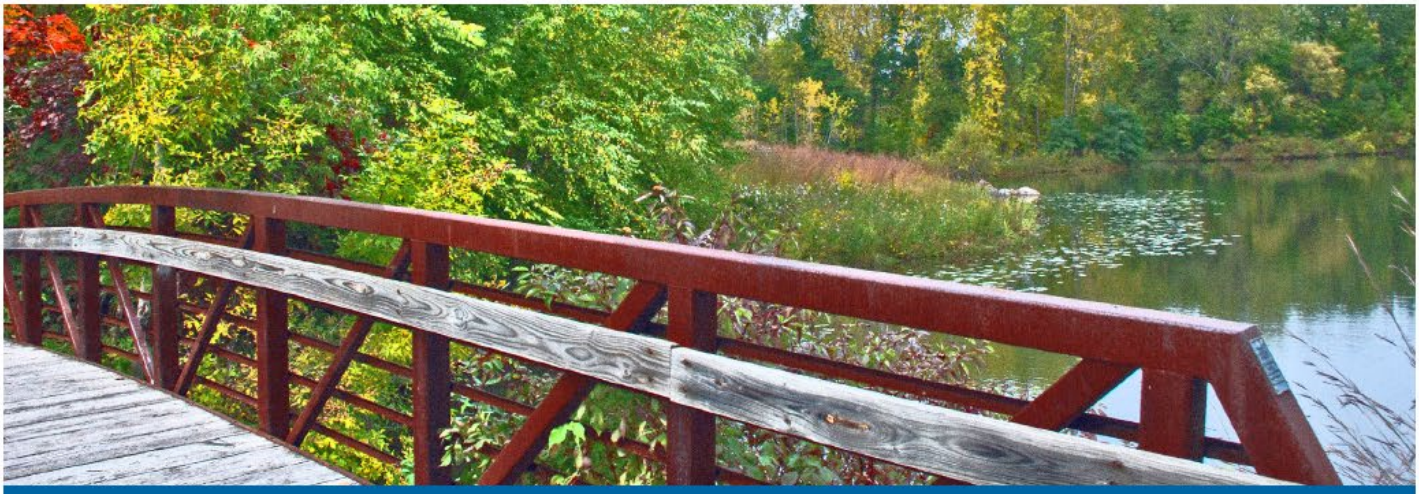

# Watershed Restoration and Protection Strategies Report

## Ramsey-Washington Metro Watershed District


July 2017

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

Minnesota Pollution Control Agency

CLEAN WATER LAND & LEGACY AMENDMENT

wq-ws4-35a

### *Note Regarding Legislative Charge

*The science, analysis and strategy development described in this report began before accountability provisions were added to the Clean Water Legacy Act in 2013 (MS114D); thus, this report may not address all of those provisions. When this watershed is revisited (according to the 10-year cycle), the information will be updated according to the statutorily required elements of a Watershed Restoration and Protection Strategy Report.*

### Cover Picture Descriptions

Top picture: Gervais Mill Pond

Middle left picture: Maplewood Living Streets Project

Middle right picture: Fishing contest at WaterFest

Bottom Left picture: Maplewood Mall tree trenches

Bottom right picture: Lake Phalen shoreline restoration

## Project Partners

*The following organizations and agencies contributed to the development of the Ramsey-Washington Metro Watershed District Restoration and Protection Strategies Report*

**Barr Engineering Co.**

**City of Gem Lake**

**City of Landfall**

**City of Little Canada**

**City of Maplewood**

**City of North St. Paul**

**City of Oakdale**

**City of Roseville**

**City of Shoreview**

**City of St. Paul**

**City of Vadnais Heights**

**City of White Bear Lake**

**City of Woodbury**

**Metropolitan Council**

**Minnesota Board of Water and Soil Resources**

**Minnesota Department of Natural Resources**

**Minnesota Department of Transportation**

**Minnesota Pollution Control Agency**

**Ramsey Conservation District**

**Ramsey County**

**Ramsey-Washington Metro Watershed District**

**Washington Conservation District**

**Washington County**

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## Key Terms

**Assessment Unit Identifier (AUID):** The unique water body identifier for each river reach comprised of the USGS eight-digit HUC plus a three-character code unique within each HUC.

**Aquatic life impairment:** The presence and vitality of aquatic life is indicative of the overall water quality of a stream. A stream is considered impaired for impacts to aquatic life if the fish Index of Biotic Integrity (IBI), macroinvertebrate IBI, dissolved oxygen, turbidity, or certain chemical standards are not met.

**Aquatic recreation impairment:** Streams are considered impaired for impacts to aquatic recreation if fecal bacteria standards are not met. Lakes are considered impaired for impacts to aquatic recreation if total phosphorus, chlorophyll-*a*, or Secchi disk depth standards are not met.

**Hydrologic Unit Code (HUC):** A Hydrologic Unit Code (HUC) is assigned by the USGS for each watershed. HUCs are organized in a nested hierarchy by size. For example, the Minnesota River Basin is assigned a HUC-4 of 0702 and the Pomme de Terre River Watershed is assigned a HUC-8 of 07020002.

**Impairment:** Water bodies are listed as impaired if water quality standards are not met for designated uses including: aquatic life, aquatic recreation, and aquatic consumption.

**Index of Biotic integrity (IBI):** A method for describing water quality using characteristics of aquatic communities, such as the types of fish and invertebrates found in the waterbody. It is expressed as a numerical value between 0 (lowest quality) to 100 (highest quality).

**Protection:** This term is used to characterize actions taken in watersheds of waters not known to be impaired to maintain conditions and beneficial uses of the waterbodies.

**Restoration:** This term is used to characterize actions taken in watersheds of impaired waters to improve conditions, eventually to meet water quality standards and achieve beneficial uses of the waterbodies.

**Source (or Pollutant Source):** This term is distinguished from 'stressor' to mean only those actions, places or entities that deliver/discharge pollutants (e.g., sediment, phosphorus, nitrogen, pathogens).

**Stressor (or Biological Stressor):** This is a broad term that includes both pollutant sources and non-pollutant sources or factors (e.g., altered hydrology, dams preventing fish passage) that adversely impact aquatic life.

**Total Maximum Daily Load (TMDL):** A calculation of the maximum amount of a pollutant that may be introduced into a surface water and still ensure that applicable water quality standards for that water are met. A TMDL is the sum of the wasteload allocation for point sources, a load allocation for nonpoint sources and natural background, an allocation for future growth (i.e., reserve capacity), and a margin of safety as defined in the Code of Federal Regulations.

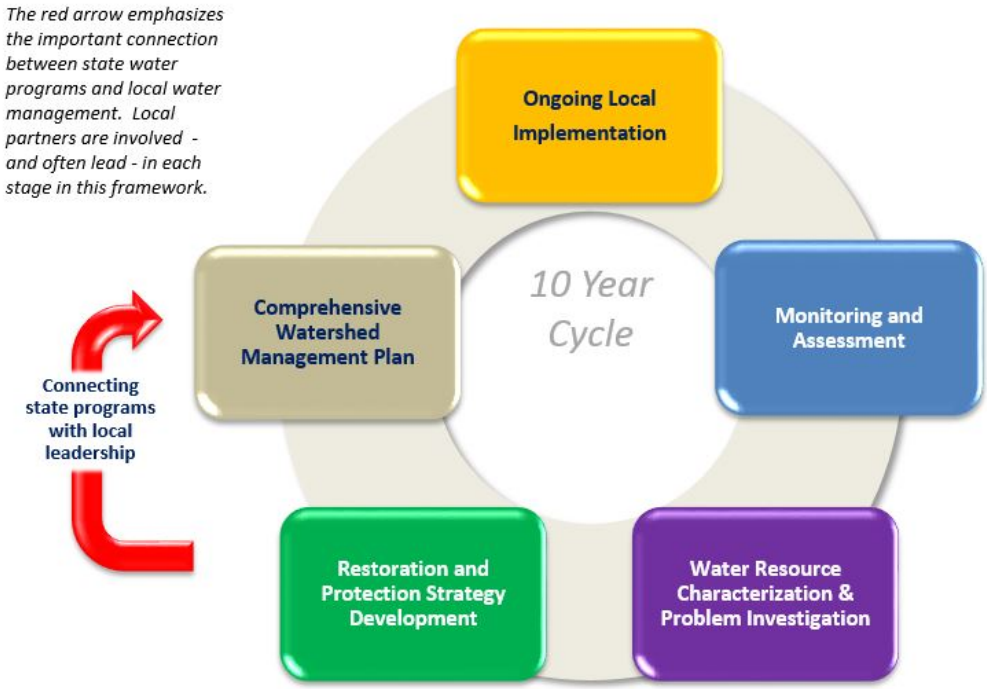
## Executive Summary

The Ramsey-Washington Metro Watershed District (RWMWD) is located in eastern Ramsey County and western Washington County in the state of Minnesota and encompasses portions of a number of communities including White Bear Lake, Vadnais Heights, Gem Lake, Little Canada, Maplewood, Landfall, North St. Paul, St. Paul, Oakdale, Woodbury, Roseville, and Shoreview.

Battle Creek, Fish Creek, Bennett Lake and Wakefield Lake within the RWMWD are impaired for both aquatic life use and aquatic recreation use. Stormwater runoff and stream bank erosion are having negative effects on the watershed's water quality. Urban development in the watershed has resulted in runoff that carries excess phosphorus, sediment, and bacteria into bodies of water that degrades water quality and is harmful to aquatic life.

The intent of this Watershed Restoration and Protection Strategy (WRAPS) report was to develop a scientifically-based restoration and protection strategy for the RWMWD. This WRAPS summarizes past efforts to monitor water quality, identifies impaired water bodies and those in need of protection, and identifies strategies for restoring and protecting water quality in the watershed. The strategies included in this report target point and nonpoint sources of pollution and include reducing streambank erosion, reducing in-lake nutrients, and improving stormwater management to help improve water quality in the watershed.

## What is the WRAPS Report?




The state of Minnesota has adopted a "watershed approach" to address the state's 80 "major" watersheds (denoted by 8-digit hydrologic unit code or HUC). This watershed approach incorporates water quality assessment, watershed analysis, civic engagement, planning, implementation, and measurement of results into a 10-year cycle that addresses both restoration and protection. In the Twin Cities Metropolitan Area (TCMA), watershed approach activities may be focused at the scale of the 33 Metro Watershed Management Organizations and Districts. This report focuses on the RWMWD.

As part of the watershed approach, waters not meeting state standards are still listed as impaired and Total Maximum Daily Load (TMDL) studies are performed, as they have been in the past, but in addition the watershed approach process facilitates a more cost-effective and comprehensive characterization of multiple water bodies and overall watershed health. A key aspect of this effort is to develop and utilize watershed-scale models and other tools to help state agencies, local governments, and other watershed stakeholders determine how to best proceed with restoring and protecting lakes and streams. For nonpoint source pollution, this report informs local planning efforts, but ultimately the local partners decide what work will be included in their local plans. This report also serves as a watershed plan addressing the Environmental Protection Agency's (EPA's) Nine Minimum Elements to qualify applicants for eligibility for Clean Water Act Section 319 implementation funds. This report summarizes past assessment and diagnostic work and outlines ways to prioritize actions and strategies for continued implementation.

| | |
|---|---|
| Purpose | • Support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning<br>• Summarize Watershed Approach work done to date including the following reports:<br>  • RWMWD *Watershed Management Plan - 2017-2027 (Draft)*<br>  • *Ramsey-Washington Metro Watershed District TMDL Report - 2017*<br>  • *Battle Creek Stressor Identification Report - 2015*<br>  • *Mississippi River-Twin Cities Monitoring and Assessment Report - 2013*<br>  • *Strategic Lake Management Plans (SLMPs) and Lake Status Reports (LSR) developed for many of the lakes within the RWMWD*<br>  • *Kohlman Lake TMDL Report - 2010* |
| Scope | • Impacts to aquatic recreation and impacts to aquatic life in streams<br>• Impacts to aquatic recreation in lakes |
| Audience | • Local working groups (RWMWD, cities, etc.)<br>• State agencies (MPCA, DNR, BWSR, etc.) |

# 1. Watershed Background and Description

The Ramsey-Washington Metro Watershed District (RWMWD or District) is located in eastern Ramsey County and western Washington County. The RWMWD spans a 64.8-square-mile area and includes all or part of Gem Lake, Landfall, Little Canada, Maplewood, North St. Paul, Oakdale, Roseville, Shoreview, St. Paul, Vadnais Heights, White Bear Lake, and Woodbury. Approximately 53.2 square miles of the area lie within Ramsey County; the remaining 11.6 are within Washington County. Located in the Upper Mississippi River Basin, Twin Cities (8-Digit HUC) watershed, the District is generally bounded on the west by Lexington Parkway, on the north by County Highway 96, on the east by I-694/I-494, and on the south by the Mississippi River. Topography within the District varies from steep river bluffs along the east side of the Mississippi River Valley and southeastern St. Paul, to moderately rolling land in Oakdale, Maplewood and eastern St. Paul, to gently rolling land in White Bear Lake, North St. Paul and Little Canada. The entire District is within the St. Croix Outwash Plain and Stagnations Plains of the North Central Hardwood Forest (NCHF) ecoregion.

The drainage system throughout the RWMWD is characterized by many wetlands, lakes, streams, and conveyance systems, which all eventually drain to the Mississippi River through the Mississippi River Bottomlands area. There are 18 major lakes and 5 streams within the RWMWD, including the Phalen Chain of Lakes, a significant recreational destination. Figure 1-1 depicts the RWMWD Subwatersheds, the existing land use, and the general flow direction from each subwatershed using arrows.

The RWMWD is largely extensively developed and includes a mixture of all types of urban land uses. Although some additional development is likely to occur in select locations, most changes in land use will be the result of redevelopment. Analysis of impervious surfaces within the District as part of the *Detailed Assessment of Phosphorus Sources to Ramsey-Washington Metro Watershed District (Barr 2005)* found that impervious coverage in the various subwatersheds ranged from 21% to 43% impervious, with the average being 34% impervious. Figure 1-2 shows the breakdown of each land use in terms of percent coverage throughout the District.

### *Additional Ramsey-Washington Metro Watershed Resources*

Ramsey-Washington Metro Watershed District Website: *http://www.rwmwd.org/*

MCPA Twin Cities Metropolitan Area Chloride *TMDL* and *Management Plan*

USDA Natural Resources Conservation Service (NRCS) Rapid Watershed Assessment for the Twin Cities HUC 8 Watershed:
*http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mn/technical/dma/rwa/?cid=nrcs142p2_023595*

Minnesota Department of Natural Resources (DNR) Watershed Assessment Mapbook for the Twin Cities HUC 8 Watershed:
*http://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/wsmb20.pdf*

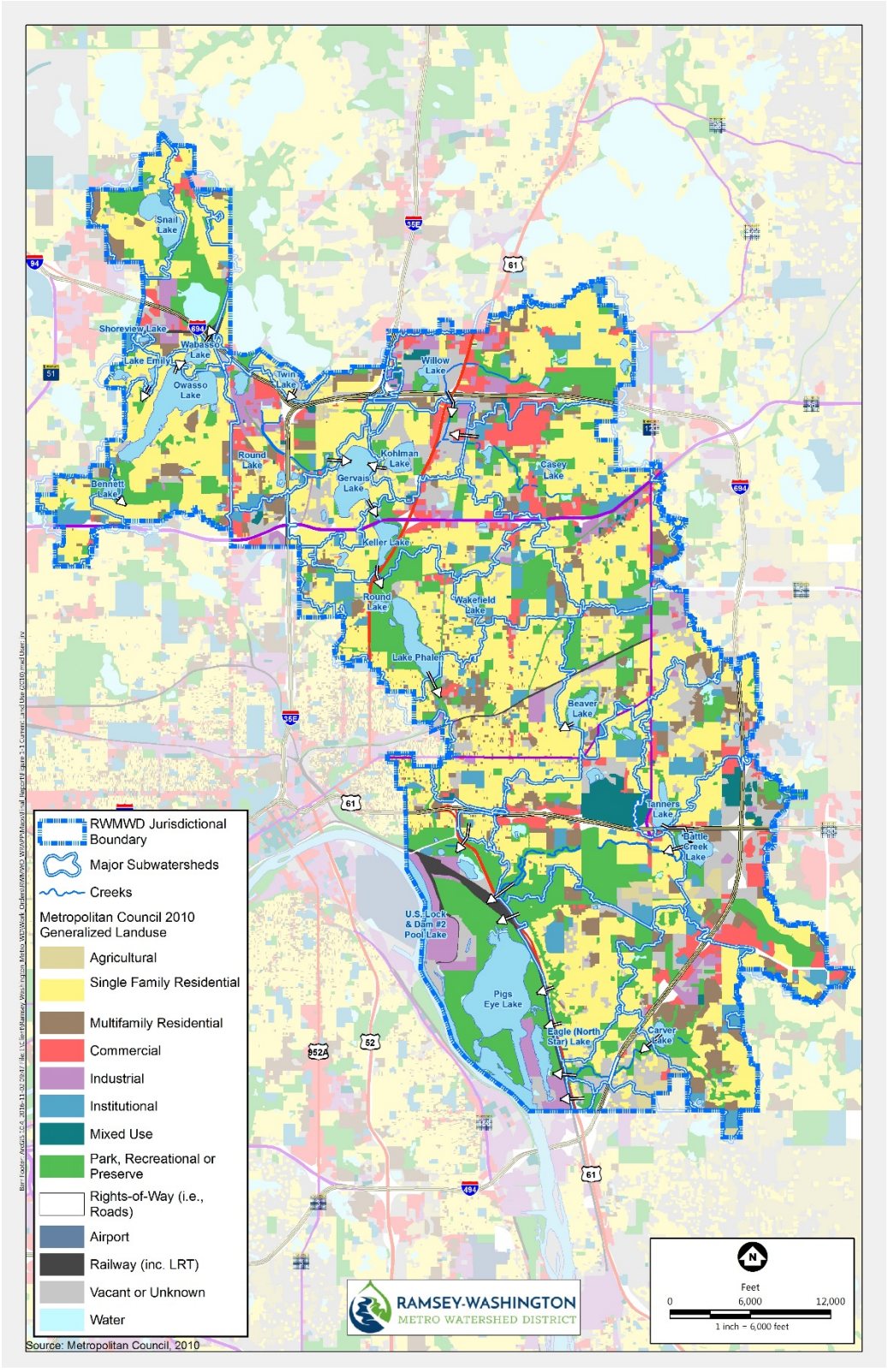



Figure 1-1 Current Land Use (2010)

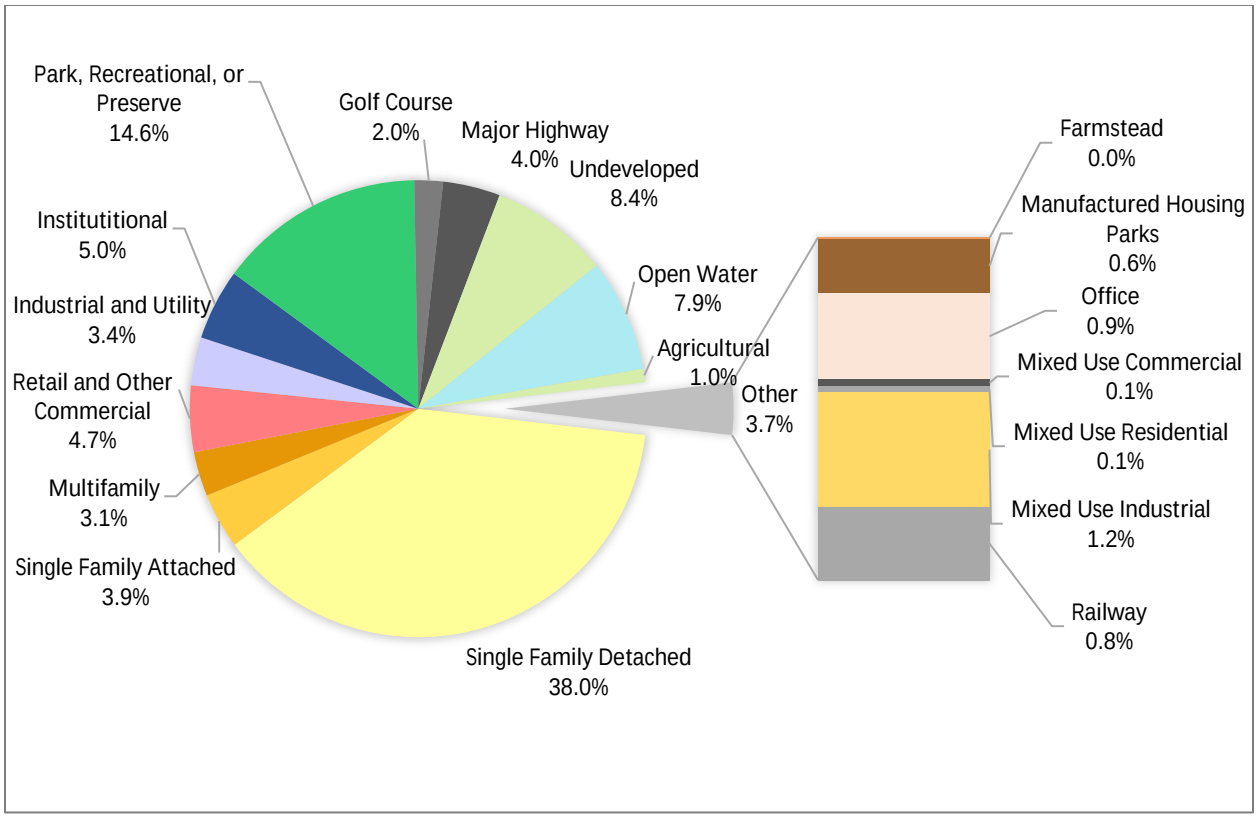



**Figure 1-2 Distribution of Metropolitan Council Land Use Data (2010) in RWMWD**

The *USDA-NRCS Gridded Soil Survey Geographic Database for Ramsey and Washington County (2012)* provides a comprehensive assessment of soils and soil complexes throughout the District. The soils are classified based on the infiltration capacity of the underlying soils (well drained, sandy soils are classified as "A" soils; poorly drained, clayey soils are classified as "D" soils). Soils with a higher infiltration rate have a lower runoff potential. Conversely, soils with low infiltration rate produce high runoff volumes and high peak runoff rates. According to the survey, the underlying soils in the District are predominantly classified as hydrologic soil group B, with moderate infiltration rates. However, soils in many areas of the District have been disturbed due to urban development.

Prior to the RWMWD WRAPS effort, the District had completed strategic lake management plans (SLMPs) for many District-managed lakes. The objectives of the SLMPs were to evaluate the feasibility and appropriateness of the water quality goals, determine whether each lake currently meets its water quality goals, and identify water quality improvement measures throughout the watershed that would help achieve the goals for each lake. For many other lakes, lake status reports (LSRs) had been completed that compiled all the existing data available for each lake. A list of prior SLMPs and LSRs completed for RWMWD waterbodies can be found in the *RWMWD Watershed Management Plan 2017-2027 (RWMWD 2016 (draft).*

*A TMDL study was completed for Kohlman Lake in 2010*. More recently (as a part of this WRAPS report), a watershed-wide TMDL report has been completed to address all of the existing impairments throughout the District, including:

- Wakefield and Bennett Lakes (excess nutrients impairment)
- Battle Creek (aquatic life impairment)
- Fish Creek (aquatic recreation impairment)

The RWMWD watershed-wide TMDL can be found on the MPCA's webpage for the *RWMWD WRAPS Project*.

## 1.1 Watershed Management Plan, Rules, and Policies

The mission of the RWMWD is to preserve and improve water resources and related ecosystems to sustain their long-term health and integrity, and contribute to the well-being and engagement of stakeholders within the community. Specifically, the RWMWD has the following goals:

- **Achieve Quality Surface Water -** Maintain or improve surface water quality to support healthy ecosystems and provide the public with a wide range of water-based benefits. Improving and protecting the quality of surface water and groundwater resources.
- **Support Sustainable Groundwater -** Consider groundwater management in decisions and collaborate with others responsible for groundwater management and protection.
- **Manage Risk of Flooding -** Reduce the public's risk to life and property from flooding through programs and projects that protect public safety and economic well-being. Preserving and enhancing the quantity and quality of wetlands.
- **Achieve Healthy Ecosystems –** Manage water and related natural resources to create and preserve healthy ecosystems.
- **Inform and Empower Communities –** Inform and empower communities to become partners in improving and protecting the watershed through their own efforts.
- **Manage Organization Effectively –** Operate in a manner that achieves the District's mission while adhering to its core principles.

