LOCAL SURFACE WATER MANAGEMENT PLAN

FOR THE CITY OF

ARDEN HILLS, MINNESOTA

WSB Project No. 3455-200
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PREPARED BY

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TABLE OF CONTENTS

Title Page
Table of Contents

SECTION 1: EXECUTIVE SUMMARY
SECTION 2: LAND AND WATER RESOURCE INVENTORY
SECTION 3: AGENCY COOPERATION
SECTION 4: ASSESSMENT OF ISSUES
SECTION 5: GOALS AND POLICIES
SECTION 6: IMPLEMENTATION PROGRAM
SECTION 7: ADMINISTRATION

LIST OF TABLES

Table 2-1 – Average Monthly Temperature and Precipitation Data
Table 2-2 – Atlas 14 Rainfall Frequencies
Table 2-3 – Summary of City Soil Groups
Table 2-4 – Lake Tier Classification
Table 2-5 – Lake Recreational Suitability Measures (Southwest Urban Lakes Study)
Table 2-6 – MPCA Impaired Waters Summary
Table 2-7 – Benchmark Inter-community Flow Rates
Table 5-1 – Summary Data on Lakes in Arden Hills
Table 5-2 – Minimum Control Measures (MCM) and Best Management Practices (BMPs) Summary Sheets
Table 6-1 – Advantages and Disadvantages of Different Funding Alternatives
Table 6-2 – Surface Water Management Implementation Plan

LIST OF APPENDICES

Appendix A – Figures
- Figure 1 – Location Map
- Figure 2 – Soils Map
- Figure 3 – 2010 Existing Land Use
- Figure 4 – 2040 Future Land Use
- Figure 5 – MLCCS
- Figure 6 – Protected Waterways Map
- Figure 7 – Subwatersheds and Drainage System
- Figure 8 – Flood Hazard Areas Map
- Figure 9 – Drinking Water Supply Management Areas (DWSMA)
- Figure 10 – Special and Impaired Waters Map
- Figure 11 – Groundwater Appropriations
- Figure 12 – Pollutant Source Location Map
- Figure 13 – Subwatershed Areas

Appendix B – Relevant City Ordinances
Appendix C – Regulatory Responsibilities and Developer Guidelines
Appendix D – Karth Lake Improvement District
Appendix E – MPCA Listed Pollutant Sources
Appendix F – Previous Pond Modeling and Reference Materials
Appendix G – Southwest Urban Lakes Study – Arden Hills Lake Assessments and MAPs
Appendix H – Previous Study Summary – Lake Josephine
Appendix I – Grant Opportunities
Appendix J – Current MPCA MS4 Coverage Letter
Appendix K – Current City SWPPP

SECTION 1

1. EXECUTIVE SUMMARY

1.1. Local Surface Water Management Plan Purpose

This Local Surface Water Management Plan (LSWMP, SWMP, Plan, local plan) for the City of Arden Hills has been developed to meet local watershed management planning requirements of Minnesota Statutes 103B.201-103B.255 (***Appendix B***), Minnesota Rule Chapter 8410 (***Appendix B***), the Metropolitan Council, and the Rice Creek Watershed Management Plan. Local water management plans must be prepared by the respective local governments and be consistent with the watershed's plan. The Arden Hills LSWMP has been prepared according to State statutory and rule requirements. This document and its referenced literature is intended to provide a comprehensive inventory of pertinent water resource related information that affects the City and management of those resources as well as serve as a guide to reach goals related to water quality, volume reduction, and flood management. The purposes of the water management programs are to:

- Protect, preserve, and use natural surface and groundwater storage and retention systems;
- Minimize public capital expenditures needed to correct flooding and water quality problems;
- Identify and plan for means to effectively protect and improve surface and groundwater quality;
- Establish more uniform local policies and official controls for surface and groundwater management;
- Prevent erosion of soil into surface water systems;
- Promote groundwater recharge, where beneficial;
- Protect and enhance fish and wildlife habitat and water recreational facilities; and
- Secure the other benefits associated with the proper management of surface and groundwater.

The Arden Hills Local Surface Water Management Plan addresses these purposes.

The boundaries of Arden Hills lie entirely within the RCWD. The objectives and policies adopted by the City are consistent with those of RCWD and represent the shared goals between the City and watershed district. Since the City and RCWD will share authority in implementing surface water management objectives, the City will reference the RCWD rules for development projects.

The City is currently developing the 2040 Comprehensive Plan, which must include the LSWMP as required by Minnesota Statutes, Section 473.859, Subdivision 2, and be reviewed by the Metropolitan Council and RCWD.

1.2. Executive Summary

The Arden Hills Local Surface Water Management Plan is organized as follows:

- ***Section 1 Executive Summary*** provides background information and summarizes the plan contents.
- ***Section 2 Land and Water Resource Inventory*** describes the physical setting; the history, natural resources and land uses within the City.

- ***Section 3 Agency Cooperation*** outlines other governmental controls and programs that affect stormwater management.

- ***Section 4 Assessment of Problems and Issues*** presents the City's water management related problems and issues.

- ***Section 5 Goals and Policies*** outlines the City's goals and policies pertaining to water management.

- ***Section 6 Implementation Program*** describes the implementation program for the City of Arden Hills, which includes defining responsibilities, prioritizing, and listing the program elements.

- ***Section 7 Administration*** outlines the continued administration of this plan with respect to plan updates and amendments.

Figures are referenced in the plan and can be found before the appendices. Appendices are included in the back of the plan and are summarized below. These documents are included because they provide supporting information to the main body of the plan.

Appendix A: Figures. All figures referenced in the report.

Appendix B: Relevant City Ordinances. A copy of the City's water resource related ordinances.

Appendix C: Regulatory Responsibilities and Developer Guidelines. A summary of the various agency responsibilities in reviewing water analysis data and reporting.

Appendix D: Karth Lake Improvement District. The resolution establishing the Karth Lake Improvement District and adopting the board bylaws.

Appendix E: MPCA Listed Pollutant Sources. Active and inactive pollutant sites in Arden Hills.

Appendix F: Previous Pond Modeling and Reference Materials. A summary of hydraulic and water quality analysis of regional ponds that were identified in a past comprehensive drainage study.

Appendix G: Southwest Urban Lakes Study – Arden Hills Lake Assessments and MAPs. Rice Creek Watershed District's study on lake water quality and the development of management action plans for each lake.

Appendix H: Previous Study Summary – Lake Josephine. Summarizes findings on Lake Josephine's Lake Assessment Report.

Appendix I: Grant Opportunities. State grant opportunities for future projects within the City.

Appendix J: Current MPCA MS4 Coverage Letter. The Issuance of Coverage letter under the National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) General Permit MNR040000 for Municipal Separate Storm Sewer Systems for the City of Arden Hills MS4.

Appendix K: Current City SWPPP.

Additional material is referenced within this report and is available from the Engineering Department.

1.3. Background

The land that became the City of Arden Hills was originally part of Mounds View Township. The area was first settled in the mid-1800s. In 1906, Joseph Hackney, a State senator and millionaire, settled on the land and built Arden Farms. This farm and the terrain would eventually give the City its name. In 1951, the City of Arden Hills was created.

The City of Arden Hills is in Ramsey County, approximately eight miles north of the downtown areas of Minneapolis and St. Paul (***Figure 1***). The City's area covers approximately 9.4 square miles.

The lakes have always been the focus of the Arden Hills community. There are eight lakes that lie entirely or partially within the City limits. Lake Johanna is the largest lake in the City, covering approximately 230 acres. There are also public ditches and wetland complexes throughout the City. Because the lakes have always been a focus of the City, the protection of its water resources is a high priority. The City has ordinances for shoreland protection, floodplain management and sediment and erosion control in place, which can be reviewed in ***Appendix B.***

The southern portion of Arden Hills is fully developed. Plans for redevelopment of the Twin Cities Army Ammunition Plant (TCAAP) property in the northern portion of the City continue to evolve at the time of this report. The redevelopment of TCAAP will have a significant impact on the future nature of the City. A large portion of the City is residential, but Arden Hills also consists of lakes and parks, and serves as home to many businesses of multiple sizes, along with two private colleges. The City of Arden Hills aims to maintain its existing residential neighborhoods, strengthen its commercial and industrial areas, and incorporate the redevelopment of TCAAP into the City's long range planning.

A sketch plan for the reuse of the TCAAP property was first developed as part of the City's 2030 Comprehensive Plan to address up-to-date planning efforts for the property. The TCAAP Redevelopment Code was approved by City Council on July 13, 2015 and revised on December 12, 2016. This plan establishes goals and objectives associated with the TCAAP redevelopment. Additional information regarding the TCAAP redevelopment can be found in the City's 2040 Comprehensive Plan.

SECTION 2

2. LAND AND WATER RESOURCE INVENTORY

In conformance with the Metropolitan Surface Water Management Act and as required in Minnesota Rules Section 8410.0060, this section of the plan provides a general description and summary of the climate, geology, surficial topography, surface and ground water resource data, soils, land use, public utilities services, water-based recreation, fish and wildlife habitat, unique features, scenic areas, and pollutant sources. This section also identifies where detailed information can be obtained for many of these areas of concern.

2.1. Physical Setting

2.1.1. Climate

The climate within the Minneapolis/St. Paul metropolitan area is described as a humid continental climate with moderate precipitation, wide daily temperature variations, warm humid summers, and cold winters. The total average annual precipitation is approximately 31 inches, of which approximately one-third occurs in the months of June, July, and August. The annual snowfall average is about 54 inches and is equivalent to approximately 5.4 inches of water. Average monthly temperature and precipitation are shown in ***Table 2-1***. Additional climatological information for the area can be obtained from State Climatologist website at http://climate.umn.edu/.

Table 2-1 Average Monthly Temperature and Precipitation Data

Months	Average Temp (F°)	Precipitation (inches)	Snowfall (inches)
January	15.6	0.9	12.2
February	20.8	0.77	7.7
March	32.8	1.89	10.3
April	47.5	2.66	2.4
May	59.1	3.36	0
June	68.8	4.25	0
July	73.8	4.04	0
August	71.2	4.3	0
September	62	3.08	0
October	48.9	2.43	0.6
November	33.7	1.77	9.3
December	19.7	1.16	11.9
Totals	**46.2**	**30.61**	**54.4**

Source: Minnesota Climatology Working Group, MSP Airport (1981-2010)

2.1.2. Precipitation

Rainfall frequency estimates are used as design tools in water resource projects. In 2013, the National Oceanic Atmospheric Administration (NOAA) published the Atlas 14 Precipitation-Frequency document that showed an increase in rainfall intensity and design storms from the

previous Technical Paper 40 precipitation values. Selected rainfall frequencies for Arden Hills are listed in ***Table 2-2***.

Table 2-2 Atlas 14 Rainfall Frequencies

Recurrence Interval (years)	24-hr Rainfall Depth (in)	Chance of Occurrence Each Year
1	2.45	99%
2	2.82	50%
10	4.21	10%
50	6.27	2%
100	7.35	1%
100-year 10-day Runoff	7.3	1%

Additional precipitation information for the area can be obtained from the NOAA website at http://hdsc.nws.noaa.gov/.

2.1.3. Geology and Topography

Arden Hills is located in Ramsey County, which is dominated by the Eastern St. Croix Moraine. This glacial and terminal moraine is characterized by steep hills interspersed with deep depressions. The depressions are occupied by small lakes or are filled with peat.

The topography of the City is relatively diverse, with undulating to steep slopes. The highest point in Ramsey County is in Arden Hills on the TCAAP property. The entire City is ultimately a tributary to Rice Creek. The specific drainage patterns, which depict topography for areas within the City, are shown on the subwatershed delineation map (***Figure 7***). As can be observed from the subwatershed delineation map, the City is divided into many small watersheds.

Detailed descriptions of the City's bedrock geology can be obtained from the RCWD. In addition, the Minnesota Geological Survey can provide maps detailing the bedrock hydrogeology of Minnesota, addressing rock formations and aquifers.

2.1.4. Soils

Most of the soils within Arden Hills are glacial tills. The soils tend to be well drained and moderately coarse textured.

The main source of information on existing soils found within the City of Arden Hills was prepared by the Natural Resource Conservation Service (NRCS). The hydrologic soil classification map is shown in ***Figure 2***. The NRCS has established four general types of soil groups based on texture and slope as described below:

Group A - These soils have high infiltration rates even when thoroughly wetted. The infiltration rates generally range from 0.8 to 1.63 inches per hour. These soils consist chiefly of deep, well drained to excessively drained sands and gravel. Group A soils have a high rate of water transmission, therefore resulting in a low runoff potential.

Group B - These soils have moderate infiltration rates generally ranging from 0.3 to 0.45 inches per hour when thoroughly wetted. Group B soils consist of deep moderately well to well drained soils with moderately fine to moderately coarse textures.

Group C - These soils have slow infiltration rates generally ranging from 0.06 to 0.2 inches per hour when thoroughly wetted. Group C soils have a moderately fine to fine texture.

Group D - These soils have very slow infiltration rates generally ranging from 0 to 0.06 inches per hour when thoroughly wetted. Group D soils are typically clay soils with high swelling potential, soils with high permanent water table, soils with a clay layer at or near the surface, or shallow soils over nearly impervious material.

