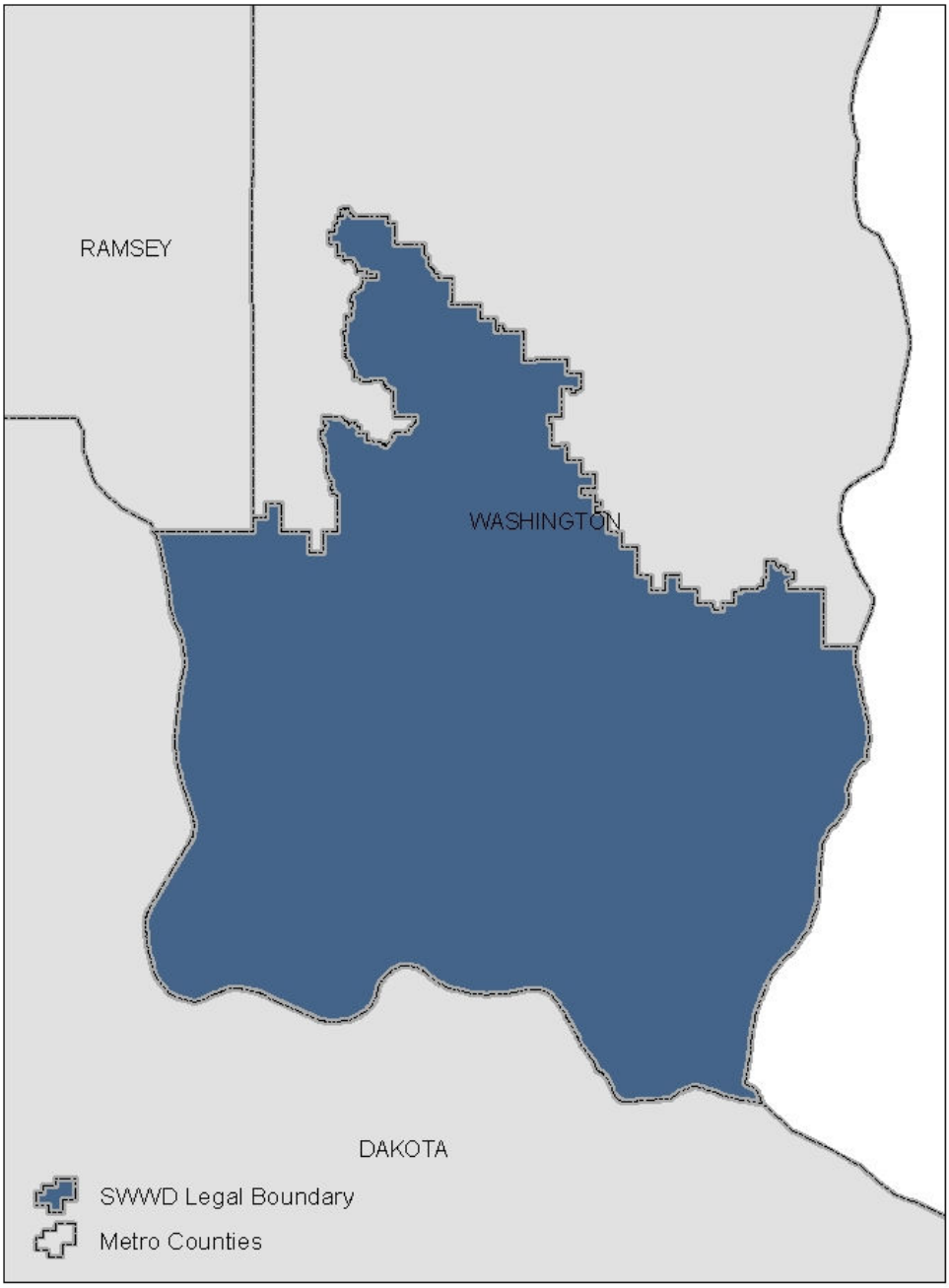
Houston Engineering, Inc. 2007. South Washington Watershed District Watershed Management Plan.

MPCA. 2006. Sampling Procedures for Ground Water Monitoring Wells.