To support their mission and achieve these goals, the RWMWD has adopted rules, implemented policies, and developed a permitting program. These efforts are summarized below and are reflected in greater detail in the *RWMWD Watershed Management Plan 2017-2027 (RWMWD 2017)* (Plan).

The strategies outlined in this WRAPS report pertain primarily to the Plan's "Achieve Surface Water Quality" and "Achieve Healthy Ecosystems" goals, but are also related to "Support Sustainable Groundwater" and "Inform and Empower Communities", especially in terms of protecting resources.

Figure 3-1 of this WRAPS report is cross- referenced with the Implementation Table in the Plan, to indicate how the strategies in this report have been incorporated into the Plan.

The RWMWD's permit program governs how land is redeveloped throughout the District, and has a direct role in the restoration and protection strategies described in this WRAPS report. Private developers and government agencies are required to apply for a grading permit for any grading or filling activity involving more than one acre of land and for any alteration to a wetland or floodplain. Permit requirements include:

1. **Rate Control** – Runoff rates shall not exceed existing runoff rates for the 2-year, 10-year, and 100-year critical storm events using Atlas 14 rainfall magnitudes.

2. **Volume Reduction** – Stormwater runoff volume reduction shall be achieved onsite in the amount of 1.1 inches of runoff from the new and newly reconstructed impervious surfaces.

3. **Water Quality** – Developments must incorporate effective nonpoint source pollution reduction BMPs to achieve 90% Total Suspended Solids (TSSs) removal from the runoff generated by a NURP water quality storm (2.5-inch rainfall) or on an annual basis.

RWMWD adopted *new development rules on April 1, 2015*. Rule changes include revisions to volume reduction requirements, credit given for filtration BMPs, and use of a stormwater reuse calculator to determine volume reduction benefits of reuse systems.

# 2. Watershed Conditions

Water quality in lakes, wetlands and streams is closely linked to watershed conditions and internal waterbody processes. Now that the RWMWD is almost completely urbanized, nutrient and sediment inputs (i.e., loadings) from stormwater runoff can far exceed the natural inputs to its lakes, wetlands, and streams. Stormwater runoff can carry significant amounts of phosphorus from the watershed into a waterbody. Land use changes resulting in increased imperviousness (e.g., urbanization) or land disturbance (e.g., urbanization, construction, or agricultural practices) also result in increased amounts of phosphorus carried in stormwater runoff. The increased runoff from urbanization can also lead to higher stream velocities, resulting in erosion and higher sediment loading to downstream waterbodies. In addition to watershed sources, other sources of phosphorus include atmospheric deposition, internal loading (e.g., release from anoxic sediments, algae die-off, aquatic plant die-back, and fish-disturbed sediment) and non-compliant subsurface sewage treatment systems (SSTS). Non-compliant SSTS also have the potential to add bacteria, and other pollutants to RWMWD waterbodies.

If loadings increase, it is likely that water quality degradation will accelerate, resulting in unpleasant consequences, such as profuse algae growth (algal blooms), reduced diversity of rooted aquatic plants, and fish kills.

## 2.1 Condition Status

There are several RWMWD water bodies that appear on the MPCA's 303(d) list, or Impaired Waters List, for a range of constituents, including: excess nutrients, chloride, mercury in fish tissue, polychlorinated biphenyls (PCBs) in fish tissue, low fish index of biotic integrity (F-IBI), and low macroinvertebrate index of biotic integrity (M-IBI) (Figure 2-1). It is important to note that this report does not cover toxic pollutants (chloride, mercury, PCBs). More information on how TMDLs for these toxic pollutants are handled is discussed later in this section.

Although there are a number of water bodies in the District listed on the *Minnesota Impaired Waters List* that either have an approved TMDL or will soon have an approved TMDL, many of the RWMWD-managed water bodies currently meet the MPCA water quality standards. However, many of these water bodies are just meeting the established standards. In order to prevent further degradation of these water bodies and future listing on the 303(d) list, the RWMWD will implement protection measures to maintain (or improve) the water quality in these resources as described in Table 3-1.

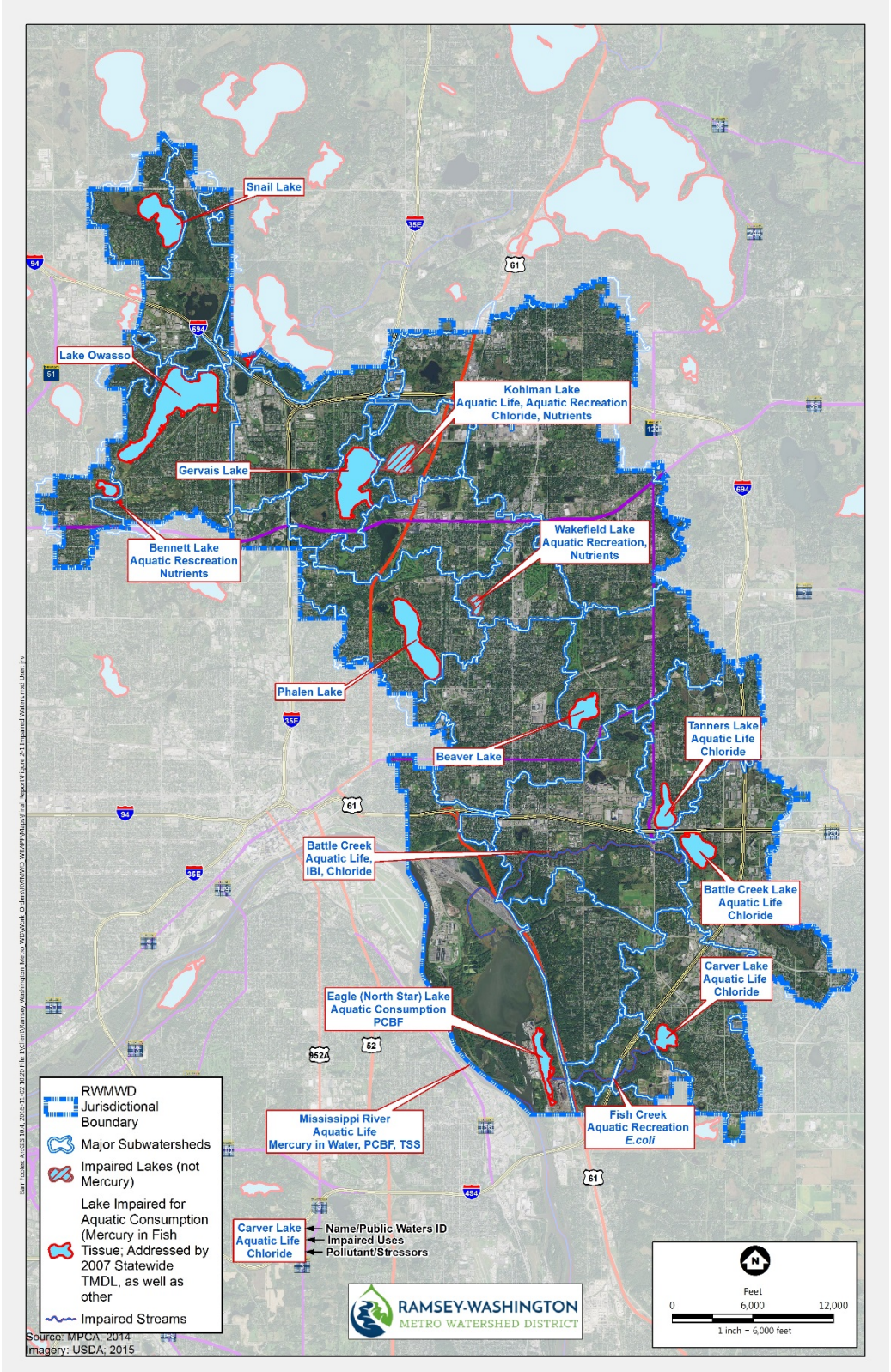



Figure 2-1 Impaired Waters

## Streams

There are several small streams within the RWMWD. However, only two of the streams have sufficient data to assess the beneficial uses. These two streams are Fish Creek and Battle Creek. Table 2-1 summarizes the beneficial use data for the various streams in the RWMWD. The data included in Table 2-1 is based on data available through the *MPCA Environmental Data Access (EDA) database*, and is generally listed from upstream to downstream locations in the RWMWD.

According to the *MPCA's Minnesota Nutrient Criteria Development for Rivers (Draft, MPCA 2013),* the TP eutrophication criteria for streams in Minnesota ranges from 50 µg TP/L to 150 µg TP/L. For streams in the Central River Nutrient Region (including Battle Creek), the criteria are that TP should remain below 100 µg TP/L (≤100 µg TP/L).

TSS standards for rivers and streams were adopted at the June 24, 2014, MPCA Citizen Board meeting. The standard that is applicable to Battle Creek, located in the Central River Nutrient Region, is 30 mg/L. Additional information about the TSS water quality standard in Minnesota (Minn. R. ch. 7050) can be found here: *https://www.revisor.mn.gov/rules/?id=7050*.

Battle Creek was listed for elevated concentrations of chloride on the 2008 303(d) list. During the 2012 assessment, the MPCA determined that Battle Creek should be listed on the 2014 303(d) list due to low scores on the Fish and Invertebrate Indices of Biotic Integrity (IBI). Fish Creek was also listed on the 2014 303(d) list due to elevated levels of *E. coli* bacteria.

**Table 2-1 Assessment status of stream reaches in the Ramsey-Washington Metro District**

| HUC-10 Sub-watershed | AUID (Last 3 digits) | Stream | Reach Description | Aquatic Life | | | | | Aq Rec | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Fish Index of Biotic Integrity | Macroinvertebrate Index of Biotic Integrity | Dissolved Oxygen | Chloride | Turbidity/TSS | Bacteria | RWMWD Nutrient Classification |
| City of St. Paul Mississippi River | 543 | Unnamed Creek (Willow Lake Outlet) | Willow Lake to Unnamed Creek | NA | NA | NA | NA | NA | NA | NA |
| City of St. Paul Mississippi River | 758 | Unnamed Creek (Kohlman Creek) | Unnamed Ditch to Beam Pond | NA | NA | NA | NA | NA | NA | At Risk[1] |
| City of St. Paul Mississippi River | 591 | Unnamed Creek (Kohlman Creek) | Beam Pond to Unnamed Creek (Willow Creek) | NA | NA | NA | NA | NA | NA | At Risk[1] |

| HUC-10 Sub-watershed | AUID (Last 3 digits) | Stream | Reach Description | Aquatic Life | | | | | Aq Rec | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Fish Index of Biotic Integrity | Macroinvertebrate Index of Biotic Integrity | Dissolved Oxygen | Chloride | Turbidity/TSS | Bacteria | RWMWD Nutrient Classification |
| City of St. Paul Mississippi River | 544 | Unnamed Creek (Willow Lake Outlet) | Unnamed Creek to Kohlman Lake | NA | NA | NA | NA | NA | NA | NA |
| City of St. Paul Mississippi River | 546 | Unnamed Creek (Kohlman Lake Outlet) | Kohlman Lake to Gervais Lake | NA | NA | NA | NA | NA | NA | Stable |
| City of St. Paul Mississippi River | 910 | Unnamed Creek (Gervais Creek) | To Gervais Lake | NA | NA | NA | NA | NA | NA | At Risk[1] |
| City of St. Paul Mississippi River | 609 | Unnamed Creek | Gervais Lake to Keller Lake | NA | NA | NA | NA | NA | NA | Stable |
| City of St. Paul Mississippi River | 611 | Unnamed Creek | Keller Lake to Round Lake | NA | NA | NA | NA | NA | NA | Stable |
| City of St. Paul Mississippi River | 613 | Unnamed Creek | Round Lake to Phalen Lake | NA | NA | NA | NA | NA | NA | Stable |
| City of St. Paul Mississippi River | 587 | Unnamed Creek | Headwaters to Wakefield Lake | NA | NA | NA | NA | NA | NA | At Risk[1] |
| City of St. Paul Mississippi River | 747 | Unnamed Creek | Wakefield Lake to Phalen Lake | NA | NA | NA | NA | NA | NA | Stable |
| City of St. Paul Mississippi River | 615 | Unnamed Creek | Phalen Lake to Unnamed Ditch | NA | NA | NA | NA | NA | NA | Stable |
| City of St. Paul Mississippi River | 616 | Unnamed Creek | Unnamed Ditch to Mississippi River | NA | NA | NA | NA | NA | NA | NA |

| HUC-10 Sub-watershed | AUID (Last 3 digits) | Stream | Reach Description | Aquatic Life | | | | | Aq Rec | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Fish Index of Biotic Integrity | Macroinvertebrate Index of Biotic Integrity | Dissolved Oxygen | Chloride | Turbidity/TSS | Bacteria | RWMWD Nutrient Classification |
| City of St. Paul Mississippi River | 606 | Fish Creek | Carver Lake to Unnamed (North Star) Lake | IF | IF | IF | NA* | IF | Imp | At Risk[1] |
| City of St. Paul Mississippi River | 592 | Battle Creek | Battle Creek Lake to Pigs Eye Lake | Imp | Imp | IF | Imp | Imp | IF | Impaired[2] |

*At risk for chloride impairment

Sup = found to meet the water quality standard, Imp = does not meet the water quality standard and therefore, is impaired, IF = the data collected was insufficient to make a finding, NA = not assessed

[1]Water quality monitoring data indicates that total phosphorus concentrations may exceed the State standard for TP.
[2]Impaired for excess TSS, which is associated with TP

### *Battle Creek*

Battle Creek is currently impaired by chloride. Chloride impairments in TCMA are being handled through the MPCA's TCMA Chloride TMDL and Management Plan, which will lay out strategies for addressing chloride impacts to our surface waters for the seven-county metropolitan area. For more information on this project, see the *MPCA's TCMA Chloride Project website*.

Battle Creek was listed as impaired in 2014 for degraded fish and macroinvertebrate biological community health. The biological *Battle Creek Stressor Identification (SID) Report (Bar 2015*) was completed in spring 2015 using the United States EPA's Causal Analysis/Diagnosis Decision Information System (CADDIS). The SID report found that chloride and TSS are the primary stressors to the fish and macroinvertebrate assemblages within Battle Creek. Additionally, analysis of TSS water quality data found that Battle Creek is impaired by TSS based on the MPCA water quality standard for Class 2B streams in the Central River Nutrient Region. The SID study identified total phosphorus as a probably secondary stressor (likely associated with TSS loading). Therefore, the District has assigned a RWMWD nutrient water quality classification of Impaired to Battle Creek.

### *Fish Creek*

Fish Creek was placed on the 2014 303(d) list due to elevated levels of *E. coli*. *E. coli* bacteria is used in water quality monitoring as an indicator organism to identify water that is contaminated with human or animal waste and the accompanying disease-causing organisms. Bacterial abundance in excess of the water quality standards can pose a human health risk.

Based on an average phosphorus concentration exceeding the MPCA stream eutrophication standards, the District has assigned a RWMWD nutrient water quality classification of At Risk to Fish Creek.

### *Willow Creek*

Willow Creek has not been assessed relative to these standards by the MPCA. Due to lack of data, the District has not assigned a RWMWD nutrient water quality classification to Willow Creek (NA).

### *Kohlman Creek*

Kohlman Creek has not been assessed relative to these standards by the MPCA. Based on water quality data collected in 2011 and available from the MPCA website, the District has assigned a RWMWD nutrient water quality classification of At Risk to Kohlman Creek.

### *Gervais Creek*

Recent monitoring data indicates the creek likely exceeds the MPCA's stream water quality standard for total phosphorus, although the creek is not listed as impaired by nutrients. Thus, the District has assigned a RWMWD nutrient water quality classification of At Risk to Gervais Creek.

## Lakes

Table 2-2 summarizes the beneficial use data for the various lakes in the RWMWD, as well as the status of TMDL for the various impairments (if applicable). The data included in Table 2-2 are based on data available through the *MPCA Environmental Data Access (EDA) Database*.

Lake impairments are based on an aquatic recreation standard centered on protecting the ability to recreate on and in Minnesota waters. This is considered a Class 2 standard. Additionally, lakes can also be listed as impaired based on aquatic life or aquatic consumption standards.

Several of the lakes are listed with impairment to aquatic recreation with a pollutant or stressor classification of Nutrient/Eutrophication Biological Indicators (excess nutrients). The eutrophication standards applied are based on the ecoregion and lake depth. *Minn. R. 7050.0222, subp. 4: Class 2B Waters* outlines the water quality criteria by ecoregion. This rule establishes the eutrophication criteria for deep and shallow lakes (shallow lakes are lakes with a maximum depth of 15 feet or a littoral area of 80% or more). The lakes included in this plan are all located within the NCHF ecoregion.

**Table 2-2 Assessment status of lakes in the Ramsey-Washington Metro Watershed District**

| HUC-10 Sub-watershed | Lake ID | Lake | Aquatic Recreation | Aquatic Consumption | Aquatic Life | Comments | RWMWD Nutrient Classification[1] |
|---|---|---|---|---|---|---|---|
| City of St. Paul-Mississippi River | 82-0091 | Battle Creek | Sup | Imp (Mercury FCA) | Imp (Chloride) | Statewide Mercury TMDL completed in 2007; Delisted for Nutrients in 2012; TCMA Chloride TMDL completed February, 2016 | At Risk |
| City of St. Paul-Mississippi River | 62-0016 | Beaver | Sup | Imp (Mercury FCA) | IF* | Statewide Mercury TMDL completed in 2007; Delisted for Nutrients in 2012 | At Risk |
| City of St. Paul-Mississippi River | 62-0048 | Bennett | Imp (Excess Nutrients) | Imp (Mercury Food Consumption Advisory) | IF* | Statewide Mercury TMDL completed in 2007; Nutrient TMDL to be completed in 2017 | Impaired |
| City of St. Paul-Mississippi River | 82-0166 | Carver | Sup | Imp (Mercury FCA) | Imp (Chloride) | Statewide Mercury TMDL completed in 2007; Delisted for Nutrients in 2012; TCMA Chloride TMDL completed February, 2016 | At Risk |
| City of St. Paul-Mississippi River | 62-0237 | Eagle Lake (North Star Lake) | NA | Imp (Mercury and PCB Food Consumption Advisories) | NA | Statewide Mercury TMDL completed in 2007; Target completion date for PCB TMDL is 2025. | NA |
| City of St. Paul-Mississippi River | 62-0080 | Emily[2] | IF | NA | NA | | At Risk |
| City of St. Paul-Mississippi River | 62-0007 | Gervais | Sup | Imp (Mercury Food Consumption Advisory) | IF* | Statewide Mercury TMDL completed in 2007 | Stable |
| City of St. Paul-Mississippi River | 62-0010 | Keller | Sup | IF | IF* | Delisted for Nutrients in 2012 | Stable |

| HUC-10 Sub-watershed | Lake ID | Lake | Aquatic Recreation | Aquatic Consumption | Aquatic Life | Comments | RWMWD Nutrient Classification[1] |
|---|---|---|---|---|---|---|---|
| City of St. Paul-Mississippi River | 62-0006 | Kohlman | Imp (Excess Nutrients) | IF | Imp (Chloride) | Nutrient TMDL approved in 2010; TCMA Chloride TMDL completed February 2016 | Impaired |
| City of St. Paul-Mississippi River | 62-0056 | Owasso | IF | Imp (Mercury Food Consumption Advisory) | IF | Statewide Mercury TMDL completed in 2007 | At Risk |
| City of St. Paul-Mississippi River | 62-0013 | Phalen | Sup | Imp (Mercury Food Consumption Advisory) | IF | Statewide Mercury TMDL completed in 2007 | Stable |
| City of St. Paul-Mississippi River | 62-0009 | Round (in Little Canada) | IF | NA | NA | | At Risk |
| City of St. Paul-Mississippi River | 62-0012 | Round (in Maplewood) | Sup | IF | IF | Delisted for Nutrients in 2007 | Stable |
| City of St. Paul-Mississippi River | 62-0079 | Shoreview | IF | NA | NA | | At Risk |
| City of St. Paul-Mississippi River | 62-0073 | Snail | Sup | Imp (Mercury Food Consumption Advisory) | IF | Statewide Mercury TMDL completed in 2007 | Stable |
| City of St. Paul-Mississippi River | 82-0115 | Tanners | Sup | Imp (Mercury Food Consumption Advisory) | Imp (Chloride) | Originally listed for excess nutrients, but delisted in 2004 due to improvements; Statewide Mercury TMDL completed in 2007; TCMA Chloride TMDL completed February 2016 | Stable |
| City of St. Paul-Mississippi River | 62-0039 | Twin | Sup | NA | IF | | Stable |

| HUC-10 Sub-watershed | Lake ID | Lake | Aquatic Recreation | Aquatic Consumption | Aquatic Life | Comments | RWMWD Nutrient Classification[1] |
|---|---|---|---|---|---|---|---|
| City of St. Paul-Mississippi River | 62-0082 | Wabasso | Sup | NA | IF* | | Stable |
| City of St. Paul-Mississippi River | 62-0011 | Wakefield | Imp (Excess Nutrients) | NA | IF* | Nutrient TMDL to be completed in 2017 | Impaired |
| City of St. Paul-Mississippi River | 62-0040 | Willow | NA | NA | NA | | Stable |

*At risk for chloride impairment.

[1]RWMWD nutrient classifications are based on the relationship between the historic average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards**.**

**Stable** indicates water bodies with water quality that consistently meet the MPCA water quality (phosphorus) standards.

**At-Risk** indicate water bodies with water quality that just meets the MPCA water quality (phosphorus) standards but could potentially be listed as impaired in the future.

**Impaired** indicates water bodies that do not currently meet the MPCA water quality (phosphorus) standards and are currently listed as impaired.

**NA** indicates that there is insufficient water quality data to determine the RWMD nutrient classification.

[2]Insufficient data for classification, but available data indicates waterbody may be impaired.

Sup = found to meet the water quality standard, Imp = does not meet the water quality standard and therefore, is impaired, IF = the data collected was insufficient to make a finding, NA = not assessed

Many of the lakes listed in Table 2-2 are impaired by mercury, and one lake (Eagle Lake/North Star Lake) is listed as impaired by PCBs, due to a Minnesota Department of Health fish consumption advisory (FCA) limitation that is more restrictive than one meal per week. The mercury in Minnesota fish comes almost entirely from atmospheric deposition, with approximately 90% originating outside of Minnesota (*MPCA 2009).* Because the main source of mercury comes from outside the state and the atmospheric deposition of mercury is relatively uniform across the state, the MPCA developed a statewide TMDL, approved in 2007 and amended annually. However, beyond summarizing the lakes with mercury and PCB impairments, this RWMWD WRAPS Report does not cover toxic pollutants (mercury and PCBs). For more information on the mercury impairments see the statewide mercury TMDL at:

*http://www.pca.state.mn.us/index.php/water/water-types-and-programs/minnesotas-impaired-waters-and-tmdls/tmdl-projects/special-projects/statewide-mercury-tmdl-pollutant-reduction-plan.html*

The statewide approach for addressing PCB impairments has not yet been determined.

Several lakes are impaired by chloride (Battle Creek Lake, Carver Lake, Kohlman Lake and Tanners Lake). Chloride impairments in TCMA have been addressed through the *MPCA's TCMA Chloride TMDL* and *Management Plan*.

## 2.2 Water Quality Trends

Many of the major lakes within the RWMWD have long-term historical water quality records, due to the monitoring program supported by the District. Each year, the RWMWD performs trend analyses on the

lake water quality data. The trend analyses are used to determine if the lakes in the watershed have experienced significant degradation or improvement during all (or a portion of) the years for which water quality data are available. Summer-average values (the typical averaging period was June through September to be consistent with the MPCA's method for evaluating lake water quality) were calculated and analyzed to determine water quality trends.

Long-term trends are typically determined using statistical methods (i.e., linear regression and analysis of variance). Trend analyses were run for two different time periods. The first period was for the most recent 10 years of water quality data, evaluating the same time period that the MPCA typically considers when looking at listing surface waters for water quality impairment on the 303(d) list. The second considered a period with complete water quality data for all three water quality parameters.