The runoff potential of an area is determined using these general soil characteristics in combination with land use classifications, vegetation of the area, and rainfall intensity determined from charts for the various design storms.

A summary of the soil group classifications in Arden Hills can be found in ***Table 2-3***. ***Figure 2*** shows a soils map for the City.

Urban Land generally consists of fill that has been placed in urban areas. It tends to not fit under a soil group. Areas where the land was unable to be surveyed fall under the “unknown” category, due to the inability to classify the soil groups.

Soil characteristics are also considered when developing erosion control plans. Special procedures for erosion and sediment control should be incorporated into all construction projects per the City’s Erosion and Sediment Control Ordinance (***Appendix B***).

Table 2-3 Summary of City Soil Groups

Soil Group	Percentage of Total
A	7.8%
A/D	6.0%
B	20.9%
B/D	4.6%
C	0.1%
C/D	0.0%
D	0.0%
Urban	46.5%
Water	7.9%
Unknown	6.2%

Various resources on sediment and erosion control are available through several agencies, institutions, and trade groups as follows:

- Minnesota Local Road Research Board (LRRB): The 2003 Erosion Control Handbook for Local Roads.

- Minnesota Pollution Control Agency (MPCA): Design guidance is available through several MPCA publications.
  - The Minnesota Stormwater Manual
  - The March 1, 2000 document entitled *Protecting Water Quality in Urban Areas: Best Management Practices for Dealing with Storm Water Runoff from Urban, Suburban and Developing Areas of Minnesota*.

- University of Minnesota (U of M): The U of M offers training seminars and certification classes for various entities involved in stormwater regulation compliance and enforcement. Courses include training for Stormwater Pollution Prevention Plan Certification, NPDES courses, and training on water quality modeling and monitoring. These courses are available through the U of M Internet website at http://www.erosion.umn.edu.

- Minnesota Erosion Control Association (MECA): MECA is an organization comprised of design professionals, contractors, vendors and government agencies devoted to encouraging the use of erosion control and stormwater management practices. They offer various resources such as workshops, conferences and a directory of vendors. This information is available through the MECA Internet website at http://mnerosion.org.

2.1.5. Land Use

2.1.5.1. General

Arden Hills is a stable community and foresees minimal amount of development and population growth with exception of the TCAAP property.

Disregarding the TCAAP area, most the City of Arden Hills is residential. There are also many large corporations, various sized businesses, two private colleges, and parks and open areas in the City. ***Figure 3*** shows the 2010 existing land use, while the potential 2040 future land use is shown in ***Figure 4***. ***Figure 5*** shows the Minnesota Land Cover Classification System (MLCCS) for the portion of the City where it has been created.

2.1.5.2. Parks

The City of Arden Hills has 14 City-maintained parks and designated open spaces totaling approximately 145 acres. Within the City limits is Tony Schmidt Regional Park, which is 217 acres of Ramsey County-maintained park space along the northern shore of Lake Johanna. As part of the TCAAP Park and Open Space Plan, the City has tentatively planned for approximately 25 acres of parks, with additional acreage reserved for open spaces and wildlife corridor lands. The City intends to maintain their designated park areas, make necessary improvements to the park system, continue to expand the trail system to connect the neighborhoods to these parks, and collaborate with other agencies to connect the system to area regional trails. The parks are a vital part of the Arden Hills community.

2.1.5.3. TCAAP

The Twin Cities Army Ammunition Plant property occupies northernmost portion of the city. The TCAAP redevelopment area amounts to 427 acres of the total area of 2,371 acres according to the 2015 approved land reuse proposal:

- 151 acres of residential

- 168 acres of commercial/industrial
- 24 acres of parks and other open space
- 84 acres of institutional, roads, and other public use

The other 1,944 acres outside of the proposed redevelopment area is preliminarily proposed for the following uses:

- 221 acres owned by Ramsey County for the Rice Creek Trail Corridor
- 1,611 acres will remain as the Arden Hills Army Training Site (AHATS) and kept as park preserve space.
- 113 acres adjacent to the creek were transferred to Ramsey County in 2006 for the development of the Rice Creek North Regional Trail.

2.1.5.4. MLCCS

The Minnesota Land Cover Classification System, or MLCCS, categorizes urban and built up areas in terms of land cover rather than land use. MLCCS serves as a tool for City staff to integrate natural area preservation into land planning, land use, and zoning decisions. ***Figure 5*** provides MLCCS coverage for Arden Hills for the portion of the City where it has been created.

2.2. Surface Water Resources

Residents of Arden Hills enjoy a variety of high quality natural resources with numerous lakes, creeks and wetlands within the City limits. Available surface water resource data within the City is summarized in this section. Detailed information has been included either in the appendices to this report or has been identified by reference and is available from the Engineering Department.

2.2.1. Unique Features and Scenic Areas

Unique features and scenic areas include State-designated Scientific and Natural Areas, designated scenic areas, areas containing rare and endangered species, biologically diverse areas, and historic areas.

The City has many natural areas, water bodies, and city or regional parks. Some of these areas contain a moderate significance of biodiversity and special habitats. Reference ***Figure 3*** for the existing land use which indicates park locations. Reference ***Figure 6*** for the protected waters map indicating wetlands, ponds, and public waters.

The City does not have historical and architectural resources as identified by the Minnesota State Historical Preservation Office.

2.2.2. Fish and Wildlife Habitat

The City provides habitat for a variety of small mammals, reptiles, birds, amphibians, and insects. Maintenance of habitat for wildlife species is important in maintaining the ecological stability of the City's natural areas.

The Department of Natural Resources (DNR) has developed fish management plans for Lake Johanna and Lake Josephine within the City of Arden Hills. The plans include existing or proposed management practices such as fish stocking, winter oxygen monitoring, lake

investigations, and other similar practices. Further information can be found on the DNR's Lake Finder website at www.dnr.state.mn.us/lakefind/index.html.

The DNR has also prepared limited lake depth maps for certain lakes. The reports, management plans, and lake depth maps are available at DNR's Lake Finder at www.dnr.state.mn.us/lakefind/index.html.

2.2.3. DNR Protected Waterbodies

The DNR Designated Public Waters which lie within the City limits are shown in ***Figure 6***. The DNR Protected Waters are comprised of watercourses such as Rice Creek, lakes, and wetlands as defined in Minnesota State Statutes 103G.005. The DNR has jurisdiction over these water bodies at and below the Ordinary High Water (OHW) level, which is defined as the elevation delineating the highest water level which has been maintained for sufficiently long periods of time to leave evidence upon the landscape.

2.2.4. Creeks

Rice Creek traverses the extreme northwestern portion of the City through the TCAAP area. The location of Rice Creek is shown in ***Figure 6***.

2.2.5. Lakes

There are eight lakes which lie entirely or partially within the Arden Hills city limits: Lake Johanna, Lake Josephine, Little Lake Johanna, Valentine Lake, Round Lake, Karth Lake, Sunfish Lake, and Marsden Lake. RCWD has prioritized lakes within the district into four management tiers based on trophic state indices, recreational facilities, and lake capability:

- Tier I lakes consistently provide regional public recreation opportunities including boating activities and swimming facilities. Tier I lakes also represent a high-quality resource for fisheries and wildlife.

- Tier II lakes have the capability to provide passive regional public recreation opportunities including aesthetic enjoyment or other special purpose uses.

- Tier III lakes have minimal public access and have negligible regional recreational opportunities unless improvements are made to increase access or install facilities. The quality of fisheries within these lakes are limited by depth, presence of invasive species, and area land use.

- Tier IV lakes are all other lakes that do not fit into Tiers I, II and III. These lakes are typically unable to provide public access and are suited primarily for stormwater conveyance.

Table 2-4 lists the tier identification of the lakes within the City of Arden Hills, according to the Rice Creek Watershed District Watershed Management Plan.

Table 2-4 Lake Tier Classification

Lake	Tier
Johanna	I
Josephine	I
Karth	II

Little Johanna	II
Round	II
Marsden	IV
Sunfish	Not Assigned
Valentine	II

2.2.6. Monitored Water Quality and Quantity Data

Water quality data for the City has been obtained from the MPCA's Environmental Data Access site at https://www.pca.state.mn.us/environmental-data. This database is utilized by participating agencies to compile water quality testing data and is almost entirely used for the storage of water quality parameters.

Table 2-5 provides summary data from the Southwest Urban Lakes Study on each of the lakes in Arden Hills.

Table 2-5 Lake Recreational Suitability Measures (Southwest Urban Lakes Study)

Lake Name	MnDNR Number	TP (µg/L)	Chl (µg/L)	Secchi Depth (m)
Josephine	62-0057	36	11	2.0
Round	62-0070	--	--	--
Valentine	62-0071	70	18	1.7
Sunfish	62-0065	37	--	--
Marsden	62-0059	--	--	--
Karth	62-0072	54	18	1.0
Johanna	62-0078	31	12	2.0
Little Johanna	62-0058	80	25	1.5
Shading indicates that the measurement does not meet State Water Quality Standards.				

Also available is a 1998 Lake Assessment Report on Lake Josephine (***Appendix H***) – the result of a collaboration between Ramsey County, RCWD, MPCA and the Lake Josephine Improvement Association.

2.2.7. Impaired Waters

The MPCA lists the following waterbodies/water courses in ***Table 2-6*** within and near the City as having impaired uses due to excess pollutant(s):

Table 2-6 *MPCA Impaired Waters Summary*

Waterbody/Watercourse	Year Added to List	Affected Use	Pollutant/Stressor	TMDL Status
Lake Johanna	2002	Aquatic Consumption	Mercury in fish tissue	Approved
Lake Johanna	2010	Aquatic Consumption	PFOS in fish tissue	Underway
Lake Josephine	1998	Aquatic Consumption	Mercury in fish tissue	Approved
Little Johanna Lake	2004	Aquatic Recreation	Nutrient/eutrophication biological indicators	Approved
Little Johanna Lake	2012	Aquatic Consumption	PFOS in fish tissue	Underway
Little Johanna Lake	2014	Aquatic Life	Chloride	Approved
Pike Lake	2002	Aquatic Recreation	Nutrient/eutrophication biological indicators	Approved
Pike Lake	2014	Aquatic Life	Chloride	Approved
Rice Creek	2004	Aquatic Life	Fishes bioassessments	Approved
Rice Creek	2006	Aquatic Life	Aquatic macroinvertebrate bioassessments	Approved
Rice Creek	2014	Aquatic Recreation	E. coli	Approved
South Long Lake	1998	Aquatic Consumption	Mercury in fish tissue	Underway
South Long Lake	2002	Aquatic Recreation	Nutrient/eutrophication biological indicators	Approved
South Long Lake	2014	Aquatic Life	Chloride	Underway
Upper Mississippi River	1996	Aquatic Recreation	Fecal Coliform	Approved
Upper Mississippi River	1998	Aquatic Consumption	Mercury in fish tissue	Underway
Upper Mississippi River	1998	Aquatic Consumption	Mercury in water column	Underway
Upper Mississippi River	1998	Aquatic Consumption	PCB in fish tissue	Underway
Upper Mississippi River	2014	Aquatic Life	Total suspended solids	Underway
Valentine Lake	2002	Aquatic Recreation	Nutrient/eutrophication biological indicators	Approved
Valentine Lake	2014	Aquatic Life	Chloride	Approved

Figure 10 shows the location of the impaired waters within Arden Hills. A full list of both active and inactive MPCA listed pollutant sources in Arden Hills can be found in ***Appendix E***.

RCWD's Southwest Urban Lakes Study developed Lake Management Action Plans to summarize lake characteristics and existing lake data, provide a diagnostic assessment of the data, summarize public input, identify water quality issues, and recommend remedial strategies on a lake-watershed basis. These Lake Management Action Plans will be used as guidance for retrofit water quality improvements to address TMDL goals. An opportunity to improve resource

management exists with the redevelopment of the TCAAP site, which requires an environmental overhaul due to contaminated soils and groundwater. With the office, retail, and housing redevelopment, the natural resources are brought back into compliance. The master development concept incorporates more than 50 acres of green space and connections to parks and trails.

The MPCA and DNR also maintain lake information databases. The MPCA database is located at http://www.pca.state.mn.us under Water > Water Types and Programs > Surface Water > Lakes > Data and Reporting. The DNR Lakefinder is located at http://www.dnr.state.mn.us/lakefind/. Summary water quality data is available for all the lakes in Arden Hills except Sunfish Lake (no data) on the AHATS property.

2.2.8. Shoreland and Floodplain Ordinances

Arden Hills has DNR-approved Shoreland and Floodplain Ordinances (***Appendix B***). It is important that the shoreland of lakes be protected and developed in a manner consistent with the DNR management standards to maintain or improve the quality of the water bodies within the City.

The relevant Flood Insurance Rate Map (FIRM) panels prepared by the Federal Emergency Management Agency (FEMA) are attached in the City's Official Zoning Map. This material is on file in the Office of the City Administrator. The floodplain boundaries for the City are shown in ***Figure 8***. Flood maps are available showing the different flood zones mentioned in the ordinance by going to FEMA's website at https://msc.fema.gov/portal.