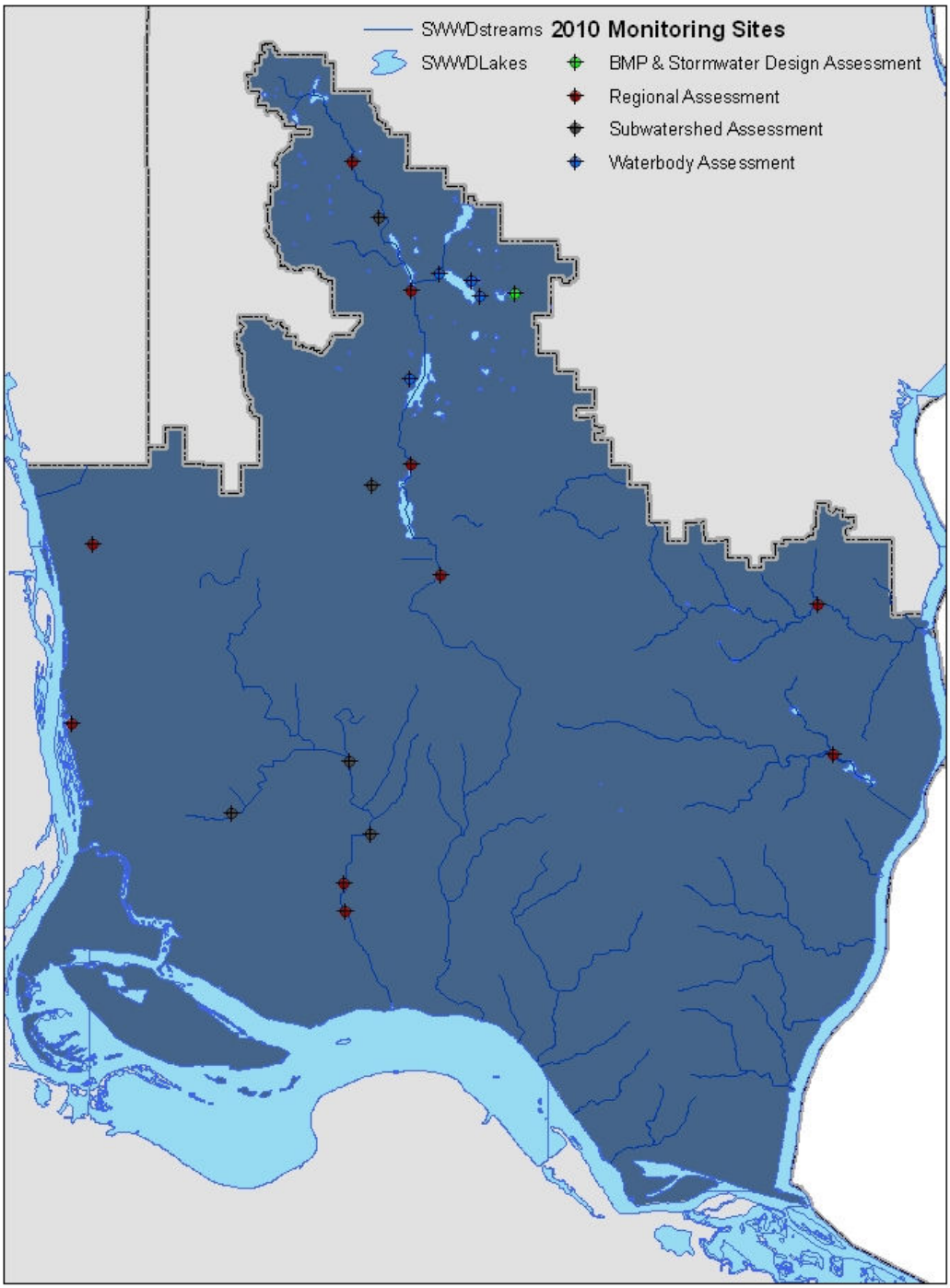
Weiss, P.T., G. LeFevre, and J.S. Gulliver. 2008. Contamination of Soil and Groundwater Due to Stormwater Infiltration Practices. Minnesota Pollution Control Agency Project Report No. 515.