The Mann-Kendall/Sen's Slope Trend Test was used to determine water quality trends and their significance. To complete the trend test, the calculated summer average must be based on at least four measured values during the sampling season and at least five years of data are required. The trend was considered significant if the slope of the regression was statistically significant at the 95% confidence interval. Also, to conclude an improvement requires concurrent decreases in TP and Chlorophyll-*a* concentrations, as well as increases in Secchi disk transparences; a conclusion of degradation requires the inverse of the relationship above. Table 2-3 summarizes the most recent trend analysis information for lakes in the RWMWD.

Additionally, Metropolitan Council Environmental Services (MCES) in partnership with the RWMWD operates Watershed Outlet Monitoring Program (WOMP) stations at the outlets of Battle Creek and Fish Creek. The MCES recently compiled the long-term flow and water quality data for all of their WOMP stations throughout the TCMA and have performed trend analyses on several water quality parameters. A WOMP station is also operated on the Beltline Interceptor; however, MCES did not perform trend analyses on the Beltline Interceptor data. Table 2-4 summarizes the results of the trend analyses performed by the MCES on the streams in RWMWD.

**Table 2-3 Water quality trends of the Lakes in the Ramsey-Washington Metro Watershed District**

| Water Resource | Dataset Date Range | Parameter | Trend, Entire Historic Dataset | Trend, Last 10 years (2003-2012) |
|---|---|---|---|---|
| Battle Creek Lake | 1997 - 2012 | Secchi Depth | Improving | Improving* |
| | | Total Phosphorus | Improving | No Trend |
| | | Chlorophyll-*a* | Improving* | No Trend |
| Beaver Lake | 1984 - 2012 | Secchi Depth | Improving | No Trend |
| | | Total Phosphorus | Improving | No Trend |
| | | Chlorophyll-*a* | Improving | No Trend |
| Bennett Lake | 1984 - 2012 | Secchi Depth | Improving | Improving |
| | | Total Phosphorus | Improving | Improving |
| | | Chlorophyll-*a* | Improving | Improving |
| Carver Lake | 1997 - 2012 | Secchi Depth | No Trend | No Trend |
| | | Total Phosphorus | Improving* | No Trend |
| | | Chlorophyll-*a* | No Trend | No Trend |
| | -- | Secchi Depth | -- | -- |

| Water Resource | Dataset Date Range | Parameter | Trend, Entire Historic Dataset | Trend, Last 10 years (2003-2012) |
|---|---|---|---|---|
| Eagle Lake (Northstar) | | Total Phosphorus | -- | -- |
| | | Chlorophyll-*a* | -- | -- |
| Lake Emily | 1980 - 2012 | Secchi Depth | Improving* | Degrading* |
| | | Total Phosphorus | No Trend | No Trend |
| | | Chlorophyll-*a* | No Trend | No Trend |
| Gervais Lake | 1981 - 2012 | Secchi Depth | Improving | No Trend |
| | | Total Phosphorus | Improving | No Trend |
| | | Chlorophyll-*a* | Improving | No Trend |
| Keller Lake | 1981 - 2012 | Secchi Depth | Improving | No Trend |
| | | Total Phosphorus | Improving | Improving |
| | | Chlorophyll-*a* | Improving | Improving* |
| Kohlman Lake | 1981 - 2012 | Secchi Depth | Improving | No Trend |
| | | Total Phosphorus | Improving | Improving* |
| | | Chlorophyll-*a* | Improving* | No Trend |
| Shoreview Lake | 2009 | Secchi Depth | -- | -- |
| | | Total Phosphorus | -- | -- |
| | | Chlorophyll-*a* | -- | -- |
| Lake Owasso | 1948 - 2012 | Secchi Depth | No Trend | No Trend |
| | | Total Phosphorus | Improving | Improving* |
| | | Chlorophyll-*a* | No Trend | No Trend |
| Lake Phalen | 1981 - 2012 | Secchi Depth | Improving* | Degrading* |
| | | Total Phosphorus | Improving | No Trend |
| | | Chlorophyll-*a* | Improving* | No Trend |
| Round Lake (in Maplewood) | 1981 - 2012 | Secchi Depth | Improving | No Trend |
| | | Total Phosphorus | Improving | No Trend |
| | | Chlorophyll-*a* | Improving | No Trend |
| Round Lake (in Little Canada) | -- | Secchi Depth | -- | -- |
| | | Total Phosphorus | -- | -- |
| | | Chlorophyll-*a* | -- | -- |
| Snail Lake | 1974 - 2012 | Secchi Depth | Improving | Improving* |
| | | Total Phosphorus | Improving | No Trend |
| | | Chlorophyll-*a* | Improving | No Trend |
| Tanners Lake | 1997 - 2012 | Secchi Depth | Improving* | No Trend |
| | | Total Phosphorus | Improving | No Trend |
| | | Chlorophyll-*a* | Improving* | Degrading* |
| Twin Lake | 1996 - 2012 | Secchi Depth | No Trend | Improving* |
| | | Total Phosphorus | No Trend | No Trend |
| | | Chlorophyll-*a* | No Trend | Improving* |
| Lake Wabasso | 1959 - 2012 | Secchi Depth | No Trend | No Trend |
| | | Total Phosphorus | Improving* | No Trend |
| | | Chlorophyll-*a* | No Trend | No Trend |
| Wakefield Lake | 1984 - 2012 | Secchi Depth | Improving | Improving |

| Water Resource | Dataset Date Range | Parameter | Trend, Entire Historic Dataset | Trend, Last 10 years (2003-2012) |
|---|---|---|---|---|
| | | Total Phosphorus | Improving | Improving* |
| | | Chlorophyll-*a* | Improving* | Improving |
| Willow Lake | -- | Secchi Depth | -- | -- |
| | | Total Phosphorus | -- | -- |
| | | Chlorophyll-*a* | -- | -- |

* Trend was detectable, but was below the 95th percentile confidence interval.
-- No (or insufficient) water quality data available.
Green values indicate an improving trend in water quality for that parameter

**Table 2-4 Water quality trends of the creeks in the Ramsey-Washington Metro Watershed District**

| Stream | Water Quality Criteria | Water Quality Trend | Percent Change |
|---|---|---|---|
| Battle Creek | Total Suspended Solids | Improving Trend | -77% |
| | Total Phosphorus | Improving Trend | -56% |
| | Nitrate | Degrading Trend | 27% |
| Fish Creek | Total Suspended Solids | Improving Trend | -37% |
| | Total Phosphorus | Improving Trend | -47% |
| | Nitrate | Improving Trend | -21% |
| Gervais Creek* Kohlman Creek* Willow Creek* | Total Suspended Solids | NA | NA |
| | Total Phosphorus | NA | NA |
| | Nitrate | NA | NA |

*Trend analyses have not yet been completed for Kohlman, Willow and Gervais Creeks, though data is being collected to support trend analyses in the future.

Green values indicate an improving trend in water quality for that parameter.
Red values indicate a degrading trend in water quality for that parameter.

## 2.3 Stressors and Sources

In order to develop appropriate strategies for restoring or protecting waterbodies the stressors, and/or sources impacting or threatening them must be identified and evaluated. Biological SID is done for streams with fish and/or macroinvertebrate biota impairments and encompasses both evaluation of pollutants and non-pollutant-related (e.g. altered hydrology, fish passage, habitat) factors as potential stressors. Pollutant source assessments are done where a biological SID process identifies a pollutant as a stressor, as well as for the typical pollutant impairment listings.

## Stressors of Biologically-Impaired Stream Reaches

In 2014, Battle Creek was placed on the draft MPCA 303(d) impaired waters list in need of a study for impaired biota due to low F-IBI score and low M-IBI score. Battle Creek was listed on the draft 2014 303(d) list for both fish and aquatic macroinvertebrates. Other streams in RWMWD have not been assessed. As such, none of the other streams in RWMWD have been listed as having fish or macroinvertebrate (biotic) impairments and stressors have not been evaluated for these resources.

SID is a formal and rigorous process that identifies stressors causing biological impairment of aquatic ecosystems, and provides a structure for organizing the scientific evidence supporting the conclusions (Cormier et al. 2000). In simpler terms, it is the process of identifying the major factors causing harm to fish and aquatic macroinvertebrates. SID is a key component of the major watershed restoration and protection projects being carried out under Minnesota's Clean Water Legacy Act (CWLA).

The purpose of SID is to explain the relationship between stressors and the degraded biological condition. It looks at causal factors – negative ones harming fish and insects, and positive ones leading to healthy biology. Stressors may be physical, chemical, or biological.

The *Battle Creek Stressor Identification Study (Barr 2015)* was initiated to find and evaluate factors, either natural or anthropogenic, which are likely responsible for the impaired condition of the fish and macroinvertebrate communities in Battle Creek. Biological, chemical, and physical data from Battle Creek were analyzed to determine candidate causes for the biological impairments. After examining many candidate causes, the stressors listed in Table 2-5 were identified as candidate causes of stress to aquatic life in Battle Creek.

**Table 2-5 Primary stressors to aquatic life in biologically-impaired reaches in the Ramsey-Washington Metro Watershed**

| HUC-10 Subwater-shed | AUID (Last 3 digits) | Stream | Reach Description | Biological Impairment | Primary Stressor | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Excess Sediment | Specific Conductance and Chloride | Dissolved Oxygen and BOD | Excess Total Phosphorus | Altered Habitat | Habitat Fragmentation | Metal Toxicity |
| City of Saint Paul-Mississippi River | 592 | Battle Creek | Battle Creek Lake to Pigs Eye Lake | Fish | ● | ○ | ●* | ◐ | ○ | ◐ | ○ |
| | 592 | Battle Creek | Battle Creek Lake to Pigs Eye Lake | Aquatic Macroinverte brates | ● | ● | ○ | ● | ◐ | ○ | ○ |

● = probable primary stressor; ◐ = probable secondary stressor; ○ = inconclusive stressor;

●* = probably station-specific primary stressor (e.g., DO impairment immediately downstream of detention areas)

Recommendations for each of the candidate causes discussed as well as inconclusive causes identified in are presented in Table 2-6. This table additionally outlines recommended management actions and monitoring efforts related to lower priority stressors and inclusive candidate causes.

Table 2-6 Recommendations to address biological impairment in Battle Creek

| Stressor | Priority | Recommendations |
|---|---|---|
| **Candidate Causes** | | |
| Excess Sediment | High | · Create and implement TMDL for sediment loading (TSS loading).<br>· TMDL should focus on watershed sediment loading, as well as sediment loading from the immediate stream channel. |
| Specific Conductance and Chloride | High | · Follow recommendations in the TCMA Chloride TMDL and Management Plan. |
| Dissolved Oxygen and BOD | Medium-High | · Increase longitudinal DO and BOD monitoring efforts along Battle Creek<br>· Efforts should focus on determining (a) whether or not DO impairment is limited to stations immediately downstream of detention areas and (b) the source of DO impairment (BOD? TP? Temperature? In-stream detention? Low Flow? Chl-a? Etc.).<br>· Consider (a) longitudinal deployment of continuous dissolved oxygen monitoring sensors and (b) additional pre-9 AM synoptic surveying efforts during the growing season. Simultaneous measurements of DO, BOD, TP, temperature, and flow will help determine potential sources of DO impairment. |
| Excess Total Phosphorus | Medium | · Continue longitudinal monitoring of TP concentrations.<br>· TP monitoring should be conducted during TSS monitoring associated with sediment loading TMDL (to determine if reduced TSS loading also reduces TP loading). |
| Altered Habitat | Medium | · Continue MSHA surveying and request quantitative substrate measurements be taken during each survey.<br>· Monitor survey results throughout sediment loading TMDL. |
| Habitat Fragmentation | Low | · Reassess biological metric impacts after other primary and secondary stressors addressed. |
| Metal Toxicity | Low | · Monitor concentrations of Cd, Cu, Pb, and Zn throughout sediment loading TMDL (to determine if reduced sediment loading reduces metal toxicity).<br>· Reassess biological metric impacts after other primary and secondary stressors addressed. |
| **Inconclusive Causes** | | |
| pH | Unknown | · Expand pH monitoring efforts along Battle Creek.<br>· Include pH in event-based sampling at station 99UM075 (WOMP station).<br>· Include pH in future synoptic surveys (include pH flux monitoring). |
| Altered Hydrology | Unknown | · Continue flow monitoring at station 99UM075, and consider installing flow monitoring stations further upstream (potentially upstream and downstream of McKnight Basin).<br>· Continue vegetation clearing and sediment removal maintenance efforts. |

### *Pollutant source*

In general, there are two forms of pollutant sources to a waterbody: nonpoint (non-permitted) sources and point (permitted) sources. Nonpoint pollution refers to water pollution from sources such as land runoff, atmospheric deposition, drainage, seepage, and/or hydrologic modification. Point sources can be defined as any discernible, discrete conveyance (i.e., pipe, ditch, channel, etc.) from which pollutants are, or may, be discharged to a waterbody. In many situations, commercial or industrial companies that produce point source pollution require permits.

Stormwater runoff carries with it a number of contaminants affecting water quality, human health, recreation, habitat and aesthetics. The principal pollutants found in runoff include nutrients (such as phosphorus), sediments, organic materials, pathogens, hydrocarbons, metals, pesticides, chlorides, trash and debris. Additionally, non-compliant septic systems can also contribute pollutants such as nutrients and pathogens (e.g. bacteria) to resources.

Table 2-7, developed using information from the Minnesota Urban Small Sites Best Management Practice (BMP) Manual (Barr 2001), summarizes the typical sources of these pollutants and their impacts. Of these pollutants, the RWMWD recognizes that phosphorus and suspended sediment are particularly detrimental to the ecological functions and recreational use of lakes, streams, and wetlands.

**Table 2-7 Principal Pollutants in Stormwater Runoff**

| Stormwater Pollutant | Examples of Sources | Related Impacts |
|---|---|---|
| **Chlorides** | Road salting and uncovered salt storage | Toxicity of water column and sediment |
| **Hydrocarbons**: Oil and Grease, PAHs (Naphthalenes, Pyrenes) | Industrial processes; automobile wear, emissions & fluid leaks; waste oil | Toxicity of water column and sediment, bioaccumulation in aquatic species and through food chain |
| **Metals**: Lead, Copper, Cadmium, Zinc, Mercury, Chromium, Aluminum, others | Industrial processes, normal wear of auto brake linings and tires, automobile emissions & fluid leaks, metal roofs | Toxicity of water column and sediment, bioaccumulation in aquatic species and through the food chain, fish kill |
| **Nutrients:** Nitrogen, Phosphorus | Animal waste, fertilizers, failing septic systems | Algal growth, reduced clarity, other problems associated with eutrophication (oxygen deficit, release of nutrients and metals from sediments) |
| **Organic Materials** | Leaves, grass clippings | Oxygen deficit in receiving water body, fish kill |
| **Pathogens**: Bacteria, Viruses | Animal waste, failing septic systems | Human health risks via drinking water supplies, contaminated swimming beaches |
| **Pesticides**: PCBs, Synthetic Chemicals | Pesticides (herbicides, insecticides, fungicides, rodenticides, etc.), industrial processes | Toxicity of water column and sediment, bioaccumulation in aquatic species and through the food chain, fish kill |
| **Polycyclic Aromatic Hydrocarbons (PAHs)** | Tar based pavement sealant | Carcinogenic to humans |
| **Sediments**: Suspended and Deposited | Construction sites, other disturbed and/or non-vegetated lands, eroding banks, road sanding | Increased turbidity, reduced clarity, lower dissolved oxygen, deposition of sediments, smothering of aquatic habitat including spawning sites, sediment and benthic toxicity |
| **Trash and Debris** | Litter washed through storm drain networks | Degradation of the beauty of surface waters, threat to wildlife |

Based on Minnesota Urban Small Sites BMP Manual (Barr 2001).

One strategy to control point source pollution is through the issuance of permits. Point sources, or permitted sources of phosphorus, are those that require a National Pollution Discharge Elimination System (NPDES)/State Disposal System (SDS) Permit (Permit) and are referred to as permitted sources. Examples of typical permitted sources in the District include the following:

- **Phase II Municipal Stormwater NPDES/SDS General Permit** - Includes coverage of municipal separate storm sewer systems (MS4s) which are publicly owned or operated stormwater infrastructure used solely for stormwater and often include cities, townships, and public institutions. The goal of the MS4 General Permit is to improve the water quality of urban stormwater runoff and reduce pollutants in stormwater discharges.
- **Construction Stormwater NPDES/SDS General Permit** – Includes coverage of any construction activities disturbing one acre of more of soil, less than one acre of soil when part of a larger development that is more than one acre, or less than one acre when the MPCA determines the activity to pose a risk to water resources. The goal of the construction stormwater permit is to control erosion and reduce the amount of sediments and other pollutants being transported by runoff from construction sites.
- **Multi-Sector Industrial Stormwater NPDES/SDS General Permit** – Includes coverage of stormwater discharges associated with a variety of industrial activities. The goal is to reduce the amount of pollution that enters surface and ground water from industrial facilities in the form of stormwater runoff.

Table 2-8 summarizes the point (permitted) sources within the RWMWD.

**Table 2-8 Point Sources in the Ramsey-Washington Metro Watershed District**

| HUC-10 Subwatershed | Point Source | | | Pollutant reduction needed beyond current permit conditions/limits? | Notes |
|---|---|---|---|---|---|
| | Name | Permit # | Type | | |
| City of Saint Paul-Mississippi River | City of Gem Lake | MS400020 | Municipal stormwater (MS4) | No | |
| City of Saint Paul-Mississippi River | City of Landfall | MS400025 | Municipal stormwater (MS4) | No | |
| City of Saint Paul-Mississippi River | City of Little Canada | MS400029 | Municipal stormwater (MS4) | No | |
| City of Saint Paul-Mississippi River | City of Maplewood | MS400032 | Municipal stormwater (MS4) | Yes | Kohlman Lake TMDL, Wakefield TMDL, Fish Creek TMDL, Battle Creek TMDL |
| City of Saint Paul-Mississippi River | MnDOT | MS400170 | Municipal stormwater (MS4) | Yes | Kohlman Lake TMDL, Bennett Lake TMDL, Battle Creek TMDL |

| HUC-10 Subwatershed | Point Source | | | Pollutant reduction needed beyond current permit conditions/limits? | Notes |
|---|---|---|---|---|---|
| | Name | Permit # | Type | | |
| City of Saint Paul-Mississippi River | City of North St. Paul | MS400041 | Municipal stormwater (MS4) | Yes | Kohlman Lake TMDL, Wakefield TMDL |
| City of Saint Paul-Mississippi River | City of Oakdale | MS400042 | Municipal stormwater (MS4) | Yes | Kohlman Lake TMDL |
| City of Saint Paul-Mississippi River | Ramsey County | MS400191 | Municipal stormwater (MS4) | Yes | Kohlman Lake TMDL, Wakefield TMDL, Bennett Lake TMDL, Fish Creek TMDL, Battle Creek TMDL |
| City of Saint Paul-Mississippi River | Ramsey-Washington Metro Watershed District | MS400190 | Municipal stormwater (MS4) | No | |
| City of Saint Paul-Mississippi River | City of Roseville | MS400047 | Municipal stormwater (MS4) | Yes | Bennett Lake TMDL |
| City of Saint Paul-Mississippi River | City of St. Paul | MN0061263 | Municipal stormwater (MS4) | Yes | Wakefield TMDL, Fish Creek TMDL, Battle Creek TMDL |
| City of Saint Paul-Mississippi River | City of Shoreview | MS400121 | Municipal stormwater (MS4) | No | |
| City of Saint Paul-Mississippi River | City of Vadnais Heights | MS400057 | Municipal stormwater (MS4) | Yes | Kohlman Lake TMDL |
| City of Saint Paul-Mississippi River | Washington County | MS400160 | Municipal stormwater (MS4) | Yes | Fish Creek TMDL, Battle Creek TMDL |
| City of Saint Paul-Mississippi River | City of White Bear Lake | MS400060 | Municipal stormwater (MS4) | Yes | Kohlman Lake TMDL |
| City of Saint Paul-Mississippi River | City of Woodbury | MS400128 | Municipal stormwater (MS4) | Yes | Fish Creek TMDL, Battle Creek TMDL |

MS4s within the Battle Creek, Bennett Lake, Fish Creek, Kohlman Lake and Wakefield Lake Watersheds are shown in Figures 2-2 through Figure 2-6.