Based on the FEMA flood insurance study, the City has adopted a Shoreland Management District. This District regulates the development of public water shoreland to preserve and enhance surface water quality. A copy of these regulations can be found on the City's website at in Chapter 13 of the Zoning Code and in ***Appendix B***.

2.2.9. Flood Hazard Zones

Figure 8 shows areas of flood hazard according to the FEMA FIRMs. These areas surround waterbodies and watercourses that are subject to inundation by the one percent annual chance flood event (100-year). Zone AE areas have established base flood elevations, while Zone A areas do not. Valentine Lake, Lake Johanna, Little Lake Johanna, and Lake Josephine have established base flood elevations according to FEMA and are labeled on ***Figure 8***.

RCWD has developed a District-wide model establishing floodplain elevations. The model is routinely updated and maintained by the District to determine the critical event; typically the 100-yr, 24-hr rainfall event or the 100-yr, 10-day snowmelt runoff event. RCWD regulates the floodplain under its own rules independent from the administration of FEMA or other regulations.

2.2.10. Wetlands

Figure 6 shows the wetlands within the City of Arden Hills that are included in the National Wetlands Inventory (NWI) prepared by the U.S. Fish and Wildlife Service. Areas shown on the DNR and NWI maps indicate the presence of wetlands, but show only their general locations. Site visits for delineation of wetland boundaries are required for permitting. It should be noted that some of these wetlands may have been created as stormwater detention basins in conjunction with urban development.

2.3. Surface Drainage Utilities

2.3.1. Public Ditches (RCWD)

The City of Arden Hills has public ditches within the City limits. RCWD is the drainage authority in the City for these public ditches. Most of the ditches in the RCWD were constructed primarily to drain land for agricultural purposes. Ramsey County Ditch 4 drains into Little Johanna Lake and subsequently outlets into Lake Johanna where it ends. A Public Watercourse then extends northwest from the outlet of Lake Johanna to Long Lake in New Brighton.

2.3.2. City-maintained Drainage Systems

The existing drainage system for Arden Hills is shown in ***Figure 7***. The system consists of various city-maintained catch basins, piping conveyances, and constructed stormwater ponds. Drainage systems are evaluated, installed, upgraded, and maintained as feasible and practical on a project-by-project basis. Evaluations for new projects are conducted during yearly CIP planning cycles.

2.3.3. Inter-Community Flows

Three points of discharge from the City of Arden Hills into other municipalities have been identified by the RCWD as part of their district-wide modeling. These points of inter-community discharge, as well as their associated peak flow rates, are identified in ***Table 2-7*** and in ***Appendix F***. These flows have been established by RCWD as benchmark flow rates based on current land use. Through its goals and policies as well as deference to RCWD rules, the City will regulate to either maintain or reduce flow rates relative to the established benchmarks.

RCWD is continuously updating the district model. Any significant outcomes of the model may need to be addressed in this SWMP.

Table 2-7 Benchmark Inter-Community Flow Rates

Receiving City	Watercourse	Peak Flows (cfs)			
		2-year/24-hour Rainfall	10-year/24-hour Rainfall	100-year/24-hour Rainfall	100-year/10-day Snowmelt
Mounds View	Rice Creek	186	419	803	1330
New Brighton	Lake Johanna Outfall	44	75	100	106
Shoreview	RCD 1 Main Trunk	13	15	21	27

2.4. Hydrologic Modeling

There are 13 proposed potential regional ponds in Arden Hills that were identified in a 1999 comprehensive drainage study by BRW Inc. TCAAP property was not considered or modeled as part of this plan. Two ponds on TCAAP property were completed as part of the reconstruction of Highway 96. Conceptual HydroCAD modeling was completed for the remaining eleven proposed regional ponds.

The hydrologic modeling effort quantifies the 5-, 10-, and 100-year, 24-hour design storms using antecedent moisture conditions. The 100-year design storm was used to calculate the peak

height of each pond and to determine if any potential damage or flooding could occur in neighboring structures.

Stormwater quality and treatment modeling was undertaken using the P8 Urban Catchment model. The ponds were designed to meet Nationwide Urban Runoff Program (NURP) standards, which are removal of 90 percent of total suspended solids (TSS) and 65 percent of total phosphorus (TP). The ponds were modeled using only the immediate drainage areas, therefore, it is recommended to model the entire drainage system during either a feasibility study or final design to calculate the pollutant removal efficiencies of the entire system.

Additional hydrological modeling is needed to identify subdrainage basins within the RCWD. Also needed is expanded modeling of the City as the current model does not analyze or determine flood elevations along the creeks streams or ditches. The City will work with RCWD if additional modeling is completed within Arden Hills and any updated modeling will be provided to RCWD as part of a data sharing initiative.

The results of these models can be seen in ***Appendix F***.

2.5. Water-Based Recreation Areas

Lakes Johanna and Josephine provide the most in terms of water-based recreation within the City of Arden Hills. The main public access points are through Ramsey County regional parks. Tony Schmidt Regional Park, located on Lake Johanna Blvd, provides a swimming beach and boat ramp to Lake Johanna. Lake Josephine Park along Lexington Avenue within the City of Roseville provides a swimming beach and boat ramp to Lake Josephine.

Rice Creek also offers recreational opportunities through a major recreational canoe route from George Watch Lake to Long Lake. A portion of this canoe route traverses the western portion of the TCAAP property owned and operated by Ramsey County Parks and Recreation.

Lakes Valentine, Little Johanna, and Karth have limited use and public access with non-motorized boat recreation from surrounding property owners. Round Lake has no public access due to bottom sediment contamination. Marsden and Sunfish Lakes are within the AHATS property, and are currently inaccessible to public use. Maintenance access for some of the TCAAP development's stormwater features will be provided in the form of a recreational, multi-use trail.

2.6. Groundwater

Information on groundwater protection in Ramsey County is available on the Ramsey County website at https://www.ramseycounty.us/residents/environment/ramsey-conservation-district/groundwater-protection. The Ramsey County Groundwater Protection Plan (RCGPP) was developed in 2010 and is still considered a draft. However, the RCGPP provides relevant information pertaining to municipal drinking water wells, which extract water from the deep Prairie du Chien-Jordan aquifer, and how they are susceptible to contamination from the shallow groundwater table providing recharge to the aquifer. The main area of point-source within the City of Arden Hills responsible for groundwater contamination is the TCAAP area. The Groundwater Plume Map (Figure 1-1, p. 4 of the RCGPP) indicates a contamination plume extending westward from the site.

Saint Paul Regional Water Services (SPRWS) provides water to the Arden Hills water utility through the City of Roseville. Apart from the TCAAP land, all areas of the City have access to the municipal water supply. When the TCAAP land is developed, it will have access to the same

municipal water supply. Since SPRWS provides water service to the City, a wellhead protection plan for municipal wells is not necessary.

Even though the City does not extract its water supply from wells, the City and RCWD will need to consider the possible down-gradient impacts of infiltrated stormwater on groundwater quality. Development and redevelopment within the City relies more on infiltration best management practices for treatment of stormwater runoff and increases risks for contamination of down-gradient wellheads in other municipalities. The Minnesota Department of Health (MDH) has developed guidelines for evaluating stormwater infiltration projects in vulnerable wellhead protection areas (July 2007). MDH provides a flow chart with six steps focusing on the location of the infiltration BMPs as well as land use and spill containment. Questions ask if the proposed infiltration site is in a vulnerable wellhead protection area or Drinking Water Supply Management Area (DWSMA). ***Figure 9*** illustrates the locations of Drinking Water Supply Management Areas in the City of Arden Hills.

2.6.1. Groundwater Appropriations

Ground water resource data for areas within the City is contained within the Ramsey County Geologic Atlas. The primary aquifers within the City are the Prairie Du Chien-Jordan Aquifer, the St. Peter Aquifer, the Franconia-Ironton-Galesville Aquifer, and the Mt. Simon Aquifer. The Prairie Du Chien-Jordan Aquifer is of special concern since it is the most heavily used ground water source in Ramsey County.

Figure 11 shows the types and locations of the DNR permitted ground water appropriation sites within the City.

2.7. Resources of Interest

Arden Hills has many public waters within the City. The lakes and wetlands provide an environmental habitat for fish and wildlife within the City.

2.7.1. Protection of Natural Resources

A natural resources assessment conducted by the RCWD is included in the City of Arden Hills 2040 Comprehensive Plan. This includes a natural resource inventory and species of interest. Approximately 168 acres of the redeveloping TCAAP property are anticipated for sale to the City for the purposes of parks, wetlands, stormwater areas, recreational areas, and a wildlife corridor.

2.7.2. Protected Species and Habitat

The DNR maintains a list of animal and plant species of interest through its Natural Heritage Information System (NHIS) database. The RCWD Watershed Management Plan references several species of interest within the district.

The City of Arden Hills is home to several species with legally protected status by the DNR. These are Black Huckleberry (threatened plant), Blanding's Turtle (threatened animal), Plains Pocket Mouse (special animal of concern), Small Green Wood Orchid (special plant of concern), Swamp Blackberry (threatened plant), and Trumpeter Swan (special animal of concern). The Upland Sandpiper is on the watch list.

The Kame glacial formation is a high value habitat residing on the TCAAP property (under the AHATS jurisdiction). It has been identified as an important natural community.

2.8. Water Appropriation Permits

There are 35 water appropriation permits issued by the DNR in the City of Arden Hills. Water appropriation permits are issued to the permittees who pump greater than 10,000 gallons per day or over one million gallons of water per year. The locations of the City's water appropriation permits and other water use information is located on the DNR website at http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html.

2.9. Pollutant Sources

The MPCA maintains lists of the generators of hazardous waste, decommissioned municipal dumps, above ground and underground storage tanks, and leaking underground storage tanks. A map of this information is shown on ***Figure 12***. There is no known water quality information about these sites. Many of the sites on the figure have been cleaned up or are in the process of being cleaned up. The MPCA should be contacted for site-specific details. Maps of active and inactive sites is located on the MPCA website at http://www.pca.state.mn.us.

2.9.1. TCAAP

The most well-known of these pollution sources within the City limits is the TCAAP land, which has been deemed a federal Superfund cleanup site. As stated on the MPCA website devoted to the TCAAP remediation:

> "Contamination resulting from past ammunition manufacturing operations at the facility has been identified in groundwater, soil, sediment and surface water. The U.S. Army, U.S. EPA, and MPCA have worked jointly to determine the contaminants involved, the extent of the contamination, and the cleanup that is required.
>
> TCAAP operated for several decades during a time when there were no laws governing disposal of chemicals. During these years, the Army generated industrial wastes that were disposed of using accepted practices of the times, which included on-site dumping, burial, and open burning. The manufacturing processes and historical disposal areas at the facility caused contamination of groundwater, soil, sediment, and to a lesser extent surface water."

More specific information and answers to frequently asked questions are available on the MPCA website at https://www.pca.state.mn.us/waste/superfund-program.

Specific information on the groundwater contamination from the site are available in the RCGPP.

SECTION 3

3. AGENCY COOPERATION

There are a number of local, State, and Federal agencies that have rules and regulations related to local water management. The City recognizes the roles of these other agencies and will cooperate, coordinate, and, when possible, partner with these agencies. This section describes the City's current surface water management program and practices and identifies the agencies and organizations having roles in the City's management of these resources.

3.1. Support Agencies

The City recognizes these other agencies' role in this endeavor and will cooperate and coordinate with these agencies as necessary. This Plan is in conformance with but does not restate all other agency rules that are applicable to water quality and natural resource protection. The other agency rules and policies include rules, policies, and guidelines associated with the following organizations:

- Rice Creek Watershed District (www.ricecreek.org)
- Minnesota Department of Health (www.health.state.mn.us)
- Minnesota Pollution Control Agency (www.pca.state.mn.us)
- Board of Water and Soil Resources (www.bwsr.state.mn.us) and the Wetland Conservation Act (www.bwsr.state.mn.us/wetlands/wca/index.html)
- Minnesota Department of Natural Resources (www.dnr.state.mn.us)
- US Army Corps of Engineers (www.mvp.usace.army.mil)
- Minnesota Department of Agriculture (www.mda.state.mn.us)
- US Fish and Wildlife Service (www.fws.gov)
- Minnesota Environmental Quality Board (www.eqb.state.mn.us)
- Metropolitan Council (www.metrocouncil.org)
- Minnesota Department of Transportation (MnDOT) (www.dot.state.mn.us)
- U.S. Environmental Protection Agency (EPA) (www.epa.gov)
- Federal Emergency Management Agency (FEMA) (https://msc.fema.gov/portal)
- Natural Resources Conservation Service (NRCS) (https://www.nrcs.usda.gov)
- U.S. Geological Survey (USGS) (https://www.usgs.gov/)

While these other agency rules, policies, and guidelines are not restated in this Plan, they are applicable to projects, programs, and planning within the City. The Minnesota Stormwater Manual, which is a document intended to be frequently updated, is incorporated and referenced into this Plan and can be found at https://stormwater.pca.state.mn.us/index.php?title=Main_Page.

3.1.1. Regulation

The policies developed in this strategy outline specific stormwater management elements that are required to be implemented through the development and/or permitting process. The regulation strategy is targeted at the public, developers, City Staff, and City Council.