5: Maps

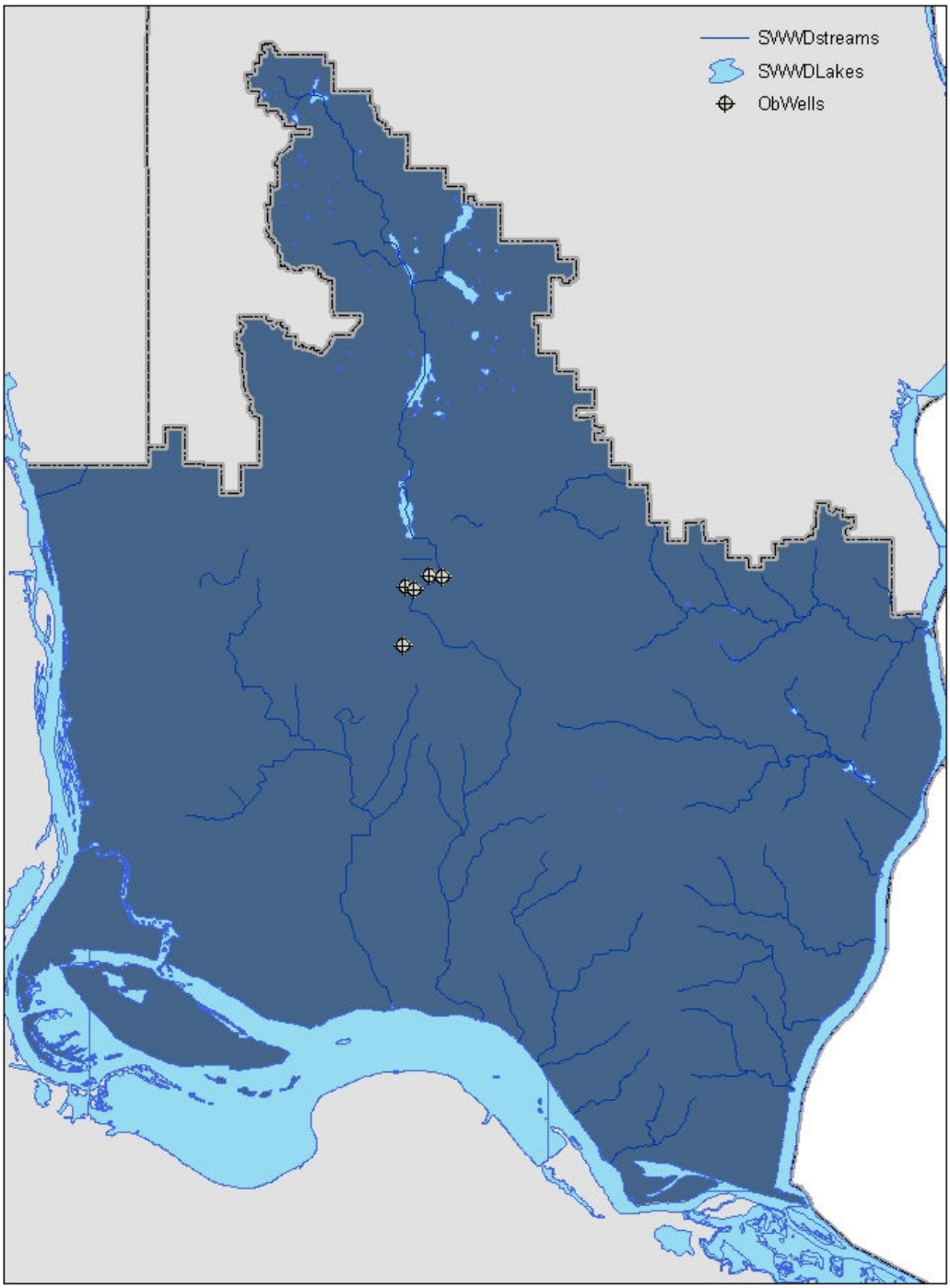
5.1: Watershed location



5.2: Surface Water Monitoring Locations



5.3: Groundwater Observation Well Locations (6 total; 2 are nested)



Appendix I: Short-term Assessments

Cottage Grove Chlorides

Monitoring Program: BMP and Stormwater Design Assessment

Background

At its May 2009 meeting, the SWWD Board of Managers discussed providing support to the City of Cottage Grove for purchase and installation of new street de-icing equipment for the City's plows. The Board instructed SWWD staff to work with Cottage Grove to develop a project agreement and guidelines. As part of the project, SWWD will conduct monitoring to assess the effectiveness of the new technologies in reducing chloride loading to surface waters. Monitoring will begin in April 2010 and continue through at least 2013. This monitoring plan describes the study sites, monitoring procedures, and preliminary analytical methods to be used.

Study Sites

All study sites are shown in Map 1. SWWD maintains two Regional Assessment monitoring locations in Cottage Grove, 100th St (outlet for West Draw and Central Draw watersheds) and Central Ravine (outlet for Central Draw watershed). Data collected at Regional Assessment sites will be utilized in this study to assess regional changes from new de-icing technologies and methods. Additionally, two new Subwatershed Assessment sites will be installed as part of this study; Thompson's Grove (West Draw watershed) and Ridgewood (Central Draw watershed). Each subwatershed is part of a single plow route. Data from Subwatershed Assessment sites will be used to directly assess changes in chloride concentrations as new technologies are implemented and methods refined. Subwatershed Assessment locations represent a more controlled assessment scale, removing potentially confounding variables including effects from Woodbury's de-icing programs and operator variability.