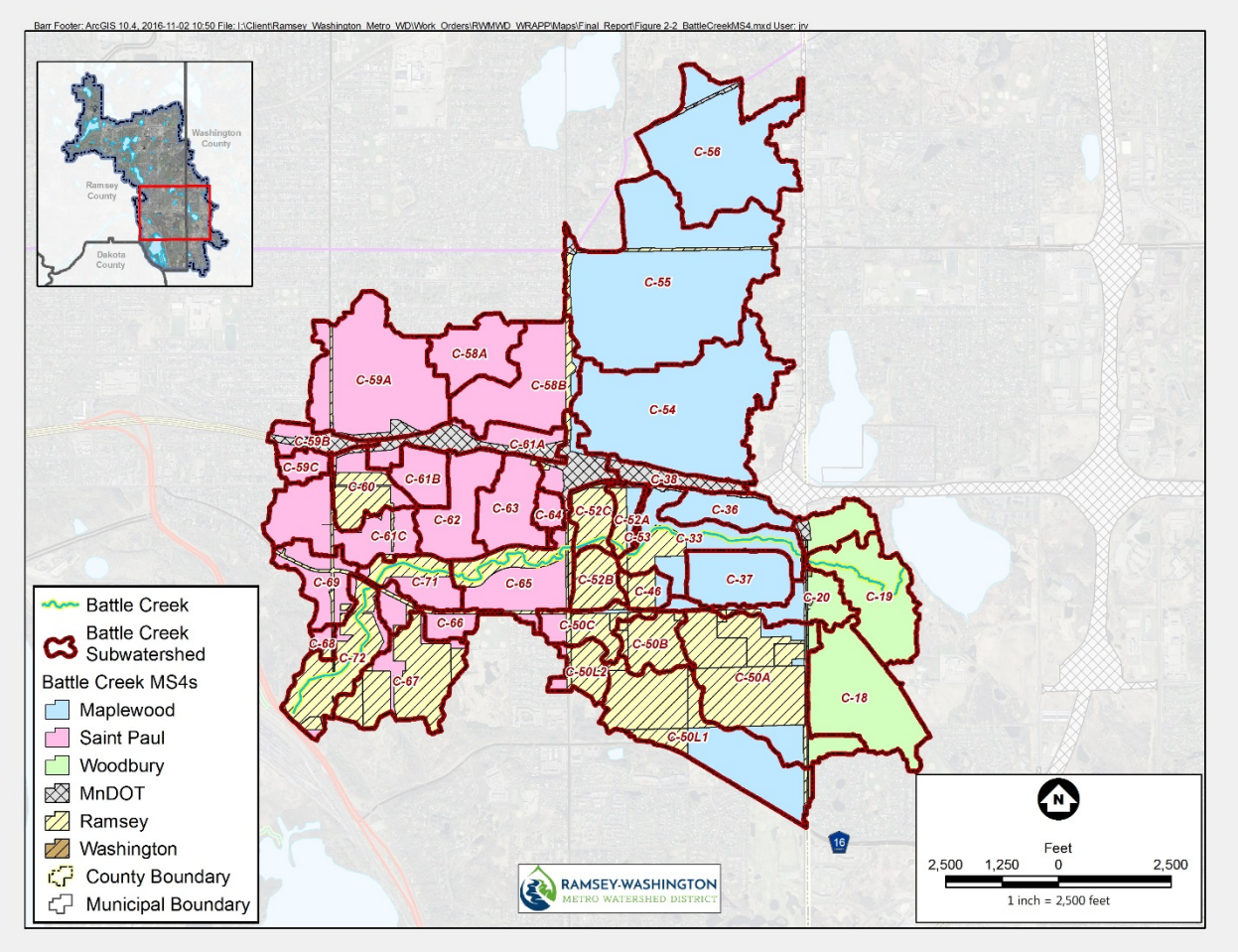



Figure 2-2 MS4s in the Battle Creek Subwatershed

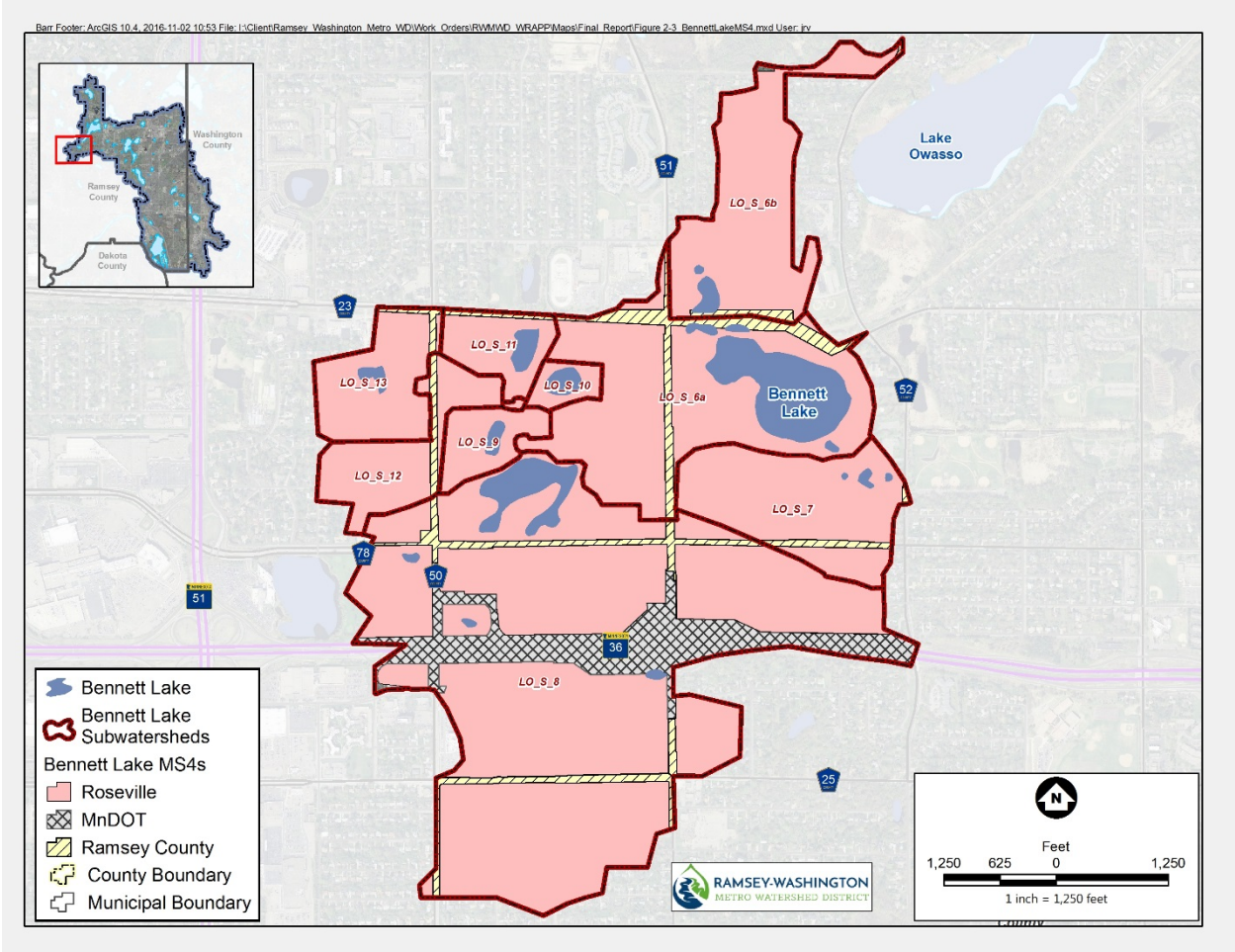



Figure 2-3 MS4s in the Bennett Lake Subwatershed

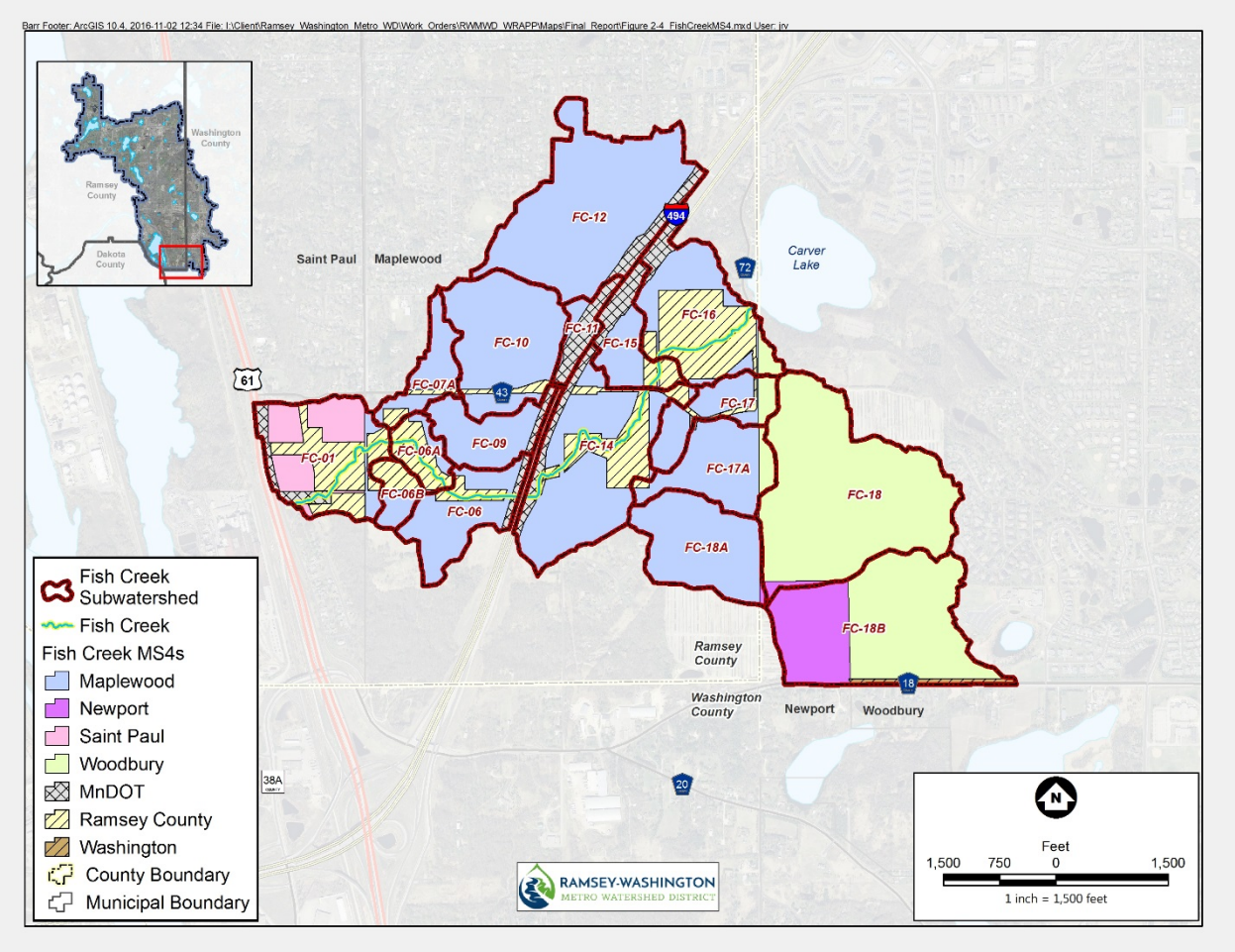



Figure 2-4 MS4s in the Fish Creek Subwatershed

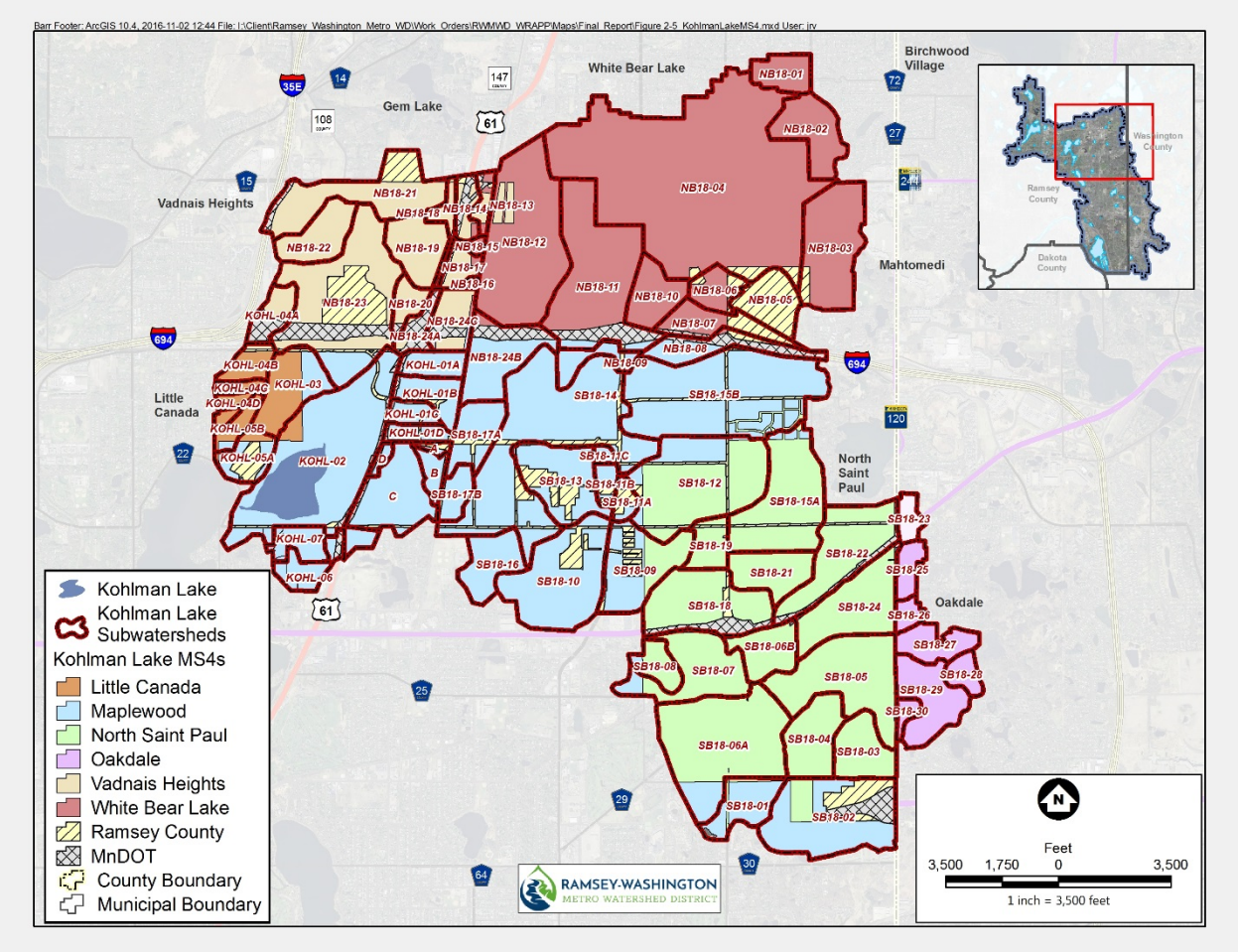



Figure 2-5 MS4s in the Kohlman Lake Subwatershed

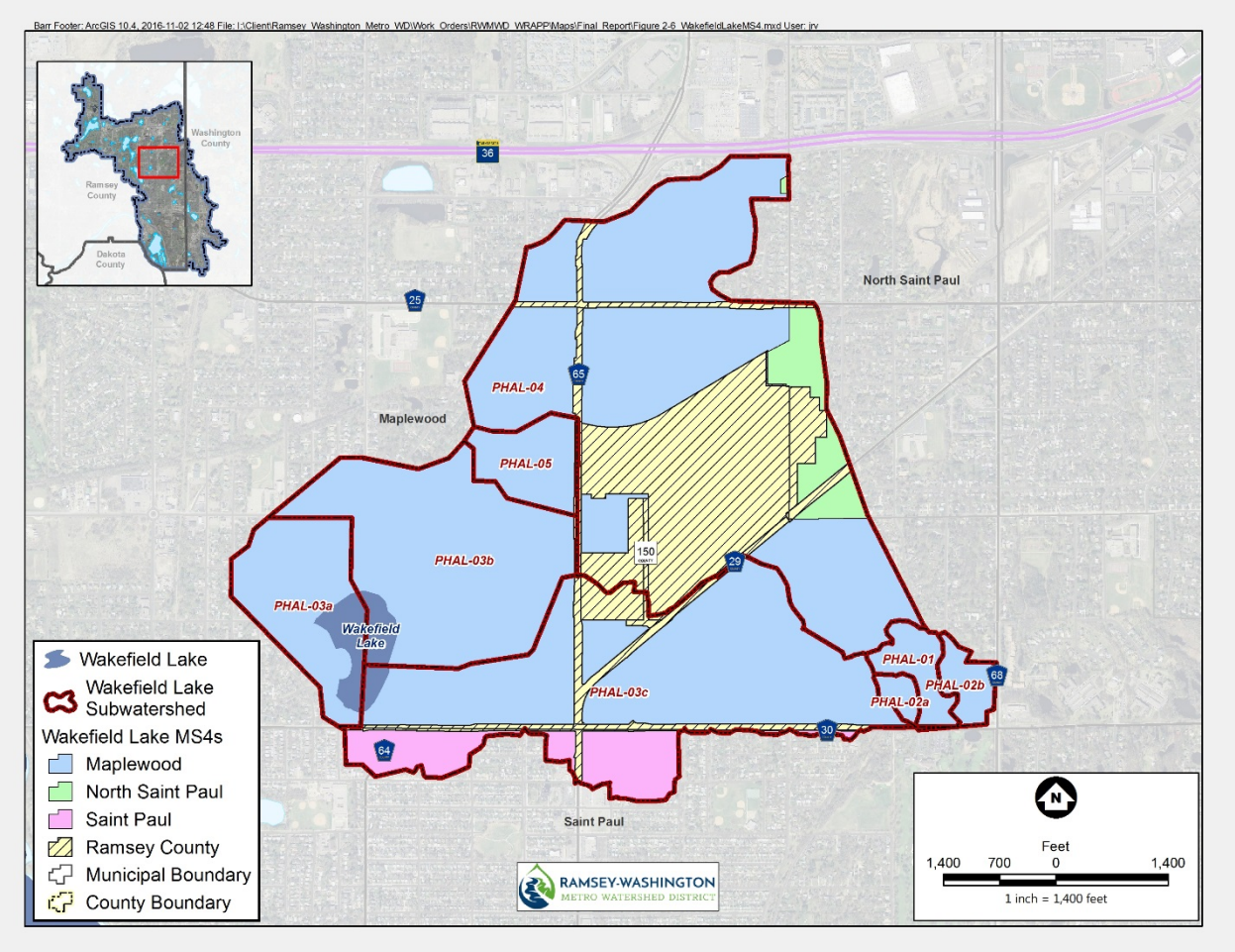



**Figure 2-6 MS4s in the Wakefield Lake Subwatershed**

Nonpoint (or non-permitted) sources of pollutants are those that are not regulated by the NPDES/SDS program. The following are examples of the typical non-permitted sources pollutants:

- **Atmospheric Deposition** – Pollutants deposited directly on the surface of the lake or stream during precipitation events and as dry deposition of particles in between events (e.g. particles suspended by wind that settle out)
- **Watershed Loading** – Runoff and pollutant loads from runoff from rural and/or urban portions of a watershed that are not regulated by an NPDES/SDS MS4 Permit and may also include discharges from upstream lakes and water resources
- **Erosion** –Loss of soil and attached pollutants from the land surface, along ravines and other drainage ways, as well as stream banks
- **Failing SSTS** – In rural areas not served by sanitary sewer systems, failing SSTS on lakeshore properties and in other locations in the watershed can contribute to various impairments, such as excess nutrients and bacteria
- **Internal Sources** – There are a variety of potential sources of phosphorus that can come from within the lake - examples include release of phosphorus bound to lake bottom sediments

during anoxic conditions, the senescence of certain aquatic vegetation (e.g., curly-leaf pondweed) during the growing season, the activity of benthivorous fish such as carp, suspension of bottom sediments due to wind and/or boat traffic, and groundwater interaction

To begin understanding the impact of both point and nonpoint sources of pollution on the water quality in the resources in the RWMWD, water quality analyses were performed on several water bodies and streams within the watershed as part of the WRAPS process.

A summary of the various contributions of pollutants to the RWMWD lakes and streams are summarized in Table 2-9. The estimated contributions are typically summarized as a percentage based on the estimating loadings for the lakes from the watershed and in-lake modeling completed for this WRAPS report, in past RWMWD studies, and from the flow and load duration and source assessments completed for Battle Creek (TSS) and Fish Creek (bacteria).

A population source inventory and assumed bacteria availability was used to estimate the sources of bacteria loading to Fish Creek. The analysis indicated that runoff from urban areas mobilizing bacteria from improperly managed pet waste is the main source of *E. coli* loading during wet-weather conditions, and failing subsurface septic treatment systems (SSTSs) and sanitary sewer exfiltration are the main sources of loading during dry-weather conditions.

**Table 2-9 Nonpoint and Point (MS4) Sources in the Ramsey-Washington Metro Watershed District**

| HUC-10 Subwater-shed | Stream/Reach (AUID) or Lake (ID) | Pollutant | Pollutant Sources | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fertilizer & manure run-off | Livestock overgrazing in riparian | Human Source (e.g., Failing septic systems, sanitary sewer, exfiltration)systems | Wildlife | Poor riparian vegetation cover | Upland soil erosion | Urban Stormwater Runoff | Internal Sources (e.g., Sediment, stream corridor) | Upstream Waterbodies | Atmospheric Deposition |
| City of Saint Paul-Mississippi River | District-Wide | Chloride | -- | -- | -- | -- | -- | -- | 100% | -- | -- | -- |
| | Battle Creek[5] (592) | TSS | -- | -- | -- | -- | -- | -- | 42% | 46% | 12% | -- |
| | Battle Creek Lake (82-0091)[1] | TP | -- | -- | -- | -- | -- | -- | 68% | 18% | 12% | 2% |
| | Beaver Lake (62-0016)[1] | TP | -- | -- | -- | -- | -- | -- | 51% | 47% | -- | 2% |
| | Bennett Lake (62-0048)[2] | TP | -- | -- | -- | -- | -- | -- | 43% | 56% | -- | 1% |
| | Carver Lake (82-0166)[1] | TP | -- | -- | -- | -- | -- | -- | 79% | 19% | -- | 2% |
| | Fish Creek (606)[3] | Bacteria | -- | -- | 53% | 2% | -- | -- | 45% | -- | -- | -- |
| | Gervais Lake[2] (62-0007) | TP | -- | -- | -- | -- | -- | -- | 24% | ~0% | 76% | NA |

| HUC-10 Subwater-shed | Stream/Reach (AUID) or Lake (ID) | Pollutant | Pollutant Sources | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fertilizer & manure run-off | Livestock overgrazing in riparian | Human Source (e.g., Failing septic systems, sanitary sewer, exfiltration)systems | Wildlife | Poor riparian vegetation cover | Upland soil erosion | Urban Stormwater Runoff | Internal Sources (e.g., Sediment, stream corridor) | Upstream Waterbodies | Atmospheric Deposition |
| | Keller Lake (62-0010)[1] | TP | -- | -- | -- | -- | -- | -- | 42% | 8% | 49% | 1% |
| | Kohlman Lake (62-0006)[2] | TP | -- | -- | -- | -- | -- | -- | 76% | 23% | -- | 15% |
| | Lake Emily (62-0080)[2] | TP | -- | -- | -- | -- | -- | -- | 37% | 42% | 20% | 2% |
| | Lake Owasso (62-0056)[2] | TP | -- | -- | -- | -- | -- | -- | 31% | 63% | -- | 6% |
| | Lake Phalen[2] (62-0013) | TP | -- | -- | -- | -- | -- | -- | 68% | ~0% | 32% | NA |
| | Lake Wabasso (62-0082)[2] | TP | -- | -- | -- | -- | -- | -- | 13% | 62% | 3% | 22% |
| | Round Lake, Little Canada (62-0009) | TP | -- | -- | -- | -- | -- | -- | NA | NA | -- | NA |
| | Round Lake, Maplewood (62-0012)[1] | TP | -- | -- | -- | -- | -- | -- | 87% | 10% | -- | 3% |
| | Shoreview Lake (62-0079)[4] | TP | -- | -- | -- | -- | -- | -- | NA | NA | -- | NA |
| | Snail Lake (62-0073)[2] | TP | -- | -- | -- | -- | -- | -- | 30% | 11% | 51% | 8% |
| | Tanners Lake (82-0115) | TP | -- | -- | -- | -- | -- | -- | NA | NA | -- | NA |
| | Twin Lake (62-0039) | TP | -- | -- | -- | -- | -- | -- | NA | NA | -- | NA |
| | Wakefield Lake (62-0011)[2] | TP | -- | -- | -- | -- | -- | -- | 67% | 32% | -- | 1% |
| | Willow Lake (62-0040)[4] | TP | -- | -- | -- | -- | -- | -- | NA | NA | -- | NA |

| HUC-10 Subwater-shed | Stream/Reach (AUID) or Lake (ID) | Pollutant | Pollutant Sources | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fertilizer & manure run-off | Livestock overgrazing in riparian | Human Source (e.g., Failing septic systems, sanitary sewer, exfiltration)systems | Wildlife | Poor riparian vegetation cover | Upland soil erosion | Urban Stormwater Runoff | Internal Sources (e.g., Sediment, stream corridor) | Upstream Waterbodies | Atmospheric Deposition |

NA = Not Assessed
[1] Values based on the water year
[2] Values based on the growing season
[3] Values based on available *E. coli* organisms generated per month
[4]Likely sources of pollutants based on knowledge of the resource and its watershed. Official water quality study has not been performed.
[5] Values based on annual loading average of last 10-years of data
[6]All sources of urban stormwater runoff in RWMWD are permitted MS4 sources.

## 2.4 TMDL Summary

The *RWMWD TMDL Study (Barr 2016)* addresses the aquatic life and aquatic recreation impairments in Battle Creek and Fish Creek, and nutrient impairments in Bennett Lake and Wakefield Lake. The goal of this TMDL report is to quantify the pollutant reductions needed to meet the Minnesota Pollution Control Agency's (MPCA's) water quality standards for all four RWMWD water bodies. This TMDL was established in accordance with Section 303(d) of the Clean Water Act and provides the wasteload allocations (WLAs) and load allocations (LAs) for the impaired water resources. The results of this effort are shown in the Table 2-10 and Table 2-11 below.

**Table 2-10 Allocations Summary for all Lake TMDLs in the RWMWD**

| Lake (ID) | Pollutant | Allocations (lbs/GS[1]) | | | | | | | | Percent Reduction[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Wasteload Allocation (WLA) | | | | | | | MOS | |
| | | WWTPs | Construction & Industrial SW | MnDOT (MS400170) | MS4s | Internal Load | Upstream Lakes | Atmosphere | Margin of Safety (MOS) | |
| Bennett Lake (62-0048) | TP | -- | 0.9 | 1.6 | 20.1 | 18.1 | -- | 2.3 | 4.8 | 74% |
| Wakefield Lake (62-0011) | TP | -- | 1.6 | -- | 93.1 | 12.1 | -- | 1.4 | 12 | 43% |

[1] GS = Growing Season [June 1 through September 30]

**Table 2-11 Allocation summary for all stream TMDLs in the RWMWD**

| Stream/Reach (AUID) | Pollutant | Flow Zone | *E. coli* allocations (billions org./day) | | | | | | | Percent Reduction[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | TP & TSS Allocations (lbs/day) | | | | | | | |
| | | | WLA | | | | LA | | MOS | |
| | | | WWTPs | Construction & Industrial SW | MnDOT (MS400170)* | MS4 Communities | Non-MS4 Watershed Load | Upstream Reach(es) | MOS | |
| Battle Creek (592) | TSS | Very High | -- | 31 | 82 | 1,763 | 2,551 | -- | 492 | 91% |
| | | High | -- | 12 | 32 | 679 | 982 | -- | 189 | 88% |
| | | Mid | -- | 7 | 17 | 371 | 537 | -- | 104 | 86% |
| | | Low | -- | 2 | 6 | 133 | 193 | -- | 37 | 66% |
| | | Very Low | -- | 0 | 1 | 12 | 17 | -- | 3 | 73% |
| Fish Creek (606) | *E. coli* | Very High | -- | -- | 2.3 | 37.3 | 0.6 | -- | 4.5 | 0% |
| | | High | -- | -- | 1.2 | 20.1 | 0.3 | -- | 2.4 | 22% |
| | | Mid | -- | -- | 0.8 | 13.4 | 0.2 | -- | 1.6 | 0% |
| | | Low | -- | -- | 0.3 | 4.6 | 0.1 | -- | 0.6 | 26% |
| | | Very Low | -- | -- | 0.1 | 0.9 | 0.0 | -- | 0.1 | 62% |

* MnDOT is currently loading below its wasteload allocation, and will not be required to further reduce bacteria loading.