The City's website (http://www.cityofardenhills.org/) contains information about how to obtain a permit from the City. Permits and/or approvals from the RCWD may also be necessary. They should be contacted for additional permitting information. If there is a conflict between the City requirements and RCWD, a variance from RCWD will need to be obtained by the applicant or the project will need to be revised.

3.2. NPDES Permitting Process

The NPDES Stormwater Permit Program is a federal regulatory program that requires owners of MS4s to prepare and implement a Stormwater Pollution Prevention Program (SWPPP) and apply for the permit with the administrative agency. The MPCA administers the Phase II MS4 program in the state. The MPCA has designated the City of Arden Hills as an NPDES Phase II Municipal Separate Storm Sewer Systems (MS4) community (MN Rules Chapter 7090). A revised coverage letter was issued by the MPCA on March 17, 2014 and can be reviewed in ***Appendix J***. The MS4 contains six minimum control measures by which a SWPPP must comply:

1. Public Education and Outreach on Stormwater Impacts
2. Public Involvement/Participation
3. Illicit Discharge Detection and Elimination
4. Construction Site Stormwater Runoff Control
5. Post-Construction Stormwater Management in New Development and Redevelopment
6. Pollution Prevention/Good Housekeeping for Municipal Operations

The SWMP does not specifically incorporate all the best management practices identified in the City's SWPPP. Instead, the Plan builds on the existing activities by specifying projects and management approaches to achieve the City's water resource goals. A copy of the City's SWPPP is included in ***Appendix K***.

The City will continue to file annual reports and collect the data necessary for compliance with the NPDES MS4 permit. The Minimum Control Measures (MCM) and associated goals are described in ***Section 5***.

3.3. Comparison of Regulatory Standards

3.3.1. Rice Creek Watershed District Rules

Rice Creek Watershed District approved their Watershed Management Plan in 2010 and amended the Plan in November 2016. The most recent RCWD rules were approved in December 2016. A significant revision added limits on the volume of runoff leaving development sites. This is consistent with regional trends discussed in the *Minnesota Stormwater Manual*. In particular, low-impact development, better site design, and on-site infiltration of runoff are recommended to offset the adverse impacts created by additional impervious surfaces. The City will continue to defer to RCWD for review and permitting of the stormwater management and wetland aspect of developments.

3.3.2. Wetland Management

RCWD is the Local Government Unit (LGU) for the Wetland Conservation Act, and will continue to administer WCA permits. WCA regulations generally focus on the prevention or mitigation of wetland fill. RCWD also regulates wetland alteration through Rule F of their watershed rules. Rule F does not include the wetland buffer requirements for the City of Arden Hills.

3.3.3. Consistency

The City is committed to working with RCWD in facilitating their land disturbance permits. The City is also committed to coordinating with the watershed as they administer WCA permits.

3.3.4. Summary of Findings

In the months and years ahead, the City will face multiple challenges in surface water management. Having received NPDES permit coverage, the City must now begin to implement new programs to address stormwater pollution. Completion of local TMDL studies will lead to challenging implementation projects throughout the City. Growth in and around the City will put additional pressure on local surface water resources.

SECTION 4

4. ASSESSMENT OF ISSUES

Outlined below is an assessment of existing and potential local water resource-related problems. These problems have been identified based on an analysis of the land and water resource data collected during the preparation of this plan and through information provided by the City, its residents, and the watershed organizations. A description of any existing or potential problem within the City has been listed and potential future corrective actions have been incorporated into an implementation plan.

This Plan documents city-wide drainage issues identified by City staff. The City will evaluate each drainage issue as part of a feasibility study and address them accordingly.

4.1. Water Quality

Problem 4.1.A. The City discharges to the following impaired waters as listed by the Minnesota Pollution Control Agency (MPCA):

- Rice Creek
- Valentine Lake
- Lake Johanna
- Little Lake Johanna
- Lake Josephine
- Upper Mississippi River
- Long Lake South
- Pike Lake

Section 2.2.7 provides additional information on the impairments for each water body.

Corrective Action 4.1.A The MPCA completed a statewide mercury TMDL in 2007. As stormwater point sources account for less than 1% of the mercury (majority is atmospheric), the City contributes an insignificant amount to this TMDL. The MPCA has since prepared a plan to reduce mercury releases by 2025. This plan describes specific strategies that the State will employ to achieve the goals of the TMDL. No additional action by the City is needed. This TMDL is relevant for Lake Johanna and Lake Josephine.

In 2009, RCWD completed the Southwest Urban Lakes Study to identify Lake Management Action Plans and BMP options to address water quality. The City has since completed numerous projects identified in this study for Lake Johanna, Lake Josephine, Karth Lake, Little Lake Johanna, Marsden Lake, Round Lake, and Valentine Lake. No projects were identified in the City of Arden Hills for Lake Josephine and Little Lake Johanna as part of this Study. Additional projects identified have been added to **Section 6** in **Table 6.1**.

The RCWD Southwest Urban Lakes TMDL Study was completed in 2014. The City has been given a categorical waste load allocation (WLA) for Little Lake Johanna, Long Lake South, Pike Lake and Lake Valentine for excess nutrients; requiring a 55% reduction for Little Lake Johanna, 36% reduction for Long Lake South, 46% reduction for Pike Lake, and 29% reduction for Lake Valentine from the base year (2003). The City has completed projects identified in the Lake Management Action Plans and have identified additional projects to meet load reduction requirements for the categorical WLA. Improvements constructed since 2003 will be used in MPCA reporting to demonstrate compliance and the City will continue to construct, where feasible and necessary, improvements aimed at improving water quality discharged toward these lakes. The City will continue to partner with neighboring communities and RCWD to complete future projects.

The City will work with the MPCA, RCWD, and neighboring communities to address any future impairments, TMDLs, and discharge to impaired waters as necessary.

Problem 4.1.B A TMDL was recently completed for the Upper Mississippi River to address the water quality standard for E. coli.

Corrective Action 4.1.B The Upper Mississippi River TMDL addresses reducing E. coli loading for different stream reaches in the metro area, including Rice Creek. The City continues to educate its residents on the importance of cleaning up after their pets to reduce pollutants entering the stormwater system. The City also has in place an ordinance requiring adequate disposal of animal waste on public and private property. BMPs that are constructed will continue to provide some removal of E. coli prior to stormwater discharge into receiving water bodies. The City also continues to promote goose management around waterbodies throughout the City.

4.2. Flooding and Stormwater Rate Control

Problem 4.2.A. Charles Perry Park trail floods, and this trail is the access to Lift Station #2.

Corrective Action 4.2.A. The City will investigate causes for the flooding and work both internally and with designers to fix the flooding.

Problem 4.2.B. A resident on Floral Drive states that an outlet was raised at the end of Floral Drive, causing standing water on the property.

Corrective Action 4.2.B. The City will investigate the outlet and determine if the flooding on the property was intended or not, and if so, will determine potential solutions.

Problem 4.2.C. During large storm events, the Indian Oaks Court and Indian Oaks Trail pond outlet overflows across Indian Oaks Court and continues into a drainage easement. The flow can at times become restricted by construction that has occurred within the easement.

Corrective Action 4.2.C. In 2017, the City dredged the pond to allow for more water volume. During the 2018 Pavement Management Program (PMP) project, the City constructed storm sewer to and from the pond. The City will continue to analyze solutions to remove the constructed blockage from the drainage easement.

Problem 4.2.D. A bituminous swale from Norma Circle drains the street into a drainage easement, which outlets to the MnDOT right-of-way. The resident is concerned about standing water.

Corrective Action 4.2.D. The City replaced the bituminous swale with storm sewer and graded the area that held water as part of the 2018 PMP project. The City will continue to analyze the stormwater in the drainage easement.

Problem 4.2.E. Stormwater runoff from forested areas south of a home at the intersection of Briarknoll Drive and Norma Avenue at times flows from the forest and into a depressed area, causing drainage issues.

Corrective Action 4.2.E. The City is proposing storm sewer, grading, or otherwise redirecting the stormwater away from the home in the 2018 PMP project.

SECTION 4

4.3. Adequacy of Existing Regulations and Programs to Address Adverse Impacts on Local Water Resources

Problem 4.3.A The City has adopted a floodplain ordinance, illicit discharge ordinance, stormwater ordinance, wetland buffer ordinance, and shoreland ordinance. These ordinances will need to be regularly updated to reflect current rules and regulations. These ordinances can be found in ***Appendix B***.

Corrective Action 4.3.A The City will continue to enforce and update all ordinances as necessary.

Problem 4.3.B The adequacy of existing capital improvement programs to correct problems.

Corrective Action 4.3.B The implementation program located in ***Section 6*** of this plan presents the projects and other implementation tasks that are considered to actively manage local water resource issues in the City. The City will incorporate into its annually updated CIP these stormwater projects/tasks and any future projects/tasks. The City's CIP, combined with the RCWD implementation program, should be sufficient to address stormwater issues in the City of Arden Hills.

4.4. Erosion and Sediment Control

Problem 4.4.A. A parking lot south of Karth Lake serving a manufacturing business drains to a private road into a flume on a steep hillside, severely undercutting the flume and introducing hillside sediment to Karth Lake.

Corrective Action 4.4.A. The City has met with RCWD and the business, and the business is drafting plans for fixing the erosion and constructing side slope stabilization. The City will provide guidance as needed.

4.5. Impact of Land Use Practices and Development

Problem 4.5.A As Arden Hills nears full development, it can be challenging for the City to implement stormwater management BMPs to efficiently meet watershed requirements on a site by site basis.

Corrective Action 4.5.A The City will investigate opportunities to implement water quality and volume reduction BMPs during new development and future reconstruction projects. In areas where project specific BMPs will be unfeasible, the City will look into completing regional water quality improvement projects to help meet future stormwater management requirements. The City currently implements a 5-year pavement management program, the most recent identified areas are listed below:

- 2020 - Old Snelling Avenue Reconstruction (includes bridge reconstruction)
- 2020 – Lake Valentine Rd
- 2022 – Glenpaul Ave, Jerrold Ave, Prior Ave, & Edgewater Ave
- 2024– Cummings Ln, Arden Oaks Dr, Arden Oaks Ct, Indian Pl, Indian Cir, & Eide Cir
- 2026 – Norma Ave, Dawn Cir W, Dawn Cir E, Thom Ct, & Thom Dr
- 2028 – Amble Cir, Amble Dr, Karth Lake Rd, Pleasant Cir, & Pleasant Dr

No specific water quality or volume reduction BMPs have yet been identified for these projects.

Feasible BMPs will be identified closer to the project dates and will be added to **Table 6.1** of this SWMP. The City will coordinate with RCWD on any for partnering opportunities with these projects.

Problem 4.5.B The Twin Cities Army Ammunition Plant (TCAAP) site is in the process of being redeveloped. The site was affected by numerous contaminants that have affected soils, sediment, and groundwater.

Corrective Action 4.5.B As the redevelopment occurs, the City will coordinate with various agencies including RCWD, MPCA, USACE, and Ramsey County to identify groundwater treatment and surface BMPs to treat runoff from the site. A Comprehensive Stormwater Management Plan (CSMP) was approved in 2015 to determine how development of the TCAAP site will meet RCWD Rule C requirements using a regional stormwater approach. The City recently partnered with Ramsey County and RCWD to complete the Rice Creek Commons Green Infrastructure and Stormwater Reuse Feasibility Study to provide additional analysis and details for the potential green infrastructure projects that go above-and-beyond the baseline requirements.

Problem 4.5.C Wetland degradation caused by urbanization. When the quality of the incoming stormwater declines, the wetland's plant community may become less diverse, retaining only those species that are tolerant of high nutrient and sediment loads.

Corrective Action 4.5.C Degraded wetlands will be identified and potential restoration sites will be prioritized. In Arden Hills, RCWD acts as Local Governmental Unit (LGU) in charge of administering the WCA in their respective jurisdictions.

Problem 4.5.D Valentine Park rain gardens are not functioning as designed. The rain gardens do not drain when lake levels are high.

Corrective Action 4.5.D The City will investigate the reason behind the rain gardens not functioning and will implement improvements as needed.

Problem 4.5.E The City of Arden Hills currently has a volume debit with RCWD of -6,989 cubic feet.

Corrective Action 4.5.E The RCWD Board of Managers took two actions regarding volume bank system debits:

1. Debit or credit could be addressed or utilized in non-public linear projects;
2. Cities could address debit using nonvolume control practices, with water quality treatment volume calculated in accordance with the current rule methodology.

The City will consider potential projects to address this debit as part of future street reconstruction and redeveloping areas, where feasible and cost effective. The City will coordinate with RCWD as potential sites become available for appropriate stormwater BMPs.

4.6. Education Program

Problem 4.6.A The City of Arden Hills recognizes the need for local water education programs to increase public awareness of local water management and improve the quality of stormwater runoff.

Corrective Action 4.6.A The City will continue to provide educational content and opportunities to residents, businesses, developers, and others. These efforts may include regular notices in the City's monthly newsletter, articles in the local paper, postings on the City website, and flyers in

the utility bill. The City may work with Rice Creek Watershed District (RCWD) to improve the efficiency of educational efforts and reduce duplication. Educational topics may include but are not limited to:

- Wetland buffers
- Yard/Pet waste management
- Illicit discharge to stormwater
- Utility easements
- Stormwater pond function
- Controlling invasive species
- Sustainable groundwater and recharge

4.7. Identification of Potential Problems to Occur in the Next 20 Years

Problem 4.7.A Inspecting and maintaining existing stormwater infrastructure throughout the City.