Monitoring Procedures

Regional Assessment Sites

Regional Assessment monitoring locations generally are installed in mid April and removed in early November. The 100th Street site has been operated continuously since 2001 (chloride monitoring added in 2003). The Central Ravine site was first installed in 2008.

Regional Assessment monitoring stations are automated to the greatest extent feasible and operated by the WCD. Sites are equipped with an area-velocity probe (stage and flow) and an ISCO 24 bottle automated water quality sampler.

Flow weighted storm event composite samples, storm event grab samples, snowmelt grab samples, baseflow composite samples and baseflow grab samples are collected throughout the monitoring season which typically runs from the beginning of April to the beginning of November. All water quality samples are and will continue to be analyzed at the Metropolitan Council Environmental Services Lab in St. Paul.

Subwatershed Assessment Sites

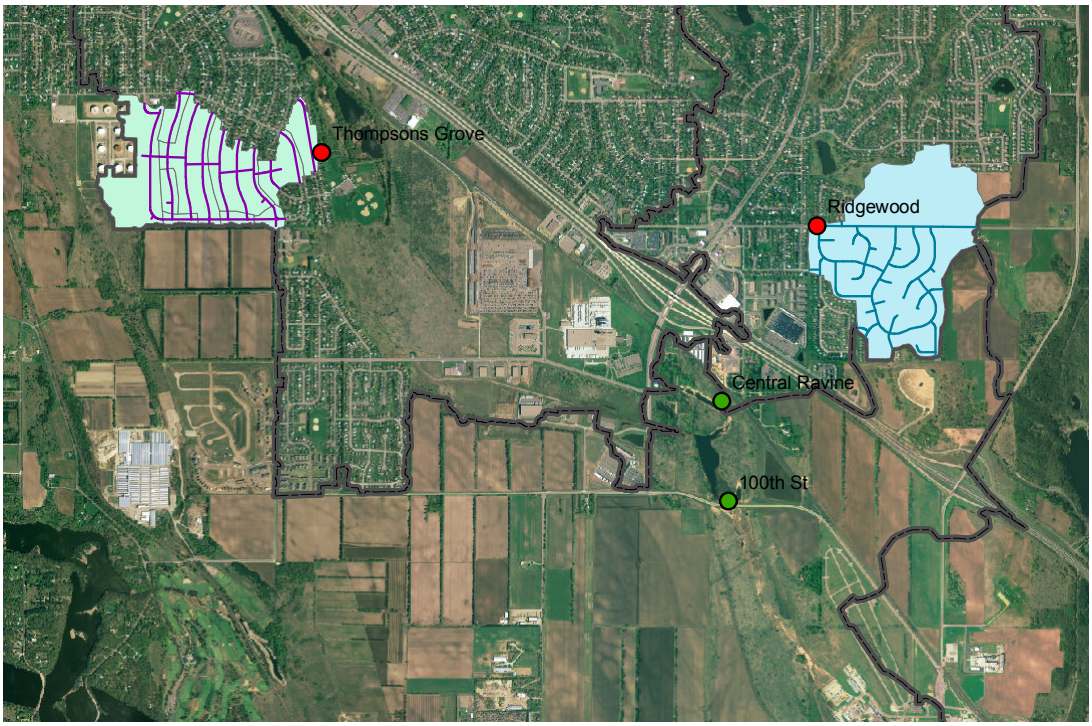
Subwatershed Assessment monitoring stations are automated to the greatest extent feasible and operated by the WCD. Both Subwatershed Assessment sites will be monitored for flow using a self-powered water level logger. Stage measurements will be taken every 15 minutes. Rating curves will be used to calculate flow.

Storm event grab samples, snowmelt grab samples, and baseflow grab samples will be collected throughout the monitoring season which typically runs from the beginning of April to the beginning of November. All water quality samples will be analyzed for chloride levels at the Metropolitan Council Environmental Services Lab in St. Paul.

Analytical Methods

Data will be analyzed using the USACE's and MPCA's Flux32 program that extrapolates loading from instantaneous concentrations and flow data using continuous flow data. Annual loading rates will be compared across monitoring seasons to identify trends in chloride loading rates.

Map 1: Monitoring locations


Thompsons Grove
Ridgewood
Central Ravine
100th St