Details concerning implementation strategies that could achieve these reductions can be found in the *RWMWD TMDL Study Report* and are reflected in the strategies described in Table 3-1 of this WRAPS report.

## 2.5 Protection Considerations

In addition to the topics and resource-specific items discussed in the preceding sections, the RWMWD also considers areas with specific protection considerations such as stormwater management, land use changes, recreational assets, AIS, non-compliant septic systems, the presence of natural communities or rare species, groundwater sensitivity to pollution, or areas that seem appropriate for targeted infiltration for the purpose of groundwater recharge.

### Land Use Changes and Stormwater

Land use and land cover play a major role in determining what happens to precipitation in the hydrologic cycle. Vegetation intercepts precipitation, slows its movement, and returns moisture to the atmosphere via transpiration. Trees and native grasses, with their extensive root systems, encourage far more water to soak into the soil than pastures or lawns, which have very shallow roots and are more likely to allow water to run off quickly if the soil is compacted or saturated. Therefore, areas in the watershed that are forested or contain native grasses will have a greater capacity to infiltrate water than those areas that are cultivated or covered by lawns.

Although the RWMWD is largely developed, there are always many areas of the watershed that are redeveloping at any given time. These proposed redevelopments can cause significant land use changes (for better or worse). Land redevelopment is an opportunity to dramatically change how stormwater runoff moves in the local watershed. In the past, the changes began during construction, when clearing and grading of the site results in less infiltration, higher rates and volumes of stormwater runoff, and increased erosion. As construction continued, natural surfaces became covered with asphalt, concrete, and other materials that are impervious and prevent infiltration of water into the soil. Impervious surfaces greatly increase the rate at which water runs off the landscape and enters waterbodies, and can alter the hydrologic cycle. An increase in surface runoff to streams can result in bank erosion, increased pollutant loads, and increased temperatures.

As such, the quality and quantity of surface water is greatly influenced by stormwater runoff. As redevelopment continues in the RWMWD, nutrient and sediment inputs (i.e., loadings) from stormwater runoff can far exceed the natural inputs to a lake, pond, or stream. To accomplish the RWMWD goals for maintaining and improving water quality and managing water quantity, stormwater runoff must be carefully and closely managed.

The RWMWD manages stormwater runoff by carrying out its regulatory and permit program, which includes preventive measures so that negative effects of stormwater runoff are addressed (and prevented) at the time of development or redevelopment, and not after problems develop. The RWMWD has adopted rules that outline requirements in relation to:

- Stormwater Management (including a volume reduction rule)
- Flood Control
- Wetland Management
- Erosion and Sediment Control

- Illicit Discharge and Connection

The RWMWD Permit program is designed to allow contractors and developers to work with District staff to address and prevent issues related to development. Staff are active in a project from the early planning stages until the site has been permanently stabilized. Additionally, long-term maintenance agreements are required through this process. The RWMWD actively encourages developers to use new, innovative stormwater management technologies.

Also, the RWMWD has an active cost share program that provides funding assistance to individuals and organizations that wish to implement stormwater management features on their properties. The proportion of funding that is provided for proposed projects depends on the project's location in the watershed. Those in "Impaired" watersheds receive higher levels of funding than those that are not.

The RWMWD carries out an extensive monitoring program for its lakes and streams in order to assess their water quality and determine what protection measures need to be used to improve or maintain water quality.

## Recreational Assets

The city of St. Paul's historic Phalen-Keller Regional Park attracts over 1 million visitors annually, making it one of the most visited Regional Parks in the Twin Cities Metropolitan Region. The park and its facilities are heavily used throughout the year. People from local neighborhoods, as well as from across the region, participate in many different activities and events throughout its nearly 750 acres.

Roseville's Central Park, which encompasses the entirety of Bennett Lake, is a popular spot for biking, walking, fishing, picnicking and events at the Frank Rog Amphitheater.

Maplewood's Wakefield Park is a community park that encompasses the southern portion of Wakefield Lake's shoreline. The park attracts local visitors to its playground and athletic fields.

## Aquatic Invasive Species

Watershed management has historically focused on water quality as a function of land use activities and the resulting increase in loading of nutrients, sediment, and other chemicals. Changes in the ecology of aquatic plants, animals, and microorganisms may also result in the degradation of aquatic environments and negatively impact aesthetics, recreation, and environmental quality. Therefore, the RWMWD conducts aquatic plant surveys to assess and prioritize the waterbodies within the watershed. Also, the RWMWD has actively managed the carp population in the Phalen Chain of Lakes since 2009, and plans to embark on carp management strategies in the waterbodies tributary to the Grass Lake wetland in the future.

The term "invasive species" describes plants, animals, or microorganisms within lakes and streams that are non-native and that: (1) cause or may cause economic or environmental harm or harm to human health; or (2) threaten or may threaten natural resources or the use of natural resources in the state (Minn. Stat. ch. 84D.01). Aquatic invasive species (AIS) is a term given to invasive species that inhabit lakes, wetlands, rivers, or streams and overrun or inhibit the growth of native species. AIS pose a threat to natural resources and local economies that depend on them.

Under direction from the Minnesota Legislature, the Minnesota Department of Natural Resources (DNR) established the Invasive Species Program in 1991. The program is designed to implement actions to prevent the spread of invasive species and manage invasive aquatic plants and wild animals (Minn. Stat. 84D).

As part of its Invasive Species Program, the DNR maintains a list of waters infested with specific AIS (*DNR Designation of Infested Waters, 2015 as amended*). The DNR list includes several RWMWD waterbodies as infested with Eurasian watermilfoil, including Beaver Lake, Gervais Lake (Gervais Mill Pond), Keller Lake (Spoon Lake), Kohlman Lake, Lake Owasso, Lake Phalen, Snail Lake and Lake Wabasso. The DNR's list of AIS infested waterbodies does not include all known AIS occurrences within the RWMWD. In addition, the RWMWD has identified the presence of the following AIS in or in the riparian areas of RWMWD waterbodies:

- Eurasian watermilfoil (*Myriophyllum spicatum*)
- Purple loosestrife (*Lythrum salicaria*)
- Curly-leaf pondweed (*Potamogeton crispus*)
- Yellow iris (*Iris pseudacorus*)
- Narrowleaf cattail (*Typha angustifolia*)
- Hybrid cattail (*Typha glauca*)
- Reed canary grass (*Phalaris arundinacea*)
- Common carp (*Cyprinus carpio*)

Of these species, curly-leaf pondweed is of special concern due to its shifted life cycle, ability to displace native vegetation, and having the potential as a source of internal phosphorus loading during the growing season. Curly-leaf and Eurasian watermilfoil have been managed as needed in Kohlman Lake since 2008. Common carp are also of great concern in the Phalen Chain of Lakes and in waterbodies tributary to the Grass Lake area, in that they negatively affect water quality and displace native populations of fish.

In addition, many shallow RWMWD lakes suffer from an overabundance of filamentous green algae (FGA). FGA forms dense, sometime noxious, green mats that interfere with recreation, and can affect water oxygen levels through respiration. Residents commonly complain about FGA in their lakes, wetlands and ponds, and lake managers have traditionally had few tools to manage this annoyance. RWMWD has recently launched a macrophyte harvesting study on Kohlman Lake that aims to assess whether physically removing FGA might help not only to reduce FGA mats, but also remove substantial quantities of phosphorus at a reasonable cost as well. Results from this study will be available in spring, 2017.

To date, zebra mussels have not been detected in any RWMWD lakes. However, it is important to note that zebra mussels have been found in neighboring Sucker, Vadnais and White Bear Lakes. Zebra mussels can cause problems for lakeshore residents and recreationists by clogging water intakes and attaching to motors and possibly clogging cooling water areas. Zebra mussels can also attach to native mussels, killing them.

Common carp are also present in many District lakes. Common carp are typically spread between lakes by the accidental inclusion and later release of live bait, but can also migrate through natural or built channels as adults. Carp feeding techniques disrupt shallow-rooted plants, which can reduce water clarity and stir up the bottom sediments, which can potentially release phosphorus bound in sediments, leading to increased algal blooms and decline in native aquatic plants.

In 2009, the Watershed partnered with the University of Minnesota's Sorensen Lab on an applied research project to investigate carp in the Phalen Chain of Lakes. The main objectives were to:

1. Determine the abundance of carp in the Phalen Chain of Lakes;
2. Identify spawning areas;
3. Better understand what influences carp recruitment (maturing from an egg to an adult).

   The watershed funded this work along with the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Since 2009, the District has made substantial progress in understanding the carp population and ecology in the Phalen Chain. Through research and management, the District has:

- Reduced the adult carp density by over 60%, from 158 pounds per acre to 55 pounds per acre (average biomass for Kohlman, Gervais, and Keller)
- Located the key spawning areas in the Chain and are actively working to eliminate carp in these systems (e.g., Casey Lake, Markham Pond, and Kohlman Basin).
- Installed a carp barrier in Kohlman Creek that will reduce the number of adult carp migrating into the Kohlman Basin wetlands during spring spawning.

The RWMWD limits its management of AIS to instances where the AIS have a demonstrated negative effect on water quality. Planned AIS management actions for the major RWMWD waterbodies are described in the *RWMWD Watershed Management Plan 2017-2027 (RWMWD 2017).* The RWMWD partners with Ramsey and Washington counties to monitor and help prevent the spread of AIS in the RWMWD.

## Natural Communities and Rare Species

Through its Natural Heritage and Nongame Research Program (NHNRP), the DNR collects, manages, and interprets information about rare natural features, native plants and plant communities, and nongame animals, including endangered, threatened, and special concern species. As part of the NHNRP, the DNR maintains the Natural Heritage Information System (NHIS) as a statewide database of these resources. The DNR limits publication of spatial attributes and locations of these items to protect rare features or species from damage or collection.

Numerous locations throughout the RWMWD Watershed are identified as part of the DNR's NHIS indicating the presence of the species found in Table 2-12.

Table 2-12 NHIS Database Species in RWMWD

| Common Name | Category |
|---|---|
| Colonial Waterbird Nesting Site | Animal Assemblage |
| Ebonyshell | Invertebrate Animal |
| Fawnsfoot | Invertebrate Animal |
| Hickorynut | Invertebrate Animal |
| Monkeyface | Invertebrate Animal |
| Rock Pocketbook | Invertebrate Animal |
| Wartyback | Invertebrate Animal |
| Proglacial River Composite (Quaternary) | Other (Ecological) |
| Alder - (Maple - Loosestrife) Swamp | Terrestrial Community - Other Classification |
| Dry Sand - Gravel Prairie (Southern) | Terrestrial Community - Other Classification |
| Lake Bed | Terrestrial Community - Other Classification |
| Mesic Prairie (Southern) | Terrestrial Community - Other Classification |
| Native Plant Community, Undetermined Class | Terrestrial Community - Other Classification |
| Northern Mixed Cattail Marsh | Terrestrial Community - Other Classification |
| Prairie Rich Fen | Terrestrial Community - Other Classification |
| Red Oak - Sugar Maple - Basswood - (Bitternut Hickory) Forest | Terrestrial Community - Other Classification |
| Red Oak - White Oak Forest | Terrestrial Community - Other Classification |
| Sand Beach (Inland Lake) | Terrestrial Community - Other Classification |
| Seepage Meadow/Carr | Terrestrial Community - Other Classification |
| Tamarack Swamp (Southern) | Terrestrial Community - Other Classification |
| Wet Prairie (Southern) | Terrestrial Community - Other Classification |
| Willow - Dogwood Shrub Swamp | Terrestrial Community - Other Classification |
| Autumn Fimbristylis | Vascular Plant |
| Black Huckleberry | Vascular Plant |
| Clinton's Bulrush | Vascular Plant |
| Club-spur Orchid | Vascular Plant |
| Cowbane | Vascular Plant |
| Half Bristly Bramble | Vascular Plant |

| Common Name | Category |
|---|---|
| Kitten-tails | Vascular Plant |
| Tall Nut-rush | Vascular Plant |
| Tooth-cup | Vascular Plant |
| Tubercled Rein-orchid | Vascular Plant |
| White Wild Indigo | Vascular Plant |
| Yellow Pimpernel | Vascular Plant |
| Bald Eagle | Vertebrate Animal |
| Black Buffalo | Vertebrate Animal |
| Blanding's Turtle | Vertebrate Animal |
| Blue Sucker | Vertebrate Animal |
| Lake Sturgeon | Vertebrate Animal |
| Least Darter | Vertebrate Animal |
| Paddlefish | Vertebrate Animal |
| Pugnose Shiner | Vertebrate Animal |
| Red-shouldered Hawk | Vertebrate Animal |
| Western Foxsnake | Vertebrate Animal |

There is one "scientific and natural area" identified by the DNR within the RWMWD. This site is the Pig's Eye Island Heron Rookery scientific and natural area. This site is owned by the city of St. Paul and is one of the largest nesting sites for colonial waterbirds within the state of Minnesota.

Tamarack Swamp, a wetland found in the southeast portion of the subwatershed upstream of Battle Creek Lake, is the largest and most ecologically diverse wetland in the District. The wetland is named for the tamarack tree, a cold-climate conifer found in far northern latitudes, but generally quite rare in this part of the state.

RWMWD also actively manages many other important habitat areas, as described in the Natural Resources portion of its website (*http://www.rwmwd.org/*). Figure 2-7 shows the managed habitat areas throughout the RWMWD.

These special areas and the species that inhabit them get special attention in District projects and programs, particularly in actions that pertain to the District's "Achieve Healthy Ecosystems" goal.

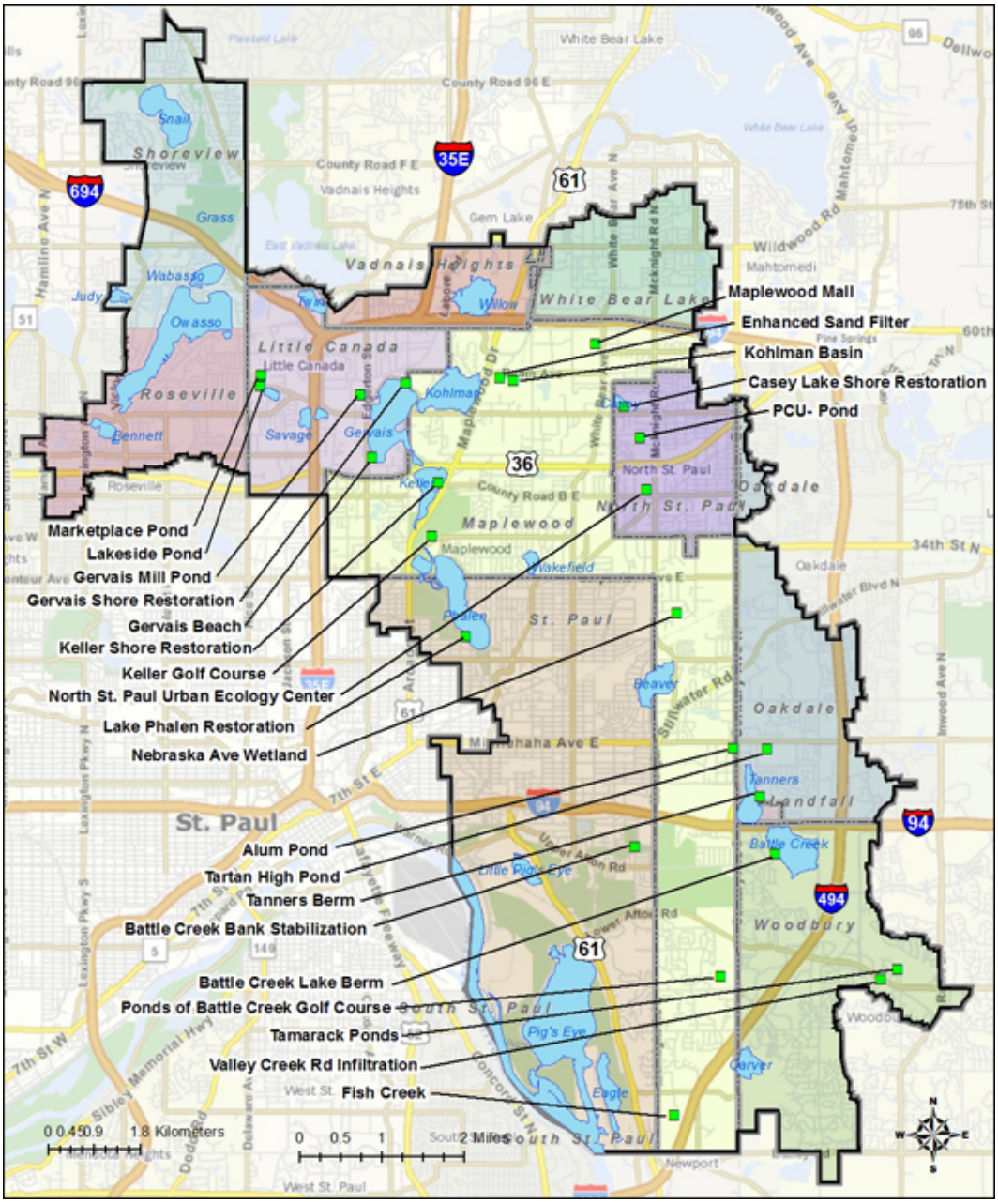



Figure 2-7 Managed habitat areas throughout the RWMWD

## Groundwater/Surface Water Interaction

Understanding how changes in the groundwater system may affect water levels, stream flow, and water quality is an important component of long-term planning and protection of water resources in the RWMWD. How well connected, or disconnected, surface waters are to the groundwater system affects how they may respond to seasonal changes (such as drought), long-term climate change, or groundwater pumping. In addition, understanding the connection between groundwater and surface waters throughout the RWMWD can help inform how best to target infiltration practices to promote groundwater recharge, or to avoid infiltration in sensitive groundwater areas.

To better the RWMWD's understanding of these connections across the watershed, the RWMWD Groundwater/Surface Water Interaction Study was completed in 2015 (Barr 2015). This study evaluated how groundwater and surface water interact across the District and identified surface waters that may be susceptible to changes in groundwater levels. The second part of the study identified areas for focused groundwater recharge to replenish stressed aquifers while also achieving stream-flow volume reductions and water quality improvements and avoiding groundwater pollution.

To evaluate groundwater/surface water interaction across the District, publicly available data sets were compiled and further analyzed. A number of different agencies and organizations collect groundwater, surface water, and other environmental data throughout the District for many different purposes.

Some of the major datasets compiled and used for this study include:

- Surficial and bedrock geology
- Lake bathymetric data
- Surface typography and morphology
- Observation well data
- Well records and boring logs
- Soil survey data
- Data from the TCMA Groundwater Flow Model (Metro Model 3)
- Water use and projected demand

Figure 2-8 shows areas that may be suitable for focused groundwater recharge across the RWMWD. In the figure, higher scores indicate areas more suitable for infiltration to achieve District goals involving stormwater volume reduction and groundwater recharge, while lower scores indicate areas that are less suitable for infiltration to achieve District goals.

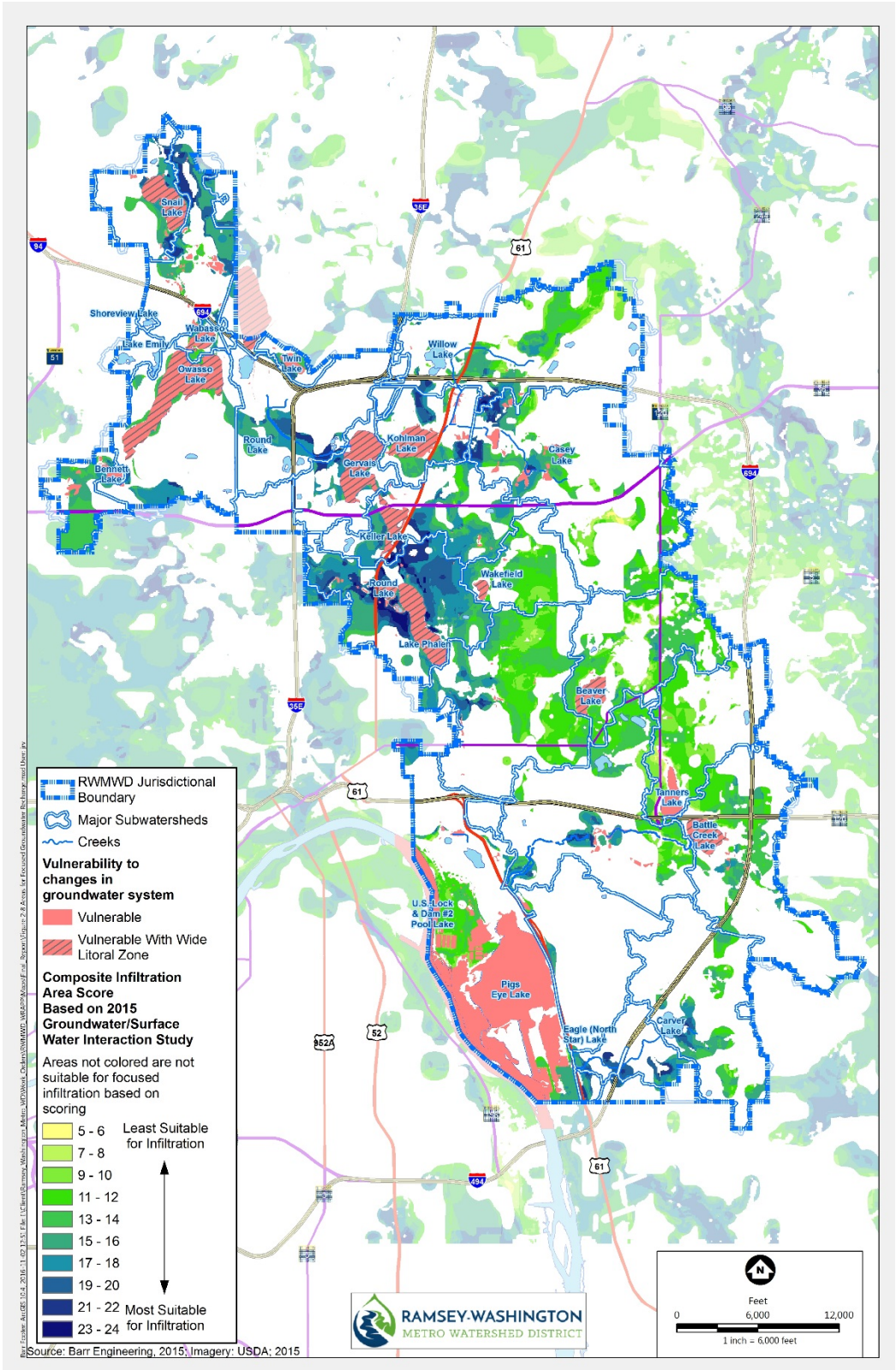



Figure 2-8 Areas for Focused Groundwater Recharge

# 3. Prioritizing and Implementing Restoration and Protection

The CWLA requires that WRAPS reports summarize priority areas for targeting actions to improve water quality, and identify point sources and nonpoint sources of pollution with sufficient specificity to prioritize and geographically locate watershed restoration and protection actions. In addition, the CWLA requires including an implementation table of strategies and actions that are capable of cumulatively achieving needed pollution load reductions for point and nonpoint sources.