Corrective Action 4.7.A The City of Arden Hills is responsible for maintenance of its stormwater system in conformance with the MCPA's MS4 Program. This includes maintenance of pipes, constructed ponds, lakes, wetlands, ditches, swales, and other drainageways. Proper maintenance will ensure that the stormwater system continues to provide the necessary flood control and water quality treatment. Refer to **Appendix K** for a copy of the City SWPPP. Other units of government are responsible for maintaining the stormwater systems under their control.

Problem 4.7.B Prioritizing inspection and maintenance of stormwater ponds as well as determining the performance of existing stormwater ponds throughout the City.

Corrective Action 4.7.B The City of Arden Hills will consider establishing a pond program that identifies pond maintenance activities and prioritizes pond inspections.

Problem 4.7.C Increasing prevalence of polycyclic aromatic hydrocarbons (PAHs) in stormwater ponds from runoff of roadways and other surfaces.

Corrective Action 4.7.C Identify stormwater ponds that are contaminated and follow protocol for disposal of dredged material on a site-by-site basis. The City also bans the use of materials for paved surfaces that contain PAHs for future development and redevelopment.

4.8. Availability and Adequacy of Existing Technical Information to Manage Local Water Resources

Problem 4.8.A Atlas 14 (updated precipitation probability information) was recently released by NOAA (National Oceanic and Atmospheric Administration).

Corrective Action 4.8.A Previously developed areas within the City (designed to meet TP-40 hydrologic demands) will continue to operate under this design criteria. New development, redevelopment, and areas where problems may exist will be evaluated (as needed) by completing a risk assessment using Atlas 14. The City will update its policies, codes, ordinances, and other appropriate documents accordingly.

Problem 4.8.B The City has not yet completed a City-wide wetland functional assessments.

Corrective Action 4.8.B Until this City-wide study is complete, the City will continue to require a

MnRAM assessment on a site-by-site basis for development or construction activity that is impacting wetlands. The City will defer to RCWD for WCA administration and enforcement and will continue to coordinate on potential wetland impacts.

Problem 4.8.C The City has mapped a majority of its storm sewer system. As new and redevelopment projects are completed, the storm sewer GIS database needs to continually be updated.

Corrective Action 4.8.C The City will annually update its storm sewer GIS database to incorporate recent projects and associated storm sewer improvements.

SECTION 5

5. GOALS AND POLICIES

The City has developed several goals, strategies, and policies for the management of stormwater within the City consistent with the RCWD Watershed Management Plan of 2010. The goals and policies are used as a guide in the design and construction of private and public developments impacting water resources in the City. They also address the routine operations of the City.

The RCWD and the City will share authority over all water resource issues within the City of Arden Hills. The City will reference the RCWD rules for development reviews and reference those goals and policies of the RCWD plan as applicable to the operations of the City. The City will inform private developers of RCWD rules while balancing the need to protect the health, safety, and welfare of the community. The City requests the RCWD to continue to implement its rules and regulations and issue permits within the community. The RCWD's rules, permit application and other pertinent information can be found on the District's web site at http://www.ricecreek.org. Regulatory responsibilities and developer guidelines specific to the City of Arden Hills can be found in ***Appendix C***.

5.1. Previous Stormwater Pond Models

Thirteen regional ponds were proposed as part of a 1999 comprehensive drainage study and modeled for water quality in the 2003 SWMP update. The narrative, treatment pond locations, and modeling from the 2003 study have been included in ***Appendix F***.

The City will evaluate the feasibility of implementing regional ponding to meet city-wide surface water management goals and RCWD rules on a project-by-project basis.

5.2. Lakes and Ponds

Table 5-1 provides summary data on the lakes within the City. The Southwest Urban Lakes Study (***Appendix G***) provides relatively new, detailed data on lakes within the City including management action plans for each lake. The study also lays out detailed management action plans for each of the lakes and possible locations for BMP retrofits. All eight lakes within the City of Arden Hills are covered in the RCWD study. The City will consider the feasibility of these management action plans as part of its CIP, balancing the availability of land (i.e., public versus private) with the cost-benefit associated with each retrofit possibility.

Table 5-1 Summary Data on Lakes in Arden Hills

Lake Name	DNR Number	Max Depth / Mean Depth (ft)	Surface Area (acres)	Recreational Suitability
Josephine	62-0057	44/20	116	Full Support (M)
Round	62-0070	7/shallow	130	Full Support (M)
Valentine	62-0071	14/4.5	64	Non-Supported
Sunfish	62-0065	5/shallow	14	Non-Supported
Marsden	62-0059	5.5/shallow	271	Non-Supported
Karth	62-0072	14/shallow	20	Non-Supported
Johanna	62-0078	41/17	214	Partial Support
Little Johanna	62-0058	28/shallow	17	Non-Supported

Lake Josephine boasts a fully supported swimmable use classification, although it is sensitive to increases in phosphorus nutrient loading. Round Lake has been known to contain pollutants from the former TCAAP plant in the bottom sediment. There is no access to Round Lake for swimming use due to physical restrictions. Lake Johanna only partially supports swimmable use classification due to algae blooms and low transparency for a significant portion of the summer. Karth, Little Lake Johanna, and Valentine lakes do not support swimmable use classification due to severe and frequent algae blooms and low transparency for most of the summer. Round, Karth, Little Lake Johanna and Valentine lakes have either small surface areas or are quite shallow in average depth and therefore would not be considered likely candidates for swimmable use. However, water quality data in support or non-support of this use is important for wildlife management of these water bodies.

Under the federal Clean Water Act, the State of Minnesota is required to monitor and assess their waters to determine if they meet water quality standards and support the beneficial uses they are intended to provide. The MPCA has developed a draft Total Maximum Daily Load (TMDL) list per Title 303(d) of the Clean Water Act.

5.3. NPDES Stormwater Pollution Prevention Plan Minimum Control Measures

The MPCA has identified the goals of the MS4 permit to restore and maintain the chemical, physical, and biological integrity of waters of the state through management and treatment of urban stormwater runoff. This is accomplished by requiring the preparation of a Stormwater Pollution Prevention Program (SWPPP) from MS4's.

Phase II requires municipal separate storm sewer systems (MS4s) in urban areas with populations over 10,000 and under 100,000 to obtain an NPDES permit. Permits for construction sites greater than one acre will also be required as part of the Phase II. The City has submitted its Stormwater Pollution Prevention Plan and Notice of Intent in conformance with the MPCA guidelines. The current MPCA MS4 Coverage Letter is included in ***Appendix J***.

The City of Arden Hills has identified best management practices (BMPs) and measurable goals associated with specific minimum control measures (MCM). The following table summarizes the BMPs for each MCM. Reference Arden Hill's SWPPP for specific information on implementing the BMPs.

Table 5-2 MCM and BMPs Summary Sheets

Key to Unique BMP ID Numbers	Required BMP Title
MCM 1: Public Education and Outreach	
1a-1	Distribute Educational Materials
1b-1	Implement an Education Program
1c-1	Education Program: Public Education and Outreach
1c-2	Education Program: Public Participation
1c-3	Education Program: Illicit Discharge Detection and Elimination
1c-4	Education Program: Construction Site Run-off Control

Key to Unique BMP ID Numbers	Required BMP Title
1c-5	Education Program: Post-Construction Stormwater Management in New Development and Redevelopment
1c-6	Education Program: Pollution Prevention/Good Housekeeping for Municipal Operations
1d-1	Coordination of Education Program
1e-1	Annual Public Meeting
MCM 2: Public Participation & Involvement	
2a-1	Comply with Public Notice Requirements
2b-1	Solicit Public Input and Opinion on the Adequacy of the SWPPP
2c-1	Consider Public Input
MCM 3: Illicit Discharge, Detection, and Elimination	
3a-1	Storm Sewer System Map
3b-1	Regulatory Control Program
3c-1	Illicit Discharge Detection and Elimination Plan
3d-1	Public and Employee Illicit Discharge Information Program
3e-1	Identification of Non-Stormwater Discharges and Flows
MCM 4: Construction Site Runoff Control	
4a-1	Ordinance or other Regulatory Mechanism
4b-1	Construction Site Inspection of Erosion and Sediment Control BMPs
4c-1	Waste Controls for Construction Site Operators
4d-1	Procedure for Site Plan Review
4e-1	Establishment of Procedures for the Receipt and Consideration of Reports of Stormwater Noncompliance
4f-1	Establishment of Procedures for Site Inspections and Enforcement
MCM 5: Post-Construction Site Runoff Control	
5a-1	Development and Implementation of Structural and/or Nonstructural BMPs
5b-1	Regulatory Mechanism to Address Post Construction Runoff from New Development and Redevelopment
5c-1	Long-Term Operation and Maintenance of BMPs
MCM 6: Pollution Prevention & Good Housekeeping	
6a-1	Municipal Operations and Maintenance Program
6a-2	Street Sweeping

Key to Unique BMP ID Numbers	Required BMP Title
6b-2	Annual Inspection of All Structural Pollution Control Devices
6b-3	Inspection of a Minimum of 20 percent of the MS4 Outfalls, Sediment Basins, and Ponds Each Year on a Rotating Basis
6b-4	Annual Inspection of All Exposed Stockpile, Storage, and Material Handling Areas
6b-5	Inspection Follow-up Including the Determination of Whether Repair, Replacement, or Maintenance Measures are Necessary and the Implementation of the Corrective Measures
6b-6	Record Reporting and Retention of all Inspections and Responses to the Inspections
6b-7	Evaluation of Inspection Frequency

5.4. Goals

5.4.1. Goal #1: Education and Public Involvement

The purpose of public participation, information and education is to:

- Disseminate information regarding the LSWMP's content;
- Create support for the implementation of the LSWMP's goals and policies; and
- Collaborate with RCWD and other agencies in disseminating information regarding stormwater best management practices.

Goal Statement: To increase the awareness, understanding, and involvement in water resource management issues throughout the City.	
Policy	**Goal #1: Education and Public Involvement Policies**
1	Develop and distribute educational materials to the public and targeted groups about city ordinances, policies, and programs related to surface and ground water resource management.
2	Cooperate and collaborate with RCWD to provide information and educational opportunities to the community.
3	Utilize all available modes of communication including the City newsletter, social media, website, public access television, water bill flyers, signage programs, and other creative methods to disseminate educational materials related to water resource management.
4	Cooperate and collaborate with local Lake Associations and other lake homeowners to encourage participation in lake protection, shoreline restoration/protection, and water quality improvement plans and initiatives.

5	Develop and provide means for distribution of informational materials for property owners and parties interested in development or redevelopment.

5.4.1.1. *Karth Lake Improvement District*

Karth Lake is a landlocked water body and has a pumped outfall. The pump discharge enters a storm sewer system on Fernwood Street, which discharges into a pond and ditch system connected to Valentine Lake. The lift station was upgraded in 2003 and included bank stabilization improvements.

The Karth Lake Improvement District was established in 2003 by Resolution No. 03-60 of the Arden Hills City Council. The resolution is attached as ***Appendix D***. The improvement district has many functions relative to Karth Lake which includes the construction and operation of water control structures, improvement projects on the lake itself, and the development of plans for the reduction of lake pollution and management of the lake water levels. The district encompasses those property owners with frontage along Karth Lake.

The City will continue to draw upon and utilize this improvement district for the purposes of managing water quality and quantity and disseminating educational information regarding Karth Lake.

5.4.1.2. *Lake Johanna Improvement Society*

The Lake Johanna Improvement Society is an association of lake property owners. This group coordinates lake issues with the City through an informal process. This lake association is a tool the City can use to provide educational opportunities.

5.4.1.3. *Lake Josephine Improvement Association*

The Lake Josephine Improvement Association consists of the area's lake property owners. The Cities of Roseville and Arden Hills have adopted joint regulations for the lake, which include a maximum speed limit and a no wake zone 150 feet from shoreline. This lake association is a tool the City can work with to provide educational opportunities.

5.4.2. Goal #2: Lakes

The City will adopt policy statements to reflect the intent to collaborate with RCWD on the management and treatment of stormwater runoff entering the City's area lakes.

In 2009, the RCWD conducted the Southwest Urban Lakes Study and developed management action plans which encompass all lakes within the southwestern leg of the RCWD with primarily urban runoff contributions. This detailed study collected data and modeled nutrient loading on the lakes from their respective subwatersheds. The report is attached in ***Appendix G***. The City will analyze and implement opportunities presented in the Southwest Urban Lakes Study's management action plans for each lake for feasibility and in conjunction with capital improvement projects.

Goal Statement: Manage lake systems for their ecological and community value in a manner consistent with user expectations and technically achievable goals and the resources available for preservation, maintenance, and restoration consistent with RCWD goals and policies.	
Policy	**Goal #2: Lakes Policies**
1	Utilize and engage citizens to promote sustainable stewardship of lakes.
2	Collaboratively manage lakes and shoreland resources by empowering lake associations, lakeshore residents, and cities, and engaging state agency and watershed management officials.
3	Work with RCWD to develop attainable lake water quality targets while recognizing water quality standards developed by the State of Minnesota and natural year-to-year variability in water quality.
4	Promote and foster activities which result in sustainable and healthy aquatic eco-systems.
5	Manage lake levels in a manner which enhances ecological integrity and function (e.g., shallow lake systems) and acknowledge the effect of water levels on recreational use, lakefront property, and flooding.

5.4.3. Goal #3: Wetlands

Rice Creek Watershed District is the Local Governing Unit (LGU) within the City with regards to managing the wetlands under the Wetland Conservation Act. RCWD also currently permits wetland impacts under Rule F Wetland Alteration.

Goal Statement: Manage wetlands in a manner which improves diversity and ecological integrity on a city-wide basis consistent with the Wetland Conservation Act (WCA) and opportunities for preservation, enhancement, and restoration while balancing multiple resource issues.	
Policy	**Goal #3: Wetlands Policies**
1	Reference the goals and policies of the RCWD and collaborate on wetland management and enforcement initiatives consistent with the RCWD goals and policies.

5.4.4. Goal #4: Maintenance, Inspection, and Municipal Operation of City-Owned Drainage Systems

Inspections help spot potential problems before they become major problems. Routine maintenance reduces the long-term costs related to drainage system maintenance while helping to achieve water quality and quantity goals. The application of development standards ensures consistency in the work produced and the documentation of the constructed systems.

The City will establish policies to develop an effective storm drainage maintenance program that will help it meet water quality and quantity goals as well as meet federal, state, and local

watershed requirements.

Goal Statement: Manage and operate municipal drainage systems in a manner which recognizes Federal, State, and watershed regulations, downstream impacts, legally established property rights, and cost-effectiveness.	
Policy	**Goal #4: Maintenance, Inspection, and Municipal Operation of City-Owned Drainage Systems Policies**
1	Apply methods, procedures, standards, and criteria for the maintenance, repair, restoration, rehabilitation, and improvement of drainage systems within the City.
2	Implement routine maintenance measures to reduce long-term capital improvement costs while achieving water quality and quantity goals.
3	Collaborate with RCWD as they manage public drainage systems in a manner that recognizes the need to provide a functional level of service to benefitted properties within the context of local, state, and federal laws and programs.
4	Require maintenance of privately constructed water quality treatment ponds and infiltration best management practices through formal development or maintenance agreements. The City will collaborate with RCWD programs that may overlap.
5	Collaborate with RCWD as they manage public drainage systems with original design purposes, periodically review these purposes, and modify operation in consideration of current resource management objectives.
6	Continue to implement a maintenance and inspection program for city-owned and operated water resource facilities meeting the requirements of the NPDES Phase II program.
7	Require adequate maintenance-related access for public and private water resource management facilities.
8	Continue operations and maintenance activities that preserve water quality including street sweeping, pond and grit chamber maintenance, and appropriate application of deicing compounds balancing public safety and environmental protection.

5.4.5. Goal #5: Data and Information Management

With more stringent NPDES Phase II reporting requirements on the horizon, the pressure to improve customer service, and the ever-demanding need to properly manage drainage infrastructure, the City recognizes that it will need effective and efficient protocols for collecting, organizing, and managing data. These policies will assist the City in fulfilling these needs.

Goal Statement: Provide the most efficient and effective means available for collecting, sharing and managing data and information.	
Policy	**Goal #5: Data and Information Management Policies**

1	Collect and manage data in an effective and efficient manner in accordance with applicable Federal, State, and Local regulations.
2	Provide a mechanism for organizing and sharing information developed through the MS4 program for City-owned and operated facilities.
3	Provide data in the most efficient manner possible while maximizing use by the public and partner agencies and minimizing duplication of data through cooperative data collection and sharing.

5.4.6. Goal #6: Excess Runoff Management and Flood Control

Development can increase runoff rates and volumes due to additional impervious surface. As areas develop or redevelop at a higher density, stormwater runoff generally increases. This increase in runoff rates and volumes can cause localized and/or large scale flooding issues in the downstream system. It is important to control these increased runoff rates and volumes to ensure reduction of flooding in the downstream system and to control the potential effects of erosive flows in streams and waterways.

The City of Arden Hills will adopt the rules of the RCWD requiring volume reduction for new development and redevelopment. The City has also adopted a floodplain ordinance, and will be consistent with RCWD rules and regulations that regulate minimum building elevations regarding proximity to surface waters. If RCWD 100-year floodplain elevations are inconsistent with FEMA floodplain elevations, the stricter of the two will apply.

Goal Statement: Minimize the potential damage to public and private infrastructure, property, land, and other important water-related natural resources caused by excess runoff and flooding.

Policy	Goal #6: Excess Runoff Management and Flood Control Policies
1	Minimize, avoid, and reduce flood damages by remaining consistent with the RCWD floodplain management program including analyses focused on identifying and assessing flood prone areas, characterizing flood damages, and regulating the placement of structures within the floodplain. The more restrictive 100-year floodplain elevation will apply when analyzing freeboard requirements of structures within the floodplain.
2	Defer to RCWD permit rules and permit program to mitigate the increase in rate and volume of runoff resulting from land disturbance, land development, increases in the amount of impervious surface, and other changes to the landscape.
3	Preserve and manage the storage associated with the 100-year floodplain along and within waterbodies to minimize the frequency and severity of flooding caused by high water.
4	Recognize the potential uncertainty associated with managing water resources and understand the implications of emerging issues, the use of monitoring data, and the interpretation of scientific and technical data in the decision-making process.

5	Foster and encourage the use of both regional and small-scale single-property focused best management practices to reduce the rate and volume of runoff.

5.4.7. Goal #7: Groundwater

The St. Paul Water Utility provides drinking water to Arden Hills through the City of Roseville. Once in Arden Hills, the City's Water Utility has jurisdiction over the system. All areas of Arden Hills are served with city water service. Residents who move to the TCAAP redevelopment area will get their drinking water from St. Paul Regional Water Services, so the groundwater contamination will not affect residential water quality.

Sanitary sewer interceptor and treatment is provided to the City via the Metropolitan Council Environment Services (MCES) system. The City's Sanitary Sewer Utility has jurisdiction over the sanitary sewer collection system within the City's borders. The City owns and operates 14 sanitary lift stations.

In 2010, the Ramsey County Conservation District published the Ramsey County Groundwater Protection Plan. It identifies groundwater contaminated areas and predicts areas that are potentially susceptible to groundwater contamination. It also contains a comprehensive topographic and geological overview describing ground water aquifers in the county.

The City, utilizing the guidance of the Ramsey County Groundwater Protection Plan and collaborating with RCWD will proceed with measures to protect groundwater resources within the City that will also have an impact on the groundwater quality of other cities.

Goal Statement: Incorporate ground water considerations into the decision-making process.	
Policy	**Goal #7: Groundwater Policies**
1	Collaborate with the RCWD and Ramsey County on efforts to manage groundwater resources consistent with district and county-wide groundwater protection initiatives.

5.4.8. Goal #8: Erosion and Sediment Control

These policies are intended to help the City achieve the erosion and sediment control goals of this Plan. The City has an Erosion and Sediment Control Ordinance as well as its NPDES MS4 Phase II SWPPP. The City partners with the Ramsey Conservation District to implement its construction site erosion control inspection program.

Goal Statement: To address and enforce both temporary and permanent sediment and erosion control practices throughout the City.	
Policy	**Goal #8: Erosion and Sediment Control Policies**
1	Require erosion and sediment control plans for all land disturbance activities as defined by city ordinance.

5.4.9. Goal #9: TCAAP Redevelopment

While the future of the exact usage and redevelopment of the TCAAP lands is still in flux, the

City's SWMP addresses, at least on a high level, the need to plan for stormwater quality and quantity provisions within the master planning process for TCAAP.

Goal Statement: Provide an effective stormwater management master plan accounting for the redevelopment of the TCAAP lands.	
Policy	**Goal #9: TCAAP Redevelopment Policies**
1	Promote conformance with the approved Comprehensive Stormwater Management Plan and Green Infrastructure and Stormwater Reuse Feasibility Study for the Rice Creek Commons (also known as TCAAP).
2	Require developers to follow the submittal sequencing steps listed in the CSMP. If the development exceeds the CSMP maximum impervious, the developer application must demonstrate how the additional runoff will be treated to meet RCWD rules.
3	Promote partnering opportunities when implementing stormwater treatment systems or educational components identified in the Green Infrastructure and Stormwater Reuse Feasibility Study. Grant funding should be pursued to assist in project costs.

5.4.10. Goal #10: Financing

Paying for water management projects has become more complex. More agencies have begun to utilize partnerships as a method to fund and construct projects. In the past, special assessments against benefitting properties financed most of the necessary improvements. However, the financial options have broadened considerably. The City utilizes a surface water management utility as a component of their overall approach to funding stormwater related projects. These policies are intended to help the City achieve the financing goals of this plan.

Goal Statement: Maintain sustainable financing for the City's stormwater infrastructure.	
Policy	**Goal #10: Financing Policies**
1	Maintain a financing strategy for surface water improvements including a wide array of financing sources including ad-valorem levies, surface water utility fees, special assessments, connection charges, developer charges, and grants.
2	Encourage partnerships with the RCWD and other agencies to finance drainage projects where appropriate and to participate in the design, planning, and funding where appropriate.
3	Encourage the coordination of City capital improvement projects with RCWD programs and projects.

SECTION 6

6. IMPLEMENTATION PROGRAM

6.1. Overview

The Implementation Plan is the final section of the Plan, and one which is intended to provide guidance in carrying out the Plan goals and policies. This section summarizes ongoing maintenance, inspection, monitoring and other management activities. The Plan is intended to serve the City for at least the next ten years and many of the program activities will continue out to the year 2040. Procedures for amending the Plan are provided.

Arden Hills has developed its implementation program to address issues identified earlier in this Local Surface Water Management Plan. This program reflects the needs and concerns of many stakeholders including the City Council, City Staff, citizens, and RCWD. The program also considers Arden Hills' ability to fund these items through its general levy, environmental fund, or stormwater utility. The implementation program consists of the following components:

- Capital Improvement Projects (CIP)
- Operation and Maintenance
- Official Controls
- Monitor and Study

Capital Improvement Projects consist of "on-the-ground" projects intended to remedy issues identified as current problems. The capital projects focus on phosphorus reduction within the TMDL subwatersheds.

Operation and Maintenance items consist primarily of the general maintenance of Arden Hills' drainage system including ponds, storm sewer, and culverts. Operation and maintenance also includes activities related to NPDES MS4 Permit compliance such as annual meetings, SWPPP updates, and SWPPP implementation.

Official Controls include ordinance and policy revisions intended to achieve water quality benefits. Each proposed implementation item has a specific driver, which are identified in the tabulated implementation program later in this section. The overarching goal of Arden Hills' implementation program is to improve the quality of its surface waters, its surface water discharge, and to achieve sustainable site development practices. Over time, codes must be updated to remain consistent with goals, policies and practices. City ordinances are revised as needed to stay current with the MS4 permit requirements and revisions to RCWD's rules.

Monitor and Study items consist primarily of projects designed to collect water resource data such as water quality monitoring projects, and projects to evaluate cost benefits for various stormwater treatments or planning opportunities.

Development of the Implementation Plan follows the guidelines in Minnesota Rules Chapter 8410, the RCWD, and Metropolitan Council. The City identified problem areas to coordinate feasibility studies to address these issues.

6.2. Implementation Priorities and Cost

The Implementation Plan includes identification and prioritization of capital improvements, administration, permitting, plan amendments, financing alternatives, and monitoring programs. Public education and operation and maintenance costs are considered separately under annual operating costs. Prioritization of improvements is based on a review of all recommended actions.

Planning-level estimates of capital expenditures has been made. Future anticipated projects are also listed. The activities have been distributed throughout a 10-year implementation plan.

The Implementation Plan is summarized in ***Table 6-1***. The Implementation Plan is not a hard and fast commitment to complete each and every activity in the time frame suggested. Rather, it is a suggested course of action that will accomplish the major goals of this plan, accommodate growth and redevelopment in the community while protecting the environment and water resources, and complying with local, state, and federal regulations.

The basis for cost considerations within the implementation plan are estimates of possible indirect costs associated with a project. Indirect costs may include feasibility studies, drainage studies, or other analyses needed to develop a project that meets a goal. In most cases, the program is either already implemented, is an MS4 requirement, or is something that is addressed on an as-needed basis (i.e., proposed development or redevelopment). Typically, City staff time is involved with most tasks; staff time on individual activities may vary according to workload and other competing priorities outside of this Plan.

The City developed a five-year Pavement Management Program, prioritizing projects based on a composite rating which accounts for RCWD Lake Tiers. A significant factor in determining the composite rating is the Stormwater Index, which reflects whether or not the street has drainage infrastructure, whether the runoff from the street enters a natural water body treated or untreated, and whether localized flooding occurs on a regular basis. The City will conduct studies on the feasibility of water treatment areas as part of individual improvement projects.