This section of this WRAPS report provides the results of such prioritization and strategy development. Because some of the nonpoint source strategies outlined in this section rely on voluntary implementation by landowners, land users and residents of the watershed, it is imperative to create social capital (trust, networks, and positive relationships) with those who will be needed to voluntarily implement best management practices. Thus, effective ongoing civic engagement is fully a part of the overall plan for moving forward.

The implementation strategies, including associated scales of adoption and timelines, provided in this section are the result of watershed modeling efforts and professional judgement based on what is known at this time and, thus, should be considered approximate. Furthermore, many strategies are predicated on needed funding being secured. As such, the proposed actions outlined are subject to adaptive management - an iterative approach of implementation, evaluation and course correction.

There are issues that are not addressed in the strategies tables, like limited local capacity and funding that can greatly affect the outcomes of this report. If resources, like staff or funding, are limited or nonexistent in the project area, it is likely that the strategies and goals laid out in this report will take longer to achieve. Therefore, it is important that as these actions are undertaken that all levels (federal government, state government, local government, non-profits, and landowners) continue to find ways to support local entities and individuals to ensure the waterbodies in the RWMWD are restored and protected.

In implementing this WRAPS report, the RWMWD will rely upon the following sources of funding and technical support:

- RWMWD tax levies
- Cost sharing opportunities with partners
- Grants and loans from federal, state and local sources
- State agencies (technical support)
- University of Minnesota (technical support)

Grants are an important funding source for RWMWD projects and programs. The District will continue to apply for grants whenever possible to reduce the portion of project and program cost borne by the District. Historically, the District has been able to secure grant funding for a majority of its ecological restoration projects. Grant funds are also often available for research projects.

Grant programs are available at the local (e.g., county, MCES), state, and federal level. Several District projects have been funded by the Clean Water Fund (CWF) grant program implemented by the Board of Water and Soil Resources (BWSR). The District recognizes that many grant programs are funded through public tax dollars. When possible, the District prefers to seek state and federal grant programs in order to spread the indirect expense across a wider tax base, thereby reducing the direct and indirect cost to the residents of the watershed.

Detailed information on the planning level costs to implement this WRAPS report and other District efforts is included in the *RWMWD Watershed Management Plan 2017-2027 (RWMWD 2017).*

## 3.1 Targeting of Geographic Areas

To improve and/or maintain water quality in the RWMWD, it is important to identify nonpoint sources of pollution and prioritize and geographically locate restoration and protection areas within the RWMWD. This section describes the strategies and tools the RWMWD uses to prioritize waterbodies and target geographic areas for water quality improvement.

### State, Basin and Regional Scale

The Minnesota Nutrient Reduction Strategy was developed in response to concern about excessive nutrient levels that pose a substantial threat to Minnesota's lakes and rivers, as well as downstream waters including the Great Lakes, Lake Winnipeg, the Mississippi River, and the Gulf of Mexico. In recent decades, nutrient issues downstream of Minnesota have reached critical levels, including the effect of nutrients in the Gulf of Mexico, which resulted in a dead zone, eutrophication issues in Lake Winnipeg, and algal blooms in the Great Lakes. Several state-level initiatives and actions highlighted the need for a statewide strategy that ties separate but related activities together to further progress in making nutrient reductions. Minnesota conducted both nitrogen and phosphorus assessments to identify nutrient source contributions. The main nutrient sources to the Mississippi River are phosphorus (P) from agricultural cropland runoff, wastewater, and streambank erosion, and nitrogen (N) from agricultural tile drainage and water leaving cropland via groundwater. The associated Phase I milestones for the Mississippi River Basin for N and P are 20% and 35% reductions respectively from baseline by 2025. Additional milestones call for 30% (N) and 45% (P) by 2035 and 45% reduction from baseline in N by 2045. The primary tools the State will use to achieve these reductions are the 10-year cycle of watershed assessments and WRAPS studies to: identify high-loading areas and critical management areas; enhanced phosphorus and nitrogen reduction strategies for wastewater effluent; facilitating implementation of agricultural BMPs targeted at increasing fertilizer use efficiency, reducing field erosion, and treating tile drainage water; and continued implementation of the SW discharge permitting system for MS4s.

While there is very little agricultural land and no wastewater effluent in the RWMWD, areas with high loads of phosphorus have been identified through the diagnostic feasibility studies described later in this section of this WRAPS report. In addition, streambank erosion is identified during annual inspections, and repairs/stabilizations are implemented each year as necessary.

The Nitrogen in Minnesota Surface Waters Strategy was developed in response to a concern for human health when elevated nitrogen levels reach drinking water supplies. The 10 mg/l nitrate-N drinking

water standard established for surface and groundwater drinking water sources and for cold water streams is exceeded in numerous wells and streams in the state. The purpose of this study was to provide an assessment of the science concerning N in Minnesota waters so that the results could be used for current and future planning efforts, thereby resulting in meaningful goals, priorities, and solutions.

More specifically, the purpose of this project was to characterize N loading to Minnesota's surface waters, and assess conditions, trends, sources, pathways, and potential BMPs to achieve nitrogen reductions in our waters. The nitrogen study contains a spreadsheet tool called the nitrogen best management practice (NBMP) tool (NBMP is described in more detail in the *Nitrogen in Minnesota Surface Waters Report Chapter F1* (Wall 2013)).

The *Twin Cities Metropolitan Area Chloride Management Plan* (CMP) was developed to address the increasing concentrations of chloride found in Minnesota's waters in urban areas as well as across the state. The CMP provides the framework to assist local communities in reducing chloride concentrations in both the state's ground and surface waters through protection and restoration efforts. The CMP contains a variety of BMPs that reduce salt use while still maintaining safe conditions for the public. The chloride reduction strategy outlined in the CMP uses a performance-based approach that does not have specific numerical requirements, but focuses on implementing BMPs and tracking trends in chloride concentrations. The primary recommended strategies for reducing chloride concentrations in the CMP, which apply to the District, include: (1) a shift to using more liquid deicing chemical products rather the granular ones, (2) improved physical snow and ice removal, (3) use of practices that prevent the formation of a bond between snow/ice and the pavement, (4) strategies that eliminate salt waste, (5) training for winter maintenance professionals, and (6) education for the public and elected officials.

## RWMWD

### Non-Compliant Septic Systems

Although much of the RWMWD is served by sanitary sewer, some residential sites within the RWMWD are served by septic systems. Septic systems or SSTS that are not properly designed or maintained can allow untreated or partially treated sewage to flow into surface waters. Human waste can be a source of bacteria loading and nutrients to surface waters, especially during dry and low flow periods. Non-compliant septic systems are especially critical in areas with high groundwater levels, which makes the groundwater more susceptible to pollution.

For septic systems in Ramsey County, the cities are the primary regulatory authority. The Washington County Department of Public Health and Environment is the primary regulatory authority for all SSTS in the RWMWD that are located in Washington County. The current *Washington County Groundwater Plan* has identified SSTS financial assistance as a priority, and the County has several opportunities for financial assistance to upgrade or fix noncompliant SSTS systems. Since Fish Creek has a bacterial impairment, critical areas for this subwatershed were identified in a bacterial source assessment, discussed in greater detail below.

## Water Quality Diagnostic Studies to Target Implementation Efforts

The primary way by which the RWMWD defines its implementation program is through the completion of water quality diagnostic feasibility studies. At this time, most of the managed water bodies in RWMWD have had such a study, including the identification of critical areas and recommended projects for implementation. These recommended projects have been incorporated into the Implementation section of the *RWMWD Watershed Management Plan 2017-2027 (RWMWD 2017).* Those items that relate only to water quality considerations are presented in Table 3-1 of this WRAPS report.

As part of this WRAPS report, the RWMWD performed water quality studies and analyses of several lakes within the district: Battle Creek Lake, Beaver Lake, Carver Lake, Keller Lake, Lake Emily, Snail Lake, Lake Owasso, and Lake Wabasso including development of TMDLs for Wakefield Lake, Bennett Lake, Battle Creek and Fish Creek. Lakes that have shown declining water quality in recent years or have the potential to be listed on the impaired waters list (such as Lake Emily) were also targeted during this WRAPS report.

The goal of these water quality studies was to understand the impact of both point and nonpoint sources of pollution on the water quality in the resources in the RWMWD and identify restoration and protection strategies. Watershed and in-lake water quality modeling for the lakes was used to identify and quantify pollutant sources and to identify, target, and prioritize water quality improvement actions.

The water quality analysis included compilation of all historic water quality and lake level data, outlet rating curves, updates to existing and/or development of new watershed pollutant loading models, and development of in-lake water quality mass balance models for each lake to identify and quantify the contributing sources of nutrients (phosphorus) to the water body. Water quality models were developed for each lake's critical water quality conditions (or the worst observed water quality conditions in the past 10 years).

The P8 (Program for Predicting Polluting Particle Passage through Pits, Puddles and Ponds) Urban Catchment (computer) Model was used to estimate watershed runoff and total phosphorus loads from each lake's tributary watershed. P8 is a useful diagnostic tool for evaluating and designing watershed improvements and BMPs because it can estimate the treatment effect of several different kinds of potential BMPs. P8 tracks stormwater runoff as it carries phosphorus across watersheds and incorporates the treatment effect of detention ponds, infiltration basins, etc. on the phosphorus and sediment loads that ultimately reach downstream water bodies. P8 accounts for phosphorus attached to a range of particulate sizes, each with their own settling velocity, tracking their removal by treatment features accordingly.

In-lake water quality modeling for the RWMWD lakes was accomplished through the creation of a mass balance models that track both the flow of water and phosphorus through the lakes, the growing season (as defined by the MPCA). The in-lake mass balance models included both a calibrated water balance as well as a phosphorus balance. The key input parameters for the in-lake mass balance models included the stage-storage-discharge relationship developed for the lakes, direct precipitation and evaporation data, groundwater exchange, the water and total phosphorus loads from the lake's watershed as predicted by the P8 model, and through quantification of other sources that are not captured in the

watershed modeling (e.g. loads from upstream lakes not in the P8 models). Water quality monitoring data is also used in the in-lake mass balance modeling.

To estimate the internal phosphorus loading from other sources or losses (e.g., sediment release, fish, etc.), the predicted phosphorus concentration in the lake epilimnion was compared to the observed in-lake water quality data on each monitoring event. The magnitude of the internal phosphorus load to the lake's surface waters was deduced by comparing the observed water quality in the lake to the water quality predicted by the in-lake model. To verify the deduced internal loads, the estimated were verified with other available data such as water quality profile information, sediment core data, macrophyte survey information, and fishery information.

The in-lake model results summarizing the growing season (June to September) internal and external (nonpoint) sources of water and phosphorus for each RWMWD lake are summarized in Table 2-8.

Additionally, a bacteria source assessment and load duration analyses were performed for Fish Creek as part of the TMDL development to help identify bacteria sources to the creek and identify and prioritize water quality improvement strategies. Data analysis indicated that bacteria levels were elevated under moist, dry, and low flow conditions. The source assessment concluded that the primary source of bacteria to the creek is from improperly management pet waste mobilized by stormwater runoff. Pollutant source assessments were not conducted for other streams in the RWMWD as they are currently not listed as impaired. Table 2-9 shows the relative sources of bacteria to Fish Creek under average flow conditions.

The *Battle Creek SID Report completed in spring 2015 (Barr 2015)* found that TSS was the primary stressor to fish and macroinvertebrates in the stream, and that TSS concentrations were over the MPCA standard for Class 2B streams in the Central River Nutrient Region. A P8 model was developed for the direct watershed to Battle Creek (downstream of Battle Creek Lake) to help understand and quantify the TSS loading from the watershed along with a flow and load duration analysis for the establishment of the Battle Creek TMDL. Water quality modeling in the Battle Creek Watershed was compared to annual loading rates predicted by the Metropolitan Council from TSS data collected at the Battle Creek WOMP station. The comparison of water quality modeling results to predicted annual loading indicates that the elevated TSS concentrations in the stream are caused nearly equally by TSS mobilized by watershed runoff and TSS sourced from the stream corridor Table 2-9.

All of this monitoring and modeling has helped RWMWD target its efforts in managing different parts of the watershed to the benefit of downstream water bodies, especially with respect to the RWMWD's efforts with their CIP Program and Cost Share Program. The Cost Share Program targets projects in what the RWMWD calls its "Priority" areas by offering a higher percentage of funding in critical areas. Figure 3-1 is a flow chart that demonstrates how the level of RWMWD funding is determined.

A CWF Accelerated Implementation grant in 2014 allowed the District to develop an inventory and methodology for assessing commercial and school properties for possible retrofit projects through the RWMWD Cost Share Program. This methodology has been used to greatly increase the number of schools and commercial properties that have participated in the program. CWF Community Partners

grants in 2013 and 2015 have helped the RWMWD to reach out to churches throughout the District as well.

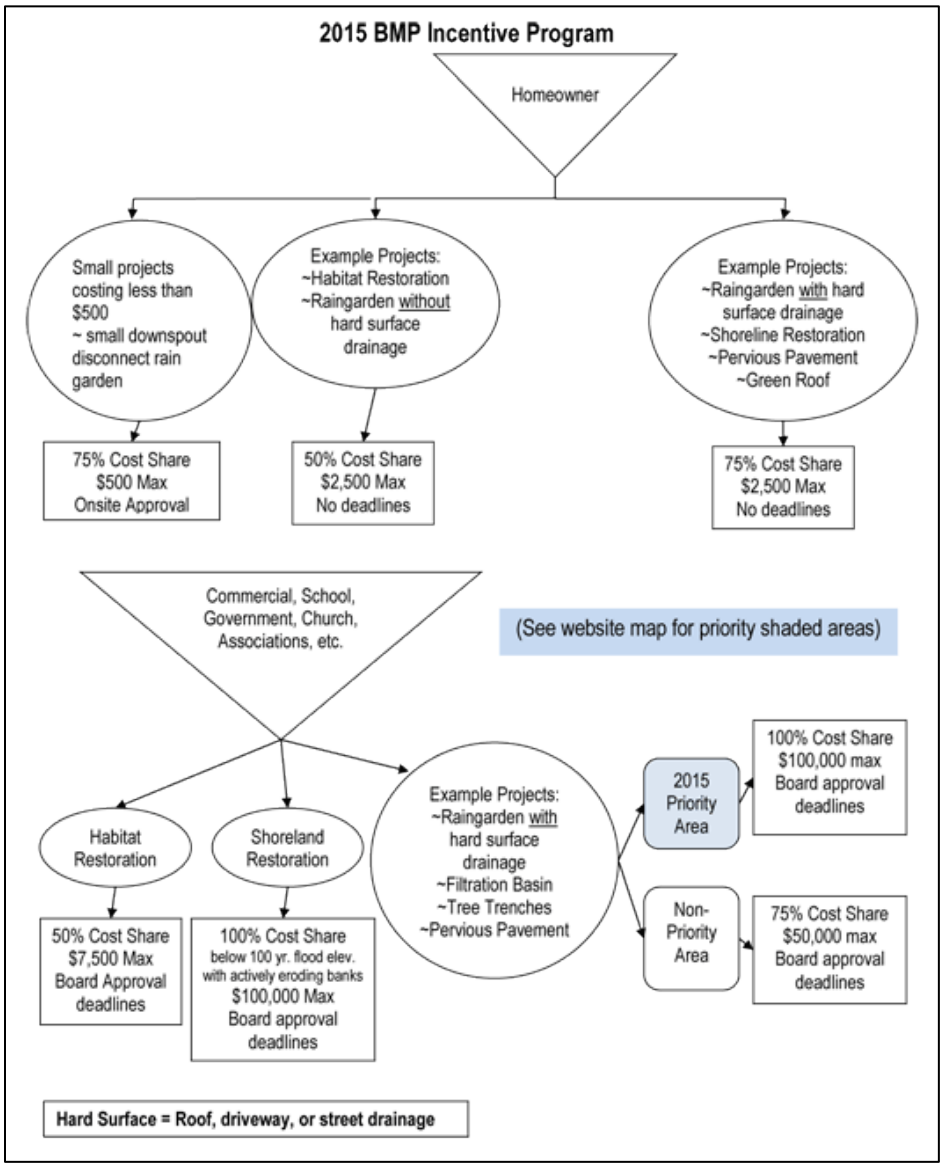



**Figure 3-1 Flow chart of RWMWD's fiscal involvement with cost share projects**

## Project Tracking

The RWMWD maintains a detailed cost benefit database of all of the projects that have resulted from the RWMWD Cost Share, CIP, and Permit Programs. This database contains information for each project such as location in the watershed, size, capital and maintenance costs (not for permitted projects), pollutant removals, stormwater volume reductions, and more, allowing the District to track its progress toward cost-efficiency and stormwater pollutant reduction goals for each waterbody.

The RWMWD has a long history of proactively finding projects and partnerships that work to improve the water quality of its resources.

### *Cost Share Program*

Since the inception of the District's cost share program in 2007, over 300 cost share projects have been implemented. The level of the RWMWD's fiscal involvement in each project depends upon where the project is located. "Priority Areas" are those that are within a subwatershed that drains to an impaired waterbody. Figure 3-2 shows the proliferation of cost share projects in the District implemented through 2015.

### *Capital Improvement Projects Program*

Capital improvement projects are long term/permanent solutions to flood control and water quality problems that the RWMWD implements and maintains. The locations and types of projects are chosen based on monitoring and modeling results. Figure 3-3 shows the proliferation of the 42 capital improvement projects that the RWMWD has implemented from its inception in 1975 through 2015.

### *RWMWD Permit Program*

The RWMWD Permit Program, described in Section 2.5 of this WRAPS report is also serving to change the watershed to benefit waterbodies in the RWMWD. Since the RWMWD's inception in 1975, over 1,640 permitted projects have responded to the District's development/redevelopment rules. Since the inception of the RWMWD permit program's volume reduction rule in 2007, over 170 development/redevelopment projects have been permitted throughout the RWMWD. Figure 3-4 shows the proliferation of development/redevelopment projects that the RWMWD has permitted through its rules from April 1976 (the start of the RWMWD's Permit program) to October 2015.

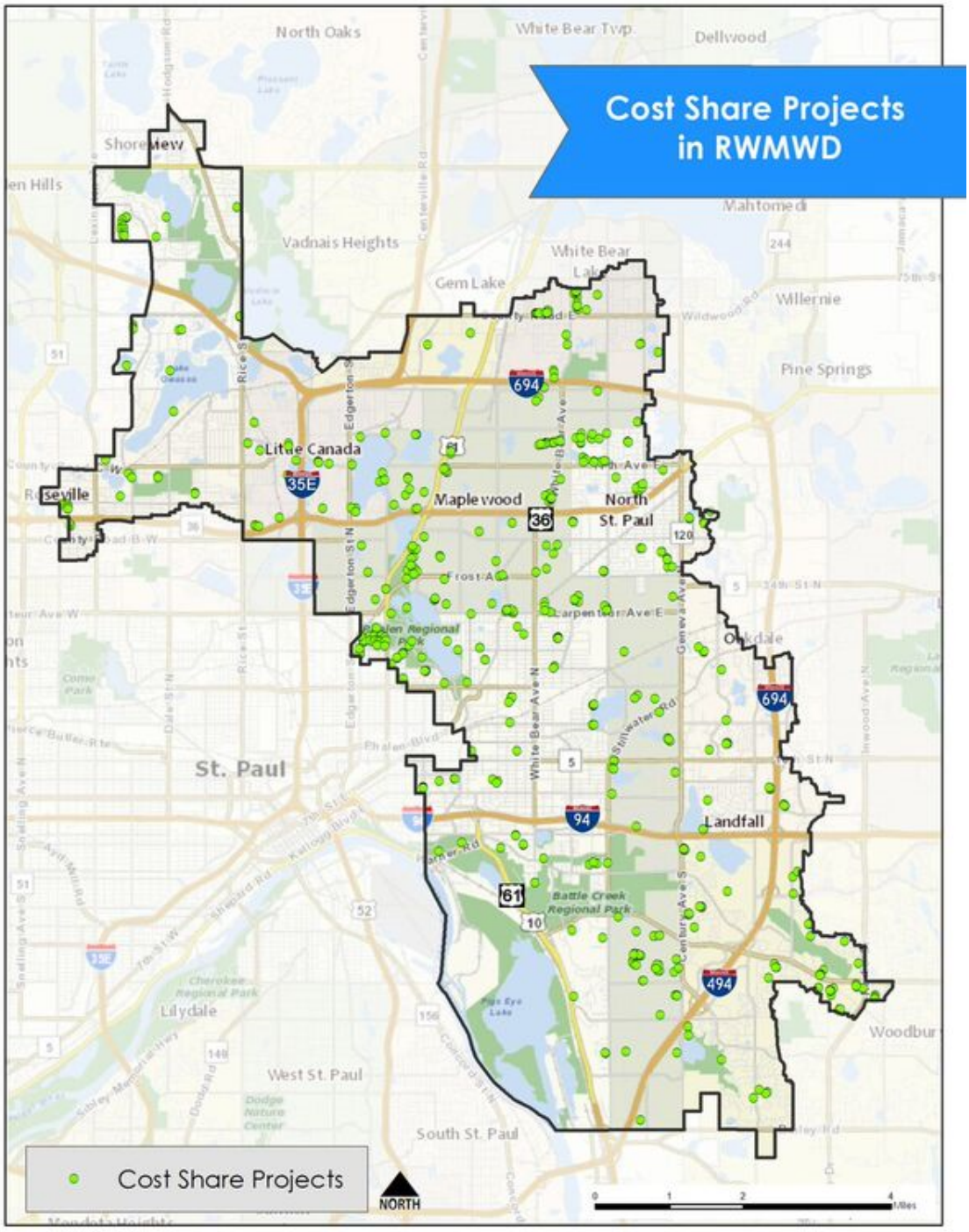



Figure 3-2 Cost Share Projects in RWMWD through 2015

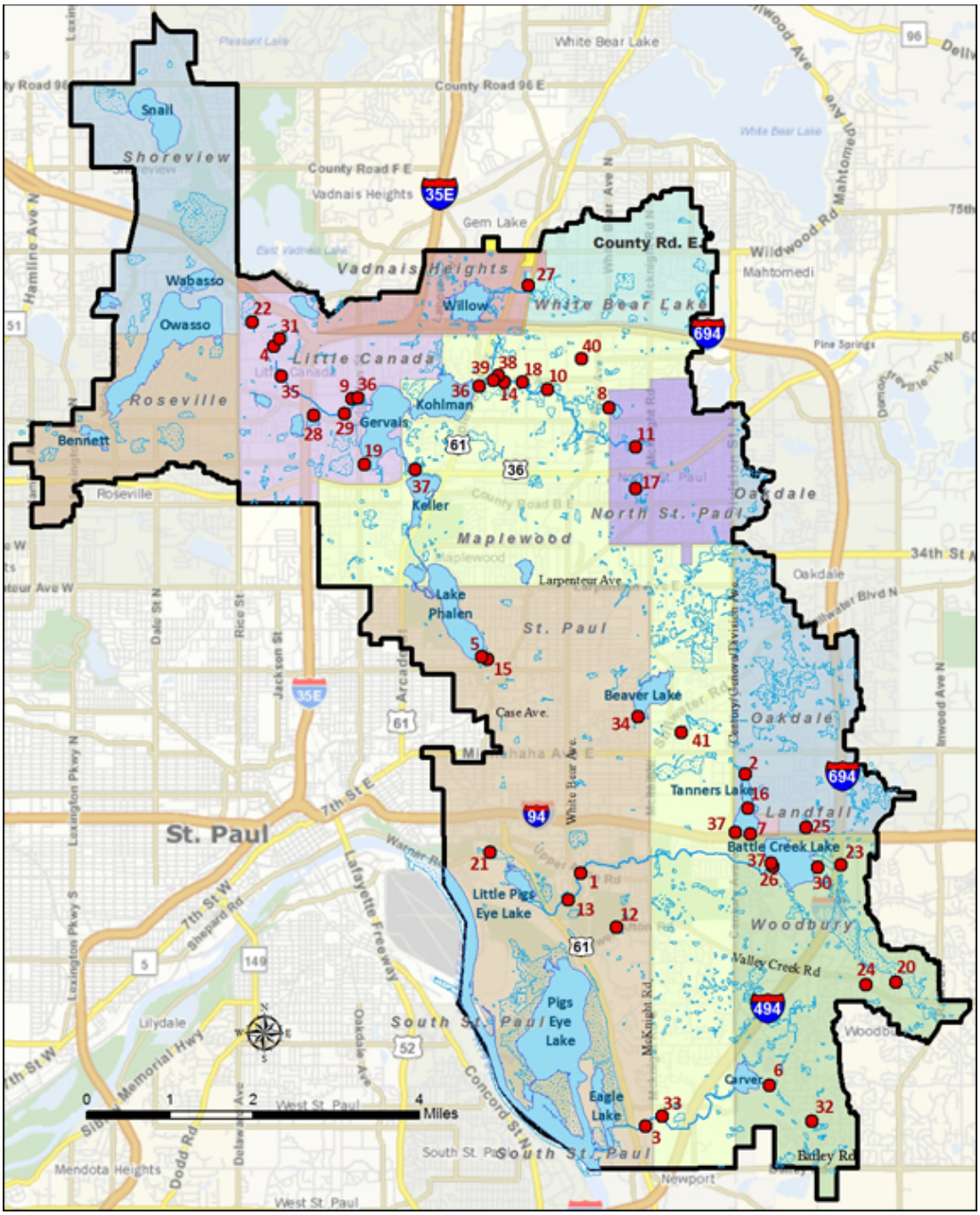



Figure 3-3 RWMWD Capital Improvement Projects through 2015

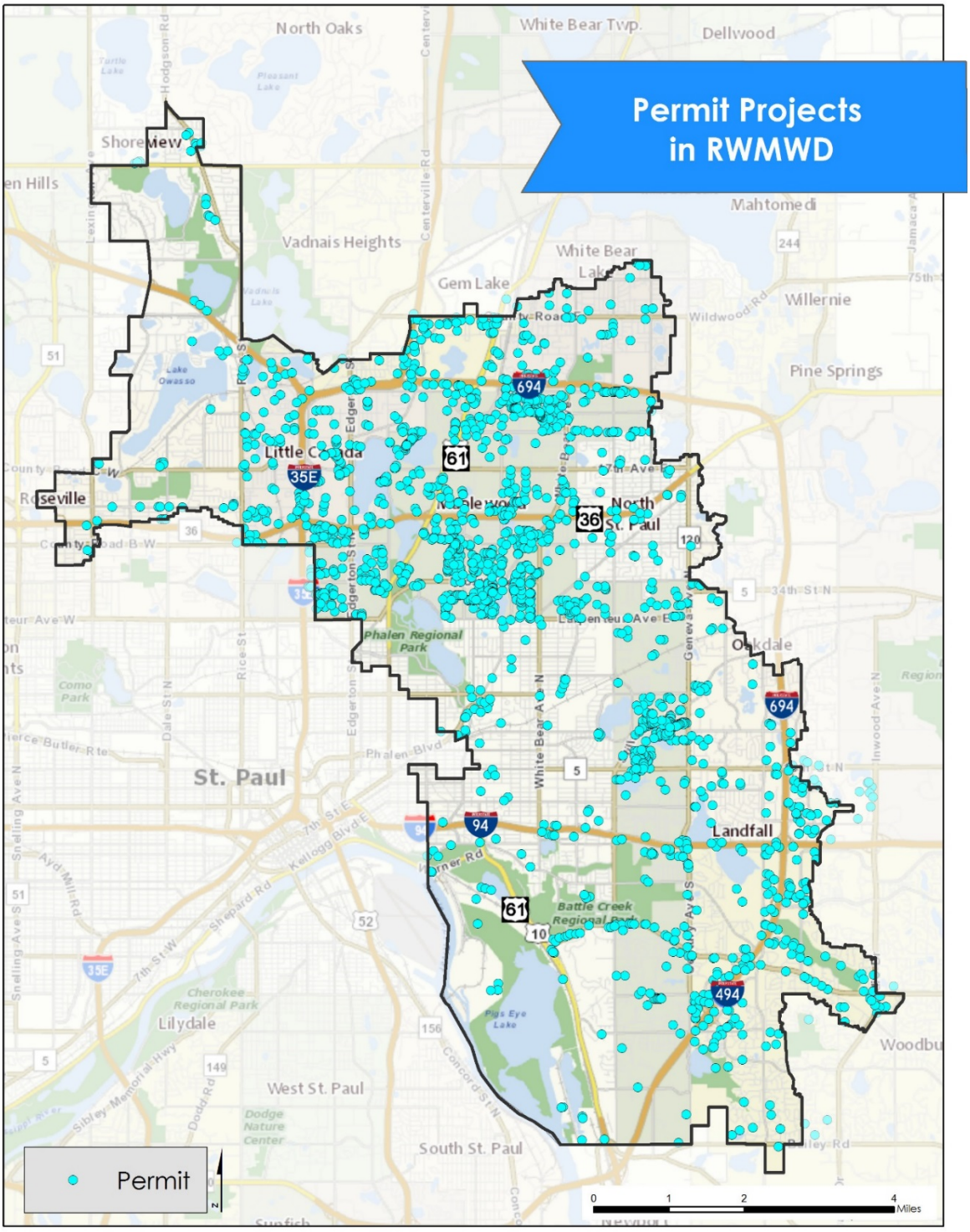
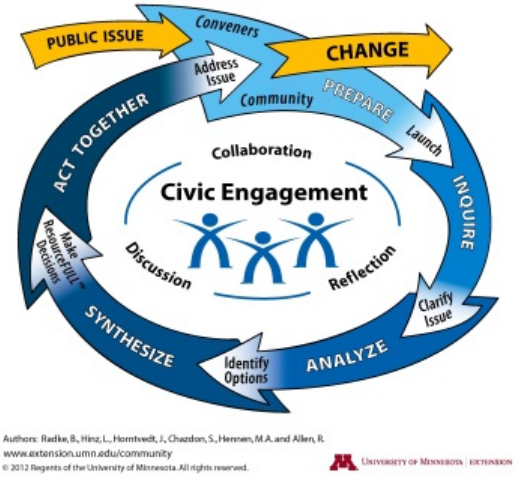



Figure 3-4 RWMWD Permitted Projects through 2015

## 3.2 Civic Engagement

A key prerequisite for successful strategy development and on-the-ground implementation is meaningful civic engagement. The University of Minnesota Extension's definition of civic engagement is "Making 'resourceFULL' decisions and taking collective action on public issues through processes that involve public discussion, reflection, and collaboration." A resourceFULL decision is one based on diverse sources of information and supported with buy-in, resources (including human), and competence. Further information on civic engagement is available at: *http://www1.extension.umn.edu/community/civic-engagement/*.




Public education and public involvement are critical to the RWMWD accomplishing its mission to protect and manage its water resources. It is through education and involvement efforts that the RWMWD increases the public's understanding of water resource management and issues in the watershed, and fosters long-term public commitment to protecting these resources through individual or group actions.

### Accomplishments and Future Plans

#### *Government Collaboration*

The RWMWD is one of several units of government that are directly or indirectly responsible for managing water resources – both water quality and water quantity. Other entities with a role in water quality protection include, but are not limited to:

- RWMWD cities
- Washington Conservation District and Ramsey Conservation District
- Minnesota DNR
- MPCA
- Minnesota BWSR
- Minnesota Department of Health
- Washington County and Ramsey County

Part of the RWMWD's mission is to promote communication and collaboration with its residents, communities and governmental units.

### *Public Involvement and Education*

Past and current RWMWD public education and public involvement efforts include the following:

**Website—**(*www.rwmwd.org*) The District website contains information on all RWMWD program areas and projects over the history of the watershed. It is the location to share upcoming events and make announcements. The public can also get connected to the RWMWD blog, e-newsletter and various social media sites.

**Citizen Advisory Committee (CAC)—**The CAC is appointed by the Board of Managers to provide input to the board and staff on program design, implementation, and evaluation. The CAC duties and tasks will be defined by District staff in consultation with the CAC membership.

**Technical Advisory Committee (TAC)—**The District plans a monthly meeting of public works, engineering and environmental staff from each city, county and conservation district. The group meets to discuss upcoming projects and programs as well as education efforts and trainings needs. The MS4 permit and SWPPP is a topic that is discussed throughout the year also. The TAC also plays a large role in the development of the District' watershed management plan and subsequent yearly budget process.

**Public Involvement and Education Program—**RWMWD's Public Involvement and Education Program's role is to inform citizens and involve them in in stewardship actions that enhance the community's awareness about water issues, and increase its capacity to help protect local water and natural resources. The PIE program engages the community in addressing local water issues through partnerships with cities and their staff, neighborhoods, developers, other natural resources and stormwater agencies and professionals, nature centers, businesses, churches, schools, colleges, lake associations and the general public. The PIE program supports stormwater, habitat enhancement/restoration and outreach projects by training, recruiting and engaging volunteers from schools, churches and the Master Gardener, Master Naturalist and Master Water Stewards programs in these initiatives. The PIE program also develops and facilitates training activities, workshops and classes for the public, cities, schools and churches and directs the use of social media, the District's website, the Ripple Effect blog/newsletter and videos to inform and increase citizen and community stewardship about local water quality and natural resources issues.

**BMP Incentive Program**— The RWMWD BMP Incentive Program offers financial, educational, and technical assistance to public and private landowners to protect and improve water and natural resources within our watershed. Assistance is available to homeowners, government agencies, churches, schools, homeowner associations, and commercial sites implementing programs and projects that support one or more of the following:

- Promote actions that prevent flooding or lessens the effect of drought
- Protect and restore clean water by capturing pollutants in rainwater runoff
- Increase the watershed's ability to store water
- Preserve and restore native plant and wildlife communities, especially lakes, rivers and wetlands
- Protect and preserve groundwater quality and quantity

- Educate and engage citizens in water and natural resources protection

**2017-2027 Watershed Management Plan, Planning Process –** During the early months of development of the RWMWD Watershed Management Plan update, this WRAPS report, and the TMDL report, nearly 100 residents came together in a series of three Community Conversations within RWMWD between mid-September and early October 2013. The Community Conversations were held on the following dates:

- 9/17/2013 at Maplewood Community Center
- 9/26/2013 at Woodbury City Hall
- 10/3/2013 at Shoreview Community Center

The goal of these Community Conversations was two-fold. The first goal was to teach residents about the history of the District, how the budget is established, and the major District initiatives and recent accomplishments. The second goal of the Community Conversations was to solicit input from participants. These gatherings were designed to begin the public input process in updating the District's Watershed Management Plan and to help brainstorm ideas for implementation to improve water quality, as well as to achieve other RWMWD goals.

At each Community Conversation, people reflected on how they value and interact with the District's lakes, wetlands and creeks, identified many of their concerns, and offered potential solutions to the identified watershed issues through a "brain-sprinting" exercise. In the first round of the exercise, the participants generated an expanded list of issues/concerns in the watershed such as invasive species, animal habitats, stormwater and other pollutants, water quality, water levels, aquatic vegetation (macrophytes), increased development/impervious surfaces and the need for education and maintenance. A second round of small group interchanges in the exercise then precipitated insights and suggestions to address the problems and make improvements. Each night the discussions culminated in a large group sharing of what the participants valued in the watershed and a summary of the key issues and ideas for improvement.

The culmination of all of these community meetings was a "Community Confluence" Event held on January 30, 2014. Members of the public, government agencies, city and county staff were invited to hear the results from the three community conversations meetings, and to review eight posters that represented a series of goal "themes" and ideas and/or issues that pertained to those themes. These themes were developed from the feedback received during the Community Conversations meetings. A ninth poster titled "What Did We Miss?" was included for citizens to write-in additional ideas and issues that they thought were not represented in the other eight posters.

Figure 3-5 shows some of the results of the brainstorming exercises shared at the Community Confluence event.


**Figure 3-5 Word cloud representation of citizens' "Ideas for Improvements in the Watershed", summarized across all three Community Confluence meetings. Larger phrases were used more often in citizen responses**

In addition to the Community Conversations and Confluence meetings described above, TAC meetings were regularly held throughout the creation of the new plan, to discuss the Plan's contents, especially implementation strategies, and priorities for the District's cost share program.

**RWMWD TMDL Process** – Several meetings were held between various stakeholders in the watershed, and other applicable local and state agencies. Public meetings were also held. The goal of this process was to discuss the development and conclusions of the *RWMWD TMDL Study (draft, Barr 2016)*, obtain input from, review results with, and take comments from those interested and affected parties.

## Future Plans

During the next phase of the *RWMWD Watershed Management Plan 2017-2027 (RWMWD 2017)*, the District's goal surrounding public involvement and education ("Inform and Empower Communities") is described as follows:

*The RWMWD will inform and empower communities to become partners in improving and protecting the watershed through their own efforts.*

Many actions and signs of success for the next 10 years of public involvement and education are described in the *Plans' Strategic Overview*.

## Public Notice for Comments

An opportunity for public comment on this draft WRAPS report was provided via a public notice in the State Register from April 3 through May 3, 2017.

## 3.3 Restoration and Protection Strategies

The mission of the RWMWD is to preserve and improve water resources and related ecosystems to sustain their long-term health and integrity, and contribute to the well-being and engagement of stakeholders within the community. The activities the RWMWD intends to undertake to achieve this mission are reflected in the *RWMWD Watershed Management Plan 2017-2027 (RWMWD 2016)*, and those activities supporting water quality are summarized in this section of this WRAPS report.

Water quality improvement projects and management activities implemented by the RWMWD are based on feasibility, prioritization, and available funding. Prioritization will be based on the RWMWD management classification (Impaired, Protect-At Risk, Protect-Stable) for water quality improvement projects identified during diagnostic feasibility studies. The RWMWD will place the highest implementation priority on water quality improvement projects that target "Impaired" waterbodies. However, the RWMWD will also give higher priority to water quality improvement projects that are the most effective at achieving water quality goals. Additionally, the RWMWD is open to partnering with other agencies (e.g. cities, county) to implement water quality improvement projects as these opportunities arise. More information on the RWMWD's approach to implementing projects and programs can be found in the Implementation Section of the Plan.

Specific strategies have been developed to restore the impaired waters within the RWMWD and for protecting/maintaining the quality of the waters within the watershed that are not impaired. The watershed-wide and the subwatershed-based implementation strategy table that follows outlines the strategies and actions that could be capable of improving water quality. The table was developed by reviewing the specific conditions affecting each of the waterbodies, targeting geographic areas through modeling and monitoring procedures, and collecting input from watershed stakeholders. These implementation items relate directly to the implementation items in the *RWMWD Watershed Management Plan 2017-2027 (RWMWD 2017)*, as indicated in the Table 3-1.

RWMWD is unique in that it is a permitted MS4 and a watershed district. Because the RWMWD owns and operates a conveyance system (Beltline and Battle Creek Interceptors), they must maintain and comply with the requirements of the MS4 General Permit (See Section 2.3). Since they are also a watershed district, they are the local unit of government that manages water resources within the RWMWD Watershed jurisdiction. Watershed districts within the TCMA must follow the guidance of both the Watershed Act (Minn. Stat. 103D) and the Metropolitan Surface Water Management Act (Minn. Stat. 103B). Minn. Stat. §§ 103B and 103D, require watershed district to prepare watershed management plans and follow the plan requirements of Minn. R. 8410. Because of their role as a watershed district, RWMWD will be taking primary responsibility for the majority of the implementation strategies listed in Table 3-1. Examples of BMPs and actions that the District will take to implement these strategies are shown in Table 3-2.

It is important to note that loading reduced from some implementation actions listed in Table 3-1 is creditable to the LA and some to the WLA. Examples of non-WLA-creditable projects include strategies aimed at reducing in-lake loading (e.g., alum treatment, aquatic plant management). For clarification on a particular project's applicability to a WLA, a project proposer should contact the MPCA Stormwater Program.

Lastly, the RWMWD and other cities, townships, and property owners have already implemented numerous stormwater runoff management projects and water quality improvement projects. In addition, hundreds of water quality improvement projects have been constructed in RWMWD as part of RWMWD-permitted projects. After implementation of the projects, it is essential that these projects be operated and maintained so that they continually provide their intended benefits.

# Table 3-1 Strategies and actions proposed for the Ramsey-Washington Metro Watershed District

| HUC-10 Subwatershed | Waterbody and Location | | Parameter (incl. non-pollutant stressors) | Water Quality | | Strategies (see Table 3-3) | Strategy types and estimated scale of adoption needed to meet final water quality target | Interim 10-yr Milestones | Governmental Units with Primary Responsibility[1] | | | | | | | | | | | | | | | | | | | | | | Estimated Year to Achieve Water Quality Target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Waterbody (ID) | Location and Upstream Influence Counties | | Current Conditions | Goals / Targets and Estimated % Reduction | | | | Rice Creek Watershed District | Ramsey Co. SWCD | Washington Co. SWCD | Saint Paul | Lauderdale | Little Canada | Maplewood | North St. Paul | Oakdale | Vadnais Heights | Shoreview | Arden Hills | White Bear Lake | Mahtomedi | Ramsey County | Washington County | MPCA | DNR | MDH | MnDOT | |
| | All | Ramsey and Washington Counties | All Conventional Pollutants | -- | -- | Inform and empower communities | Implement public information and education programs directed at multiple audience groups that includes; education events, K-12 watershed education, public education and outreach, city collaboration and support, and metro education support. | Ongoing | P | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement tours, workshops, trainings and other events to increase MS4 and community participation and awareness of watershed issues. | Ongoing | P | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | -- | -- | Support sustainable groundwater | Collaborate to address groundwater issues, including identification of data gaps and areas of vulnerability, and develop management strategies and tools | Ongoing | S | | | A | A | A | A | A | A | A | A | A | A | A | S | S | S | P | S | A | Ongoing |
| | | | | | | | Maintain an inventory of RWMWD infiltration projects and share information with agencies with groundwater jurisdiction. | Ongoing | P | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | -- | -- | Inspect and maintain stormwater facilities | Inspect and maintain stormwater facilities and natural areas, and consider opportunities to collaborate with others to support maintenance activities. | Ongoing | P | | | S | S | S | S | S | S | S | S | S | S | S | S | S | S | | | S | Ongoing |
| | | | | -- | -- | Inspect and maintain creeks | Inspect stability of creek channel and banks and implement structural improvements and habitat restoration projects to address identified stream bank erosion, gully erosion and other stream degradation problems. | Biennial inspections, improvements as needed | P | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | -- | -- | Inspect and maintain natural areas | Inspect, monitor and maintain restoration sites, shorelines and natural areas. | Ongoing | P | A | A | S | S | S | S | S | S | S | S | S | S | S | S | S | S | | S | Ongoing |
| | | | | -- | -- | Monitor lake and stream water quality | Monitor water quality of lakes and creeks to assess trends and evaluate achievement of water quality goals. Monitor subwatershed outlets to measure performance of pollutant reduction measures. | Ongoing | P | | | | | | | | | | | | | | | | P | | | | Ongoing |
| | | | | -- | -- | Monitor lake levels | Monitor lake levels within the District. | Ongoing | P | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | -- | -- | Manage risk of flooding | Collaboratively identify, assess, and address potential flooding problems. | Ongoing | P | | | P | P | P | P | P | P | P | P | P | P | P | P | P | P | | P | | P | Ongoing |
| | | | | -- | -- | Support research | Implement or support research projects, monitoring, and other activities to better understand factors affecting District water quality and seek opportunities to incorporate information into District projects and programs. | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | -- | -- | Support implementation of water quality BMPs | Implement the District's BMP Cost Share Program to assist citizens, cities, institutions, local agencies and businesses in implementing water quality improvements throughout the District. | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | -- | -- | Implement policies and rules | Implement, track, and update (as necessary) District rules and permitting program. Develop and implement methods/programs for measuring, tracking and reporting progress toward District goals. Administer the Minnesota Wetland Conservation Act (RWMWD is the Local Unit of Government). | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | Invasive Species | -- | -- | Manage Invasive Species | Collaboratively manage invasive species that threaten water resources and associated upland habitats. | Ongoing | S | A | A | S | S | S | S | S | S | S | S | S | S | S | S | S | | P | | S | Ongoing |
| | | | | | | | Implement the District's macrophyte and filamentous green algae monitoring program and assess data for trends, creating and implementing macrophyte management plans where necessary to improve lake water quality. | Ongoing | P | | | | | | | | | | | | | | | | | P | | | | Ongoing |
| | | | Parameters cited in permit | -- | -- | Permit Compliance | Ensure construction and industrial stormwater permittees comply with general permits | Ongoing | | | | S | S | S | S | S | S | S | S | S | S | S | S | S | P | | | S | Ongoing |
| | | | | | | | Ensure MS4s comply with permits | Ongoing | S | | | S | S | S | S | S | S | S | S | S | S | S | S | S | P | | | S | Ongoing |
| | | | Chloride | -- | <230 mg/L | Improve road salt management | Promote and adopt strategies in the TCMA Chloride Management Plan http://www.pca.state.mn.us/r0qgb86 | Ongoing | A | A | A | P | P | P | P | P | P | P | P | P | P | P | P | P | A | | | P | Ongoing |
| | Battle Creek (Assessment ID: 07010206-592) | St. Paul, Ramsey and Washington counties | TSS | Loads vary by flow regime; 71 mg/L seasonal average | 86% reduction 30 mg/L seasonal average | Protect/stabilize banks/bluffs | Look for opportunities to stabilize areas in Battle Creek Regional Park and along streambanks | Ongoing | P | | | | | | | | | | | | | | P | | | | | | Ongoing |
| | | | | | | Remove accumulated sediment | Continue removal of accumulated sediment from creek, as needed. | Ongoing | A | | | | | | | | | | | | | | P | | | | | | Ongoing |
| | | | | | | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TSS load to Battle Creek. 86% of reduction of TSS from baseline watershed levels (Baseline year: 2007) | Battle Creek subwatershed feasibility study in 2016/2017 to search for feasible projects. | P | S | S | | | | P | | P | | | | P | P | P | | | | P | 2026 |
| | | | Chloride | -- | <230 mg/L | Improve road salt management | Promote and adopt strategies in the TCMA Chloride Management Plan http://www.pca.state.mn.us/r0qgb86 | Ongoing | A | A | A | | | | P | | P | | | | P | P | P | A | | | P | Ongoing |
| | Kohlman Lake (62-0006-00) | Maplewood, Ramsey County | Phosphorus (TP) | 1233 lbs TP seasonal load (June through September, critical year at the time the TMDL was written in 2007); 111 ppb seasonal conc (June through September, 10 year average at the time the TMDL was written in 2007) 74 ppb seasonal conc (June through September, 2003-2012 average) | 769 lbs TP seasonal load (June through September, critical year); 60 ppb seasonal conc (June through September, 10-year average) | Reduce in-lake loading | 80% Reduction of internal load | First round of rough fish management complete, continue as needed | P | | | | | | | | | | | | | | | | | S | | | Ongoing |
| | | | | | | | | Curlyleaf Pondweed Management per DNR Invasive Aquatic Plant Management permit | P | | | | | | | | | | | | | | | S | | | Ongoing |
| | | | | | | | | Initial round of alum treatments complete, continue as needed, assess other options by 2020. | P | | | | | | | | | | | | | | | S | | | Ongoing |
| | | | | | | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Kohlman Lake. 209 pounds (or 22%) reduction from baseline watershed levels (Baseline Year: 2002) targeted at Kohlman Creek Subwatershed | Ongoing | P | A | A | P | | P | P | P | P | | | P | P | | P | P | | | | P | 2027 |
| | | | Chloride | -- | <230 mg/L | Improve road salt management | Promote and adopt strategies in the TCMA Chloride Management Plan http://www.pca.state.mn.us/r0qgb86 | Ongoing | A | A | A | P | | P | P | P | P | | | P | P | | P | | A | | | P | Ongoing |
| | Bennett Lake (62-0048-00) | Roseville, Ramsey County | Phosphorus (TP) | 143.3 lbs TP seasonal load (June through September, critical year) 138 ppb seasonal conc (June through September, 2003-2012 average) | 43.7 lbs TP seasonal load (June through September, critical year); 60 ppb seasonal conc (June through September, 10-year average) | Reduce in-lake loading | 80% Reduction of internal load | Monitor carp in Lake Owasso-Central Park Wetlands-Bennett Lake, and manage carp populations if deemed necessary (2019-2026) | P | | | | | | | | | | | | | | | | | S | | | Ongoing |
| | | | | | | | | Develop a plan for macrophyte management (including curlyleaf pondweed) of Bennett Lake by 2020. | P | | | | | | | | | | | | | | | S | | | Ongoing |
| | | | | | | | | Asess options for inactivation of sediment TP release by 2020. | P | | | | | | | | | | | | | | | S | | | Ongoing |
| | | | | | | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Bennett Lake. 42.7 pounds (or 61%) reduction from baseline watershed levels (Baseline Year: 2005) | Bennett Lake subwatershed feasibility study in 2016/2017 to search for feasible projects. | P | A | | | | | | | P | | | | P | | | | P | 2026 |
| | Wakefield Lake (62-0011-P) | Maplewood, Ramsey County | Phosphorus (TP) | 186 lbs TP seasonal load (June through September, critical year); 106 ppb seasonal conc (June through September, 10-year average) | 103 lbs TP seasonal load (June through September, critical year) 60 ppb seasonal conc (June through September, 10-year average) | Reduce in-lake loading | 80% Reduction of internal load | Develop a plan for macrophyte management (including curlyleaf pondweed) of Wakefield Lake by 2020. | P | | | | | | | | | | | | | | | | | S | | | Ongoing |
| | | | | | | | | Asess options for inactivation of sediment release of TP by 2020. | P | | | | | | | | | | | | | | | S | | | TBD |
| | | | | | | Improve stormwater management to reduce | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | Ongoing |