6.3. Funding Alternatives

6.3.1. Surface Water Management Fund

The City currently has a Surface Water Utility Fund, which funds stormwater related costs including educational efforts, construction of treatment systems, and maintenance of the overall stormwater treatment and conveyance systems including storm sewer maintenance, ditch maintenance, and street sweeping. Fees are reviewed on an annual basis to ensure adequate funding for the activities set forth in this Plan and those required by law.

6.3.2. Ad Valorem Tax

General taxation is the most common revenue source used to finance government services including minor maintenance measures for drainage and water quality facilities. Using property tax has the effect of spreading the cost over the entire tax base of a community. Special tax districts can also be used to raise revenue. The special tax district is similar to the administrative structure under general taxation except that all or part of the community may be placed in the tax district. The principle is to better correlate improvement costs to benefited or contributing properties.

6.3.3. Special Assessments

Municipalities are familiar with the use of special assessments to finance special services from maintenance to construction of capital improvements. The assessments are levied against properties benefiting from the special services. The philosophy of this method is that the benefited properties pay in relation to benefits received. The benefit is the increase in the market value of the properties.

6.3.4. Developer Charges

Fees required for new development which generate runoff can be charged to finance infrastructure needed to serve the development. This is a useful tool in communities that are rapidly developing.

6.3.5. Grants

Grants are available for surface water management and non-point source pollution. However, it is generally not a good financial practice to rely on grants for a service program. This source of revenue is not dependable and requires constant speculation as to availability. Grants are useful but only should be utilized as a supplement to a planned local revenue source. Select grant programs most applicable to City stormwater management and their outlets are summarized in ***Appendix I***. Websites for grant opportunities are as follows:

- MPCA: http://www.pca.state.mn.us.
- DNR: http://www.dnr.state.mn.us/grants/
- USEPA: https://www.epa.gov/grants
- Minnesota Board of Soil and Water Resources: http://www.bwsr.state.mn.us/grants/
- Metropolitan Council: https://metrocouncil.org/Communities/Grants-Funding-Finance.aspx
- U.S. Fish and Wildlife Service: http://www.fws.gov/grants

Grant opportunities and cost-share opportunities are most readily available to the City for stormwater improvement projects through the RCWD, which include:

- The Water Quality Grant Program created to assist property owners with implementation of BMPs is aimed at improving the quality of surface waters within the District.
- The Urban Stormwater Remediation Cost-Share Program assistance to counties, townships, school districts, libraries, and other public and private entities located within the District is aimed at redevelopment, roadway, and storm sewer improvement projects.

More information and applications for grants through RCWD are available on their website at http://www.ricecreek.org under Grant Opportunities.

Assistance and cost-share funding is also available through the Ramsey Conservation District at their web site https://www.ramseycounty.us/residents/environment/ramsey-conservation-district/cost-share-funding-assistance. Cost share programs include:

- Abandoned Water Well Sealing for Ramsey County Residents to assist owners in sealing unused wells within Drinking Water Supply Management Areas (DWSMA) and Wellhead Protection Areas.
- Native Plantings, Rain Gardens, and Shoreline Restoration includes technical assistance and funds available for Ramsey County residents interested in implementing projects to protect area lakes, streams, and wetlands.

6.3.6. Pros and Cons

Each funding method has its advantages and drawbacks. ***Table 6-1*** provides a summary of the advantages and disadvantages of each type of funding method. Funding alternatives should be viewed as a toolbox of resources and evaluated according to the needs of each specific project.

Table 6-1 Advantages and Disadvantages of Different Funding Alternatives

Funding Method	Advantages	Disadvantages
Ad Valorem Tax	1. Administrative structure for collection in place. 2. Simple and accepted source of revenue. 3. Allows for a larger revenue base. 4. Contributors pay through tax districts.	1. No incentive to reduce runoff or pollution. 2. No relationship to level of benefits received. 3. Discontinuous source of revenue. 4. Limitations on amount of expenditures due to budget constraints. 5. Competition with other City services (i.e., police, fire).
Surface Water Management Utility	1. Charges based on land usage rather than property value. 2. Simple and consistent source of revenue. 3. Contributors pay on their utility bills. 4. Incentive to reduce runoff or pollution if credit procedure is in place.	1. New fees are perceived as taxes. 2. Basis for computing fee may be controversial. 3. May place an unfair burden on some segments of the population. 4. Administrative costs for billing and setup.
Special Assessments	1. Only benefited properties pay. 2. Revenues from assessment are applied to a specific project cost. No competition with general services. 3. Benefits directly related to cost for service. 4. Assessment can be deferred in hardship cases.	1. Rigid procedural requirements. 2. Runoff contributions cannot be assessed. 3. Difficult to determine and prove benefit. 4. May place an unfair burden on some segments of the population.
Development Charges	1. New development generating runoff pays for runoff management. 2. Administrative structure for reviewing plans and collecting fees is in place. 3. Systems can be tailored to the specific needs through regulatory changes. 4. Revenues are applied to water management. No competition with general services.	1. Only address problems within the vicinity of the new development, not usually existing developments. 2. Only address prevention not correction of major problems. 3. Limited usefulness as a financing mechanism. 4. Limited new development pressure within existing City limits.
Grants	1. Reduce cost burden to residents in the community.	1. Undependable source of revenue. 2. Increase administrative costs for securing and managing the funds. 3. Most often grants require cost sharing and thus additional funding source. This results in double administrative costs due to several funding sources. 4. Limited availability on an irregular schedule. 5. Requires considerable lead time from application to receiving funds.

6.4. Plan Amendments

6.4.1. Amendment Procedures

The Arden Hills Local Surface Water Management Plan is intended to extend through the year 2027. For the plan to remain dynamic, an avenue must be available to implement new information, ideas, methods, standards and management practices. Persons either residing or doing business within the City shall be able to request amendment proposals at any time.

6.4.2. Request for Amendments

Written requests for plan amendment are submitted to the City staff. The request shall outline the need for the amendment as well as additional materials that the City will need to consider before making its decision.

6.4.3. Staff Review

A decision is made to the validity of the request. Three options exist:

a. Reject the amendment
b. Accept the amendment as a minor issue, with minor issues collectively added to the plan at a later date
c. Accept the amendment as a major issue, with major issues requiring an immediate amendment. In acting on an amendment request, staff shall recommend to City Council whether or not a public hearing is warranted.

6.4.4. City Council Consideration

The amendment and the need for a public hearing shall be considered at a regular or special City Council meeting. Staff recommendations should also be considered before decisions on appropriate action(s) are made.

6.4.5. Public Hearing, City Council, and Agency Approval

This step allows the public input based on the public sentiment. City Council shall determine when the public hearing should occur in the process. Based on the public hearing, City Council could approve the amendment, and, if necessary, refer the amendments to the Metropolitan Council and RCWD Board for comment and approval.

6.4.6. City Council Adoption

Final action on an amendment following approval by the RCWD is Council adoption. However, prior to the adoption, an additional public hearing could be held to review the plan changes and to notify the appropriate stakeholders.

6.4.7. Annual Report to City Council

A brief annual report should be made by City staff summarizing development changes, capital improvements and other water management-related issues that have occurred over the past year. The review should also include an update on available funding sources for water resource issues. Grant programs are especially important to review since they may change annually. These changes do not necessarily require individual amendments. The reports can, however, be considered when the plan is brought up to date. The report should be completed by June 1st of

each year to allow implementation items to be considered in the normal budget process. Copies of the report should be filed with the RCWD. The annual update can also serve as an important public information tool. A summary could be published in the City's newsletter.

TABLE 6.1

SURFACE WATER MANAGEMENT IMPLEMENTATION PLAN

No.	Project Description	10 Year Total Cost Estimate [1]	Schedule	Possible Funding Sources	Proposed Cost By Year[1]										Comments
					2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
Education and Public Involvement (Goal 1)															
1	Annual Public MS4 Meeting/Event Present the draft MS4 annual report at one public event per year to solicit public input regarding the adequacy of the City's SWPPP. Hold one event per calendar year of the MS4 permit cycle.	$8,000	Annually, prior to June 30th	Surface Water Utility Fund	$800	$800	$800	$800	$800	$800	$800	$800	$800	$800	Problem 4.6.A
2	Provide and update water resources-related information for the public.	$100,000	Ongoing	Surface Water Utility Fund	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	Problem 4.6.A
3	Collaboration with agencies and citizen groups on education initiatives.	$20,000	Ongoing	Surface Water Utility Fund	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	Problem 4.6.A
4	Education Activity Implementation Plan - Complete yearly outline of education activity implementation program and implementation schedule. Include procedures to meet requirements for the MS4 permit.	$15,000	Ongoing	Surface Water Utility Fund	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	Problem 4.6.A
5	Employee Training - Continue to provide a minimum of one staff training event per year to discuss illicit discharge recognition and reporting. City staff will develop an annual training schedule, record the employee names, topics covered, and date of each event, annually through the end of the MS4 permit cycle (July 31, 2018)	$5,000	Ongoing	Surface Water Utility Fund	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	Problem 4.6.A
6	E.coli Education - Continue to educate residents on the importance of cleaning up after their pets to reduce pollutants entering the stormwater system and promoting the importance of goose management.	$5,000	Ongoing	Surface Water Utility Fund	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	Problem 4.1.B
Lakes (Goal 2)															
1	Snelling Avenue (local road) reconstruction (stormwater treatment and drainage) feasibility study.	$425,000	2019-2020	Surface Water Utility Fund, RCWD, Grants			$425,000								
2	Floral Park area & surrounding streets (stormwater treatment and drainage) feasibility study.	$530,206	2019	Surface Water Utility Fund, RCWD, Grants	$530,206										Completed in 2018.
3	Participate in TMDL studies and implementation plan development efforts partnering with RCWD.	$25,000	Ongoing	Surface Water Utility Fund, RCWD, Grants	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	Problem 4.1.A
4	Support water quality monitoring programs on City lakes and key resources.	$35,000	Annually	Surface Water Utility Fund, RCWD, Grants	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	

No.	Project Description	10 Year Total Cost Estimate [1]	Schedule	Possible Funding Sources	Proposed Cost By Year[1]										Comments
					2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
5	Continue to administer the City's Floodplain and Shoreland Ordinances.	$10,000	Ongoing	Surface Water Utility Fund	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	
6	Animal Waste Ordinance - The City will regularly update and enforce their animal ordinance to properly dispose pet waste to limit E.coli discharge to the Mississippi River and other waterbodies.	$8,000	Ongoing	Surface Water Utility Fund	$800	$800	$800	$800	$800	$800	$800	$800	$800	$800	Problem 4.1.B
7	Internal Lake Management - Develop an aquatic vegetation management plan to prevent curly-leaf pondweed abundance from increasing within the lake.	$45,000	2018-2022	Surface Water Utility Fund, RCWD, Grants			$45,000								Lake Johanna Management Action Plan
8	Wetland Enhancement #2 - Potential excavation/cattail removal. Assess the current water quality treatment being provided by the basin and assess options for improvement, if warranted. Northeast of the intersection of Edgewater Avenue and Ridgewood Road.	$45,000	2023-2027	Surface Water Utility Fund, RCWD, Grants						$45,000					Lake Johanna Management Action Plan
9	Open Space BMPs - Complete an assessment for Lake Johanna to identify possible BMPs in open space areas.	$25,000	2018-2022	Surface Water Utility Fund, RCWD, Grants		$25,000									Lake Johanna Management Action Plan
10	Wetland Enhancement #3 -Incorporate treatment for adjacent roads (would need to assess current quality and function of the wetland). North of Nursery Hill Court and west of Dellwood Street.	$50,000	2023-2027	Surface Water Utility Fund, RCWD, Grants								$50,000			Karth Lake Management Action Plan
11	Parking Lot Flume - The flume for stormwater runoff from the large parking area south of Karth Lake currently discharges offsite untreated. Incorporate stormwater treatment retrofits onsite during pavement maintenance. This is on private property and is subject to site redevelopment.	$20,000	2023-2027	Surface Water Utility Fund, RCWD, Grants									$20,000		Karth Lake Management Action Plan
12	Open Space BMPs - Complete an assessment for Round Lake to identify possible BMPs in open space areas. Could include South of County Road 96 and west of Snelling Avenue and East of Round Lake Road and north of Gateway Court.	$25,000	2023-2027	Surface Water Utility Fund, RCWD, Grants							$25,000				Round Lake Management Action Plan
13	Valentine Lake Open Space and Ditch Enhancement - Large open space with ditch running to the south under I-694 and then into Valentine Lake (large contributing drainage area). Use space for large regional facility to treat the highways and upstream discharges. Complete a feasibility study to determine the effectiveness of stormwater BMPs.	$35,000	2018-2022	Surface Water Utility Fund, RCWD, Grants					$35,000						Valentine Lake Management Action Plan