| HUC-10 Subwatershed | Waterbody and Location | | Parameter (incl. non-pollutant stressors) | Water Quality | | Strategies (see Table 3-3) | Strategy types and estimated scale of adoption needed to meet final water quality target | Interim 10-yr Milestones | Governmental Units with Primary Responsibility[1] | | | | | | | | | | | | | | | | | | | | Estimated Year to Achieve Water Quality Target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Waterbody (ID) | Location and Upstream Influence Counties | | Current Conditions | Goals / Targets and Estimated % Reduction | | | | Alicia Red Dorsett | Ramsey Co. SWCD | Washington Co. SWCD | Saint Paul | Lauderdale | Little Canada | Maplewood | North St. Paul | Oakdale | St. Paul | Shoreview | Vadnais Heights | White Bear Lakes | Woodbury | Ramsey County | Washington County | MCES | BWSR | MDH | MnDOT | |
| | | | | | | Improve stormwater management to reduce runoff of TP | Implement feasible water quality projects that decrease the TP load to Wakefield Lake. | Spent lime filter planned to be constructed in 2017 by RWMWD on Maplewood property | P | A | | | | | P | P | | P | | | | | | P | | | | | 2020 |
| City of Saint Paul-Mississippi River (701020608) | Fish Creek (Assessment ID: 07010206-606) | Maplewood, Ramsey County | E. coli | 197 cfu/100 mL seasonal geomean | 126 cfu/100 mL seasonal geomean; 36% reduction (Baseline Year: 2011) | Address non-compliant septic systems | Inspect and replace (or fund through cost share programs) non-functional or noncompliant SSTS | Inspections of 20 SSTS and replacement of failing septic systems. | A | | | | | | P | | | P | | | | | | S | | | | | 2026 |
| | | | | | | Educate citizens about proper disposal of pet waste | Leverage the education and outreach programs run by District staff and other agencies to provide educational materials for distribution. | Methodology in place to disseminate information by 2020 | P | S | S | | | | P | | | P | | | | | | P | P | P | P | | | | Ongoing |
| | Lake Emily (62-0080) | Shoreview, Ramsey County | Total Phosphorus (TP) | 98 ppb seasonal conc (June through September, 10 year average) | 60 ppb seasonal conc (June through September, 10 year average) | Reduce in-lake loading | Reduction of internal load, if necessary | Assess options for inactivation of sediment release of TP by 2020. | P | | | | | | | | | | | | | | | | | | | S | | | TBD |
| | | | | | | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Lake Emily. | Lake Emily subwatershed feasibility study in 2016 to search for feasible projects. | P | S | | | | | | | | S | | | | | | S | | | | | | | 2026 |
| | Carver Lake (82-0166-P) | Woodbury, Washington County | Chloride | -- | <230 mg/L | Improve road salt management | Promote and adopt strategies in the TCMA Chloride Management Plan http://www.pca.state.mn.us/r0ppb86 | Ongoing | A | A | A | | | | P | | | | | | | | | P | P | P | A | | | | Ongoing |
| | | | Phosphorus (TP) | Currently meeting state TP standards, but thought to be "At Risk" of not meeting them in the future | 40 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Carver Lake. | Ongoing | P | S | S | | | | S | | | | | | | | | S | S | S | | | | S | Ongoing |
| | Owasso Lake (62-0056) | Shoreview, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, but thought to be "At Risk" of not meeting them in the future | 40 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Owasso Lake. | Owasso Lake subwatershed feasibility study in 2018 to search for feasible projects. | P | S | | | | | | | | S | S | | | | | S | | | | | | | 2026 |
| | | | | | | Reduce in-lake loading | Inactivation of sediment phosphorus release, if necessary | Assess options for inactivation of sediment release of TP by 2020. | P | | | | | | | | | | | | | | | | | | | S | | | TBD |
| | | | | | | | Rough fish management, if necessary | Monitor carp in Lake Owasso-Central Park Wetlands-Bennett Lake, and manage carp populations if deemed necessary (2019-2026) | P | | | | | | | | | | | | | | | | | S | | | | 2026 |
| | Gervais Lake (62-0007) | Little Canada, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, but thought to be "At Risk" of not meeting them in the future | 40 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Gervais Lake. | Ongoing | P | S | | | | | S | S | | | | | | | | S | | | | | S | Ongoing |
| | Battle Creek Lake (62-0091) | Woodbury, Washington County | Phosphorus (TP) | Currently meeting state TP standards, but thought to be "At Risk" of not meeting them in the future | 60 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Battle Creek Lake. | Battle Creek Lake subwatershed feasibility study in 2018 to search for feasible projects. | P | | S | | S | | | S | | | | | | S | S | | | | S | | | 2026 |
| | | | | | | Reduce in-lake loading | Reduction of internal load, if necessary | Assess options for inactivation of sediment release of TP by 2020. | P | | | | | | | | | | | | | | | | | | S | | | TBD |
| | | | Chloride | -- | <230 mg/L | Improve road salt management | Promote and adopt strategies in the TCMA Chloride Management Plan http://www.pca.state.mn.us/r0ppb86 | Ongoing | A | A | A | | P | | | P | | | | | | P | P | A | | | | P | Ongoing |
| | Round Lake (Little Canada) (62-0009) | Little Canada, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, but thought to be "At Risk" of not meeting them in the future | 60 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Round Lake (Little Canada) | Ongoing | P | S | | | | | S | | | | | | | | | S | | | | | | | Ongoing |
| | Beaver Lake (62-0016) | St. Paul, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, but thought to be "At Risk" of not meeting them in the future | 60 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Beaver Lake | Ongoing | P | S | S | | | | S | | S | S | | | | | | S | S | | | | | | Ongoing |
| | | | | | | Reduce in-lake loading | Inactivation of sediment phosphorus release, if necessary | Assess options for inactivation of sediment release of TP by 2020. | P | | | | | | | | | | | | | | | | | | | S | | | TBD |
| | Keller Lake (62-0010) | Maplewood, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, and currently considered to be "Stable" | 60 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Keller Lake. | Ongoing | P | S | | | | | S | S | | | | | | | | S | | | | | | | Ongoing |
| | | | | | | Reduce in-lake loading | Rough fish management, if necessary | First round of rough fish management complete, continue as needed | P | | | | | | | | | | | | | | | | | | | S | | | Ongoing |
| | Tanners Lake (62-0115-P) | Oakdale and Landfall, Washington County | Phosphorus (TP) | Currently meeting state TP standards, and currently considered to be "Stable" | 40 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Tanners Lake. | Ongoing | P | S | S | | S | | S | | S | | | | | | S | S | S | | | | S | Ongoing |
| | | | Chloride | -- | <230 mg/L | Improve road salt management | Promote and adopt strategies in the TCMA Chloride Management Plan http://www.pca.state.mn.us/r0ppb86 | Ongoing | A | A | A | | P | | P | | P | | | | | P | P | P | A | | | P | Ongoing |
| | Round Lake (Maplewood) (62-0012) | Maplewood, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, and currently considered to be "Stable" | 60 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Round Lake (Maplewood) | Ongoing | P | S | | | | | S | | | | | | | | | S | | | | | | | Ongoing |
| | Lake Wabasso (62-0082) | Shoreview, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, and currently considered to be "Stable" | 40 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Lake Wabasso | Ongoing | S | S | | | | | | | | S | | | | | | S | | | | | | | Ongoing |
| | Snail Lake (62-0073) | Shoreview, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, and currently considered to be "Stable" | 40 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Snail Lake | Ongoing | P | S | | | | | | | | S | | | | | | S | | | | | | | Ongoing |
| | Shoreview Lake (62-0079) | Shoreview, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, but thought to be "At Risk" of not meeting them in the future | 60 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Shoreview Lake | Shoreview Lake subwatershed feasibility study in 2017 to search for feasible projects. | P | S | | | | | | | | S | | | | | | S | | | | | | | 2026 |
| | Eagle Lake (Northstar) | St. Paul, Ramsey County | Phosphorus (TP) | -- | 60 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Eagle Lake (Northstar) | Ongoing | P | S | | | | | | | | S | | | | | | S | | | | | | | Ongoing |

| HUC-10 Subwatershed | Waterbody and Location | | Parameter (incl. non-pollutant stressors) | Water Quality | | Strategies (see Table 3-3) | Strategy types and estimated scale of adoption needed to meet final water quality target | Interim 10-yr Milestones | Governmental Units with Primary Responsibility[2] | | | | | | | | | | | | | | | | | | | | | | | Estimated Year to Achieve Water Quality Target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Waterbody (ID) | Location and Upstream Influence Counties | | Current Conditions | Goals / Targets and Estimated % Reduction | | | | Afton-Denmark Districts | Ramsey Co. SWCD | Washington Co. SWCD | Grant Lake | Lake Elmo | Oakdale | Maplewood | North St. Paul | Oakdale | St. Paul | Shoreview | Vadnais Lake | Vadnais Heights | White Bear Lake | Woodbury | Ramsey County | Washington County | MPCA | DNR | MDH | MnDOT | | | |
| | Twin Lake (62-0039) | Little Canada, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, and currently considered to be "Stable" | 40 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Twin Lake. | Ongoing | P | S | | | | S | | | | | | | S | | | S | | | | | | Ongoing |
| | Lake Phalen (62-0013) | St. Paul, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, and currently considered to be "Stable" | 40 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Lake Phalen | Ongoing | P | S | | | | | S | | | S | | | | | | S | | | | | | Ongoing |
| | Willow Lake (62-0040) | Vadnais Heights, Ramsey County | Phosphorus (TP) | Currently meeting state TP standards, and currently considered to be "Stable" | 60 ppb seasonal conc (June through September, 10-year average) | Improve stormwater management | Implement BMP Cost Share Program | Ongoing | P | | | | | | | | | | | | | | | | | | | | | | | Ongoing |
| | | | | | | | Implement feasible water quality projects that decrease the TP load to Willow Lake. | Ongoing | P | S | | S | | | | | | | | | | S | | | S | | | | | S | Ongoing |

**Table 3-2: Key for Strategies Column in Table 3-2**

| Parameter (including non-pollutant stressors) | Strategy Key | |
|---|---|---|
| | **Strategy Description** | **Example BMPs and Actions** |
| **All Conventional Pollutants** | **Inform and empower communities:** Implement public information and education programs directed at multiple audience groups that includes; education events, K-12 watershed education, public education and outreach, city collaboration and support, and metro education support. Implement tours, workshops, trainings and other events to increase MS4 and community participation and awareness of watershed issues. | WaterFest<br>School projects sponsored by the RWMWD<br>The RWMWD's Ripple Effect Newsletter<br>Master Water Stewards program<br>LEAP Program and Annual Volunteer Recognition Ceremony<br>MS4/RWMWD Forum Meetings<br>Annual Watershed Tour hosted by RWMWD<br>Hosted workshops and sharing of training and other informational material |
| | **Support sustainable groundwater:**<br>Collaborate to address groundwater issues, including identification of data gaps and areas of vulnerability, and develop management strategies and tools | Implement county groundwater plans<br><br>Groundwater data collection and reporting<br><br>Study the connection between surface water and groundwater throughout the District<br>Maintain an inventory of infiltration projects and share information with agencies with groundwater jurisdiction. |
| | **Inspect and maintain stormwater facilities:**<br>Inspect and maintain stormwater facilities and natural areas, and consider opportunities to collaborate with others to support maintenance activities. | RWMWD annual inspection and maintenance program<br>Pond prioritization study to help MS4s prioritize pond assessment and dredging activities |
| | **Inspect and maintain creeks:**<br>Inspect stability of creek channel and banks and implement structural improvements and habitat restoration projects to address identified stream bank erosion, gully erosion and other stream degradation problems. | Shoreline stabilization projects<br>Native revegetation of buffers<br>Removal of accumulated sediment |
| | **Inspect and maintain natural areas:**<br>Inspect, monitor and maintain restoration sites, shorelines and natural areas. | Native revegetation of buffers and riparian natural areas. |
| | **Monitor lake and stream water quality:**<br>Monitor water quality of lakes and creeks to assess trends and evaluate achievement of water quality goals. Monitor subwatershed outlets to measure performance of pollutant reduction measures. | Analysis of data trends and status of water quality<br>Evaluation of progress in improving water quality |
| | **Monitor lake levels** | Monitor lake levels within the District and share information with MS4s |
| | **Manage risk of flooding:**<br>Collaboratively Identify, assess, and address potential flooding problems. | Share RWMWD Atlas 14 modeling results with MS4s<br>Monitor areas of concern<br>Plan for improvements to infrastructure |
| | **Support research:**<br>Implement or support research projects, monitoring, and other activities to better understand factors affecting District water quality and seek opportunities to incorporate information into District projects and programs. | Spent lime filter BMP (RWMWD)<br>Macrophyte harvesting study (RWMWD) |
| | **Support implementation of water quality BMPs:**<br>Implement the BMP Cost Share Programs to assist citizens, cities, institutions, local agencies and businesses in implementing water quality improvements throughout the District. | Retrofit projects in commercial, school and church properties<br>Collaboration between MS4s and RWMWD to help water quality projects go "above and beyond" permit requirements. |
| | **Implement policies and rules:**<br>Implement RWMWD rules and policies and the rules and policies of other agencies. | Implement, track, and update (as necessary) District rules and permitting program.<br>Administer the Minnesota Wetland Conservation Act (RWMWD is the Local Unit of Government).<br>Conform to MS4 NPDES permit requirements<br>Implement SWPPPs |
| | **Permit Compliance** | Ensure construction and industrial stormwater permittees comply with general permits |
| | | Ensure NPDES compliance |
| | | Ensure MS4s comply with permits |
| **Invasive Species** | **Manage Invasive Species:**<br>Collaboratively manage invasive species that threaten water resources and associated upland habitats. | Implement the District's (and others') macrophyte and filamentous green algae monitoring program and assess data for trends, creating and implementing macrophyte management plans where necessary to improve lake water quality.<br>Mechanical harvesting<br>Lake drawdown<br>Herbicide treatments |
| **Chloride** | **Improve road salt management:**<br>Promote and adopt strategies in the TCMA Chloride Management Plan | http://www.pca.state.mn.us/r0pgb86 |
| **Total Suspended Solids (TSS)** | **Protect and stabilize banks and bluffs** | Annual inspections of streambanks to assess erosion that requires stabilization<br>Stabilization of stream banks with regrading and/or revegetation |
| | **Remove accumulated sediment:**<br>Remove sediment that has deposited in the creek bed when it alters flow or habitat for macroinvertebrates or fish | Remove accumulated sediment from creek beds as needed to maintain flow and ecological function. |
| | **Improve stormwater management:**<br>Decrease the TSS load to downstream waterbodies through the implementation of BMPs that remove sediment, reduce stormwater volume, or both. | Implement BMP Cost Share Program (District or other) to promote the proliferation of projects that reduce TSS loads to downstream waterbodies |
| | | Implement feasible water quality projects that decrease the TSS loads to downstream waterbodies. |
| **Phosphorus (TP)** | **Reduce in-lake loading** | Rough fish (carp) monitoring and management<br>Macrophyte (curlyleaf pondweed) management<br>Inactivation of sediment phosphorus release (alum or other)<br>Lake drawdown<br>Dredging |
| | **Improve stormwater management** | Implement BMP Cost Share Program (District or other) to promote the proliferation of projects that reduce TP loads to downstream waterbodies<br>Implement feasible water quality projects that decrease the TP load to lakes |
| **E. coli** | **Address non-compliant septic systems** | Inspect and replace (or fund through cost share programs) non-functional or noncompliant SSTS |
| | **Educate citizens about proper disposal of pet waste** | Leverage the education and outreach programs run by District staff and other agencies to provide educational materials about proper disposal of pet waste to limit exposure to rainfall. |

# 4. Monitoring Plan

The purpose of the RWMWD's monitoring program is to collect chemical and biological information on District water resources. This data is used to assess the health of the resources and determine if additional management activities are necessary. Monitoring has also been implemented to evaluate the effectiveness of completed projects.

The RWMWD has a comprehensive monitoring program and the district has collected a large amount of water quality data over its history. The district has also collected lake level, stream flow and lake biological data. In addition, other agencies have collected data for RWMWD waterbodies, including the MPCA and the Metropolitan Council. The amount of data currently available varies by waterbody.

Continued water quality data collection is necessary for the RWMWD to track water quality improvement or degradation, detect trends, better understand water quality processes, and ultimately determine if there are water quality problems (e.g., impaired uses). This information is critical for RWMWD to identify and prioritize water quality improvement projects, and to determine appropriate methods for preventing water quality degradation. Detection of trends, specifically improvements, is critical to determining the effectiveness of actions implemented by the RWMWD.

This section of this WRAPS report describes waterbody monitoring programs currently utilized by the RWMWD:

**RWMWD Water Quality Monitoring**

The District's Water Quality Monitoring Program tracks water quality and quantity in District lakes and streams. The program collects data on District lakes every two to three weeks from June through September. Measurements include water clarity (Secchi depth), conductivity, pH, and dissolved oxygen every meter of depth in the deepest part of the lake. In addition, water samples are collected for analysis of chloride, phosphorus and chlorophyll-*a* concentrations. Chlorides are also typically monitored in mid-February and at ice-out.

For lakes in Ramsey County, the District and the Ramsey County Environmental Services Office collaborate. For these lakes, the County collects and analyzes the samples from May through October, plus winter chloride monitoring. The District pays the staff and lab costs, and reports the results. The Washington County lakes and special interest wetlands are monitored by District staff. The District also monitors water levels of Battle Creek Lake, Carver Lake, Tanners Lake and Spoon Lake (Keller Lake) every two weeks and after major storm events. The RWMWD website's *Lake Monitoring Page* summarizes the water quality monitoring data that has been collected and compiled for each RWMWD lake and stream.

**Aquatic Plant Monitoring**

This program monitors the presence and abundance of aquatic plants in RWMWD waterbodies, usually focusing on management of both native and invasive aquatic plants and FGA.

### Phytoplankton and Zooplankton Monitoring

This program monitors the microbiotic communities in certain RWMWD waterbodies on an as-needed basis. The monitoring results track the relative distributions of phytoplankton and zooplankton and identify the presence of phytotoxins.

### Stream Water Quality Monitoring

The RWMWD stream monitoring program is part of a larger monitoring effort carried out by the MCES. The WOMP is coordinated by MCES, and includes three locations within the RWMWD: Fish Creek, Battle Creek, and the outlet of the Beltline Interceptor storm sewer. These sites have been monitored since 1995, and collect water quality and stream flow data. Links to the Met Council Stream Monitoring program and reports for District streams may be found on the *Stream Monitoring Page*.

In addition, the RWMWD has historically monitored the outlets of Kohlman Creek, Gervais Creek, and Willow Creek. Since then, the RWMWD has installed permanent stations monitoring flow and water quality on all Kohlman and Gervais Creeks.

### BMP Effectiveness Monitoring

The RWMWD monitors BMPs to evaluate the effectiveness of District water quality improvement projects. This monitoring can include flow monitoring as well as water quality, often at the inflow to and outflow from the various BMPs, to evaluate the performance of the system. The period for which a given project is monitored after construction can vary; however, this performance evaluation is typically conducted for a minimum of one growing season. Results from BMP monitoring are tracked in the RWMWD's cost benefit database of all permit, cost share and CIP projects.

The RWMWD intends to continue each of these monitoring programs into the future, collecting additional data that will help evaluate the effectiveness of implemented projects on the overall water quality of the resources in the District.

# 5. References and Further Information


Barr Engineering Co. 1993. D*iagnostic/Feasibility Study of Water Quality Problems and Restorative Measures for Tanners Lake.* Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 1995. *Battle Creek Lake Watershed Management Plan*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2000. *Carver Lake Strategic Lake Management Plan*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2001. *Minnesota Urban Small Sites BMP Manual.*

Barr Engineering Co. 2004. *Phalen Chain of Lakes Strategic Lake Management Plan*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2005. *Beaver Lake Strategic Lake Management Plan*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2005. *Detailed Assessment of Phosphorus Sources to Ramsey-Washington Metro Watershed District*.

Barr Engineering Co. 2005. *Internal Phosphorus Load Study: Kohlman and Keller Lakes*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2005. *Phalen Chain of Lakes Summary Report and Final Lake Management Recommendations*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2006. *Phalen Chain of Lakes Carp Population Study*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2007. *Casey Lake, Round Lake (in Little Canada), Savage Lake, Twin Lake, and Willow Lake Status Report*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2007. *Kohlman Creek Subwatershed Infiltration Study*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2007. *Round Lake (in Maplewood) Strategic Lake Management Plan*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2007. *Sediment Source Loading to Fish Creek and Ponds*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2008. *Carver Lake Infiltration Study*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2008. *Wakefield Lake Strategic Lake Management Plan*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2009. *Battle Creek Lake Status Report*. Prepared for Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2009. *Lake Owasso Use Attainability Analysis*. Prepared for Grass Lake Watershed Management Organization.

Barr Engineering Co. January 2010. *Kohlman Lake Total Maximum Daily Load Report*. Prepared for Minnesota Pollution Control Agency and Ramsey-Washington Metro Watershed District.

Barr Engineering Co. April 2010. *Kohlman Lake Total Maximum Daily Load Implementation Plan*. Prepared for Minnesota Pollution Control Agency and Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2015. *Battle Creek Stressor Identification Study*. Prepared for the Minnesota Pollution Control Agency and Ramsey-Washington Metro Watershed District.

Barr Engineering Co. 2015. *Ramsey-Washington Metro Watershed District Groundwater/Surface Water Interaction Study.*

Barr Engineering Co. 2016. *Ramsey-Washington Metro Watershed District Total Maximum Daily Load Study* (draft). Prepared for the Minnesota Pollution Control Agency and Ramsey-Washington Metro Watershed District.

Metropolitan Council Environmental Services. Stream Monitoring & Assessment. *http://www.metrocouncil.org/Wastewater-Water/Services/Water-Quality-Management/Stream-Monitoring-Assessment.aspx* .

DNR Designation of Infested Waters, 2015 as amended *http://www.dnr.state.mn.us/invasives/ais/infested.html*.

Ramsey-Washington Metro Watershed District. 2007 (as amended). *Ramsey-Washington Metro Watershed District 2006-2016 Watershed Management Plan*.

Ramsey-Washington Metro Watershed District. 2017. *Ramsey-Washington Metro Watershed District Watershed Management Plan 2017-2027*.

Washington County Groundwater Plan. *https://www.co.washington.mn.us/DocumentCenter/View/794*.

## *Ramsey-Washington Metro Watershed District Reports*

*All Ramsey-Washington Metro Watershed District reports referenced in this WRAPS report are available at the RWMWD watershed webpage:*

*https://www.pca.state.mn.us/water/tmdl/ramsey-washington-metro-watershed-district-watershed-restoration-and-protection-strategy*

*Or the RWMWD website:*

http://www.rwmwd.org/

*Or by contacting the RWMWD directly.*