No.	Project Description	10 Year Total Cost Estimate [1]	Schedule	Possible Funding Sources	Proposed Cost By Year[1]										Comments
					2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
14	Open Space BMPs - Complete an assessment for Valentine Lake to identify possible BMPs in open space areas. Could include North end of Valentine Lake, West of Snelling Avenue and north of Lake Johanna Boulevard, and Dunlap Street between Grey Fox Road and Red Fox Road.	$35,000	2018-2022	Surface Water Utility Fund, RCWD, Grants			$35,000								Valentine Lake Management Action Plan
15	Pipe Repair - Rusted out pipe delivering runoff from Mn/DOT right-of-way at the north end of Valentine Lake. Repair pipe and look into upstream BMPs to reduce sediment transport from I-694 to Valentine Lake.	$40,000	2018-2022	Surface Water Utility Fund, RCWD, Grants			$40,000								Valentine Lake Management Action Plan
16	Pond Enhancement - Maintain and retrofit existing stormwater pond north of Grey Fox Road and west of Dunlap Street to provide additional treatment. Remove concrete, add native vegetation, and get rid of geese.	$80,000	2018-2022	Surface Water Utility Fund, RCWD, Grants				$80,000							Valentine Lake Management Action Plan
Wetlands (Goal 3)															
1	Update wetland and pond inventory consistent with MS4 Permit requirements.	$15,000	Annually	Surface Water Utility Fund	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	
2	Continue to support RCWD WCA administration and enforcement within the City.	$5,000	Ongoing	Surface Water Utility Fund	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	
Maintenance, Inspection, and Municipal Operation of City-Owned Drainage Systems (Goal 4)															
1	Continue twice per year street sweeping program.	$300,000	Annually	Surface Water Utility Fund	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	
2	Continue annual drainage system inspection and maintenance programs in compliance with NPDES MS4 Permit, including cleaning of proprietary hydrodynamic separators.	$400,000	Annually	Surface Water Utility Fund	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	Problem 4.7.A
3	Continue pond inspection and bathymetric pond survey programs.	$15,000	Once every 5 years	Surface Water Utility Fund	$5,000				$5,000					$5,000	Problem 4.7.B
4	Stormwater pond maintenance projects including pond cleanouts and any outlet improvements. To be determined based on pond inspections and surveys.	$900,000	Ongoing	Surface Water Utility Fund		$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	Problem 4.7.B
5	Continue implementation of private system maintenance and inspection program.	$60,000	Ongoing	Surface Water Utility Fund	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	Problem 4.7.A
6	Collaborate with RCWD on WCA requirements for development projects.	$8,000	Ongoing	Surface Water Utility Fund	$800	$800	$800	$800	$800	$800	$800	$800	$800	$800	

No.	Project Description	10 Year Total Cost Estimate [1]	Schedule	Possible Funding Sources	Proposed Cost By Year[1]										Comments
					2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
7	Evaluate and update engineering standards devoted to the improvement and rehabilitation of drainage systems in the City.	$15,000	Ongoing	Surface Water Utility Fund	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	
8	Annually review and implement snow and ice control policies and de-icing compound application.	$25,000	Annually	Surface Water Utility Fund	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	
9	Construction Site Erosion and Sediment Control Inspections - City staff will continue to implement and enforce the construction site inspection program for erosion control on construction sites one acre or larger. City staff will document the number of site inspections conducted annually.	$5,000	Annually	Surface Water Utility Fund	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	
Data and Information Management (Goal 5)															
1	Continue to develop GIS information on City drainage utilities and mapping in compliance with MS4 reporting requirements.	$12,000	Ongoing	Surface Water Utility Fund	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	Problem 4.8.C
2	Continue developing efficient and effective means of sharing data with other local agencies.	$5,000	Ongoing	Surface Water Utility Fund	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	
Excess Runoff Management and Flood Control (Goal 6)															
1	Evaluate localized flooding and drainage issues. Includes those identified for Floral Drive, Indian Oaks Court, Norma Circle, and Briarknoll Drive. Issues will be addressed on a priority basis with corresponding City projects.	$82,500	Annually	Surface Water Utility Fund, RCWD, Grants	$7,500	$7,500	$7,500	$7,500	$7,500	$9,000	$9,000	$9,000	$9,000	$9,000	Problem 4.2.B, 4.2.C, 4.2.D, 4.2.E
2	Review easement coverage on City owned and maintained storm sewer systems relative to the 100-year HWL.	$10,000	Ongoing	Surface Water Utility Fund, Grants	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	
3	Continue to enforce floodplain ordinance and preserve volumes relative to existing stormwater facilities, waterbodies, and wetlands.	$18,000	Ongoing	Surface Water Utility Fund, Grants	$1,800	$1,800	$1,800	$1,800	$1,800	$1,800	$1,800	$1,800	$1,800	$1,800	
4	Continue to manage the Karth Lake elevation (no outlet) balancing environmental concerns with property owner considerations.	$5,000	Ongoing	Surface Water Utility Fund, Grants	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	
5	Evaluate the feasibility of BMPs for the management of excess runoff, water quality and flooding as part of the CIP pavement management projects.	$160,000	Bi-Annually	Surface Water Utility Fund, RCWD, Grants			$35,000		$35,000		$45,000		$45,000		Problem 4.5.A

No.	Project Description	10 Year Total Cost Estimate [1]	Schedule	Possible Funding Sources	Proposed Cost By Year[1]										Comments
					2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
6	Complete a feasibility report to analyze Charles Perry Park trail flooding and identify potential solutions.	$35,000	2018-2022	Surface Water Utility Fund, RCWD, Grants		$35,000									Problem 4.2.A
7	Complete a study to analyze the Valentine Park rain garden's lack of drainage and identify potential solutions.	$35,000	2018-2022	Surface Water Utility Fund, RCWD, Grants			$35,000								Problem 4.5.D
8	Evaluate stormwater BMP options to address the RCWD volume debit.	$25,000	Until debit is fulfilled	Surface Water Utility Fund, RCWD, Grants	$5,000	$5,000	$5,000	$5,000	$5,000						Problem 4.5.E
Groundwater (Goal 7)															
1	Evaluate impacts on groundwater relative to BMP installations.	$20,000	By project	Surface Water Utility Fund, Grants	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	
Erosion and Sediment Control (Goal 8)															
1	Continue to apply the City's sediment and erosion control ordinance and collaborate with RCWD on enforcement.	$5,000	Ongoing	Surface Water Utility Fund	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	Problem 4.4.A
TCAAP Redevelopment (Goal 9)															
1	Planning effort for storm water management on TCAAP lands.	$50,000	Ongoing	Surface Water Utility Fund, RCWD, Grants, Ramsey County, Developers	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	Problem 4.5.B
	Continue to partner with RCWD, Ramsey County and future developers to implement BMPs identified as part of the TCAAP redevelopment site referencing the approved CSMP and Green Infrastructure and Stormwater Reuse Feasibility Study.	$30,000	Ongoing	Surface Water Utility Fund, RCWD, Grants, Ramsey County, Developers	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	Problem 4.5.B
Financing (Goal 10)															
1	Review surface water utility fund needs.	$8,000	Ongoing	Surface Water Utility Fund	$800	$800	$800	$800	$800	$800	$800	$800	$800	$800	
2	Track grant opportunities and apply for grants as part of improvement projects.	$10,000	By project	Surface Water Utility Fund	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	

SECTION VI

No.	Project Description	10 Year Total Cost Estimate [1]	Schedule	Possible Funding Sources	Proposed Cost By Year[1]										Comments
					2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
	TOTAL	$3,844,706			$671,406	$296,200	$851,200	$316,200	$311,200	$277,700	$302,700	$282,700	$297,700	$237,700	

[1] Cost estimates are preliminary and subject to review and revision as engineer's reports are completed and more information becomes available. Table reflects 2018 costs and does not account for inflation. Costs generally include labor, equipment, materials, and all other costs necessary to complete each activity. Some of the costs outlined above may be included in other operational costs budgeted by the City.

SECTION 7

7. ADMINISTRATION

7.1. Review and Adoption Process

Review and adoption of this Surface Water Management Plan will follow the procedure outlined in Minnesota Statutes 103B.235:

'After consideration but before adoption by the governing body, each local government unit shall submit its water management plan to the watershed management organization[s] for review for consistency with the watershed plan. The organization[s] shall have 60 days to complete its review.'

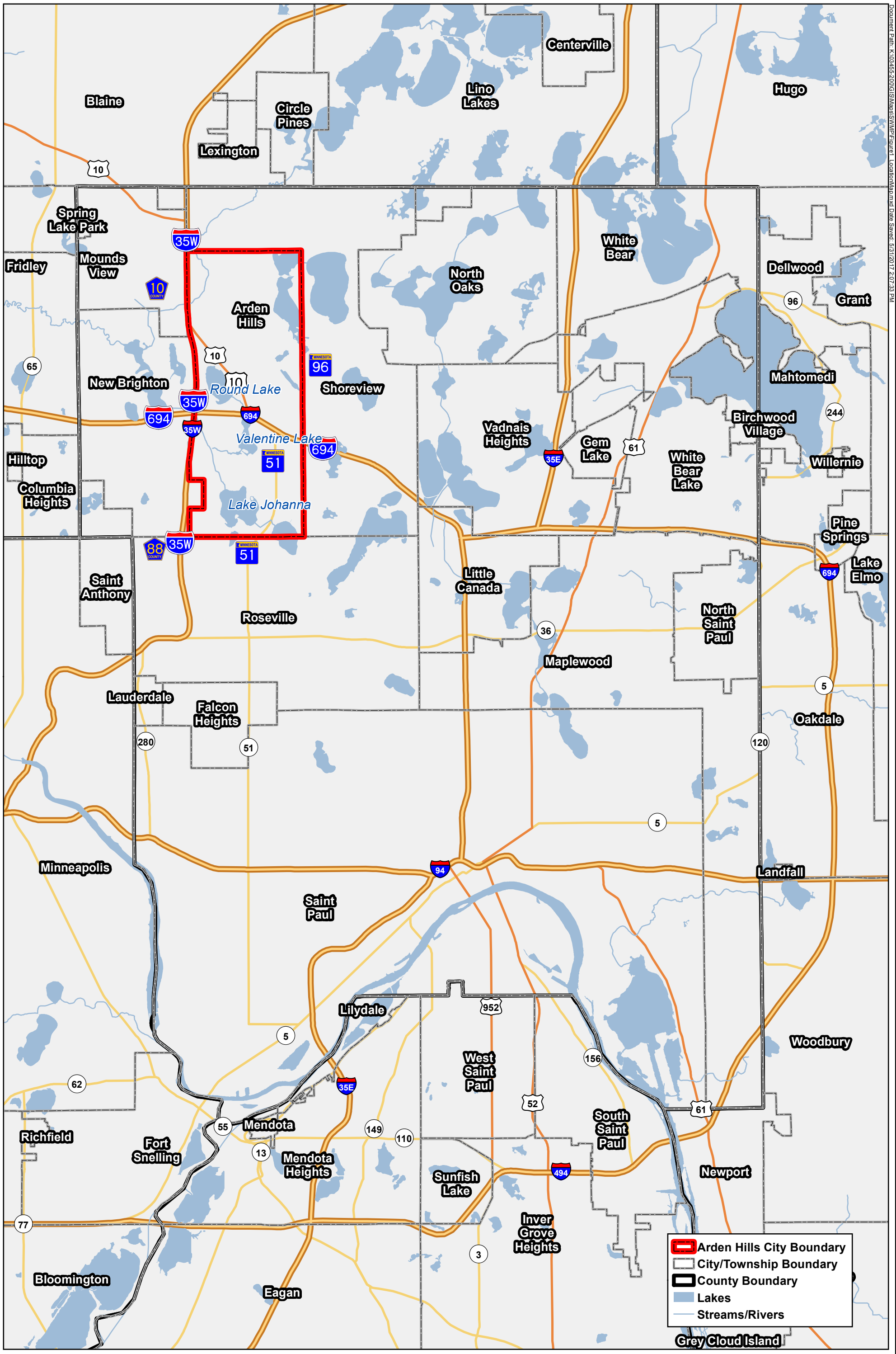
'Concurrently with its submission of its local water management plan to the watershed management organization, each local government unit shall submit its water management plan to the Metropolitan Council for review and comment. The council shall have 45 days to review and comment upon the local plan. The council's 45-day review period shall run concurrently with the 60-day review period by the watershed management organization. The Metropolitan Council shall submit its comments to the watershed management organization and shall send a copy of its comments to the local government unit.'

'After approval of the local plan by the watershed management organization[s], the local government unit shall adopt and implement its plan within 120 days, and shall amend its official controls accordingly within 180 days.'

7.2. Plan Amendments and Future Updates

This Local Surface Water Management Plan will be incorporated into the City's 2040 Comprehensive Plan update in 2019. The Plan is intended to be in effect for 10 years, at which time an updated plan will be required. Following review by Met Council and RCWD and the formal adoption process outlined above, the Arden Hills SWMP will be current. The City of Arden Hills my revise/amend the plan in response to City-identified needs.

APPENDIX A
Figures



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Arden Hills Surface Water Management Plan

Figure 1 - Location Map
Arden Hills, MN

N

0 8,000 Feet
1 inch = 8,000 feet

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Round Lake

Valentine Lake

Lake Johanna

10

35W

96

694

51

City Boundary
Not rated or not available
A
A/D
B
B/D
C
C/D
D

Arden Hills Surface Water Management Plan

Figure 2 - Soils Map
Arden Hills, MN

N

0 1,800 Feet
1 inch = 1,800 feet

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Round Lake

Valentine Lake

Lake Johanna

10

35W

96

694

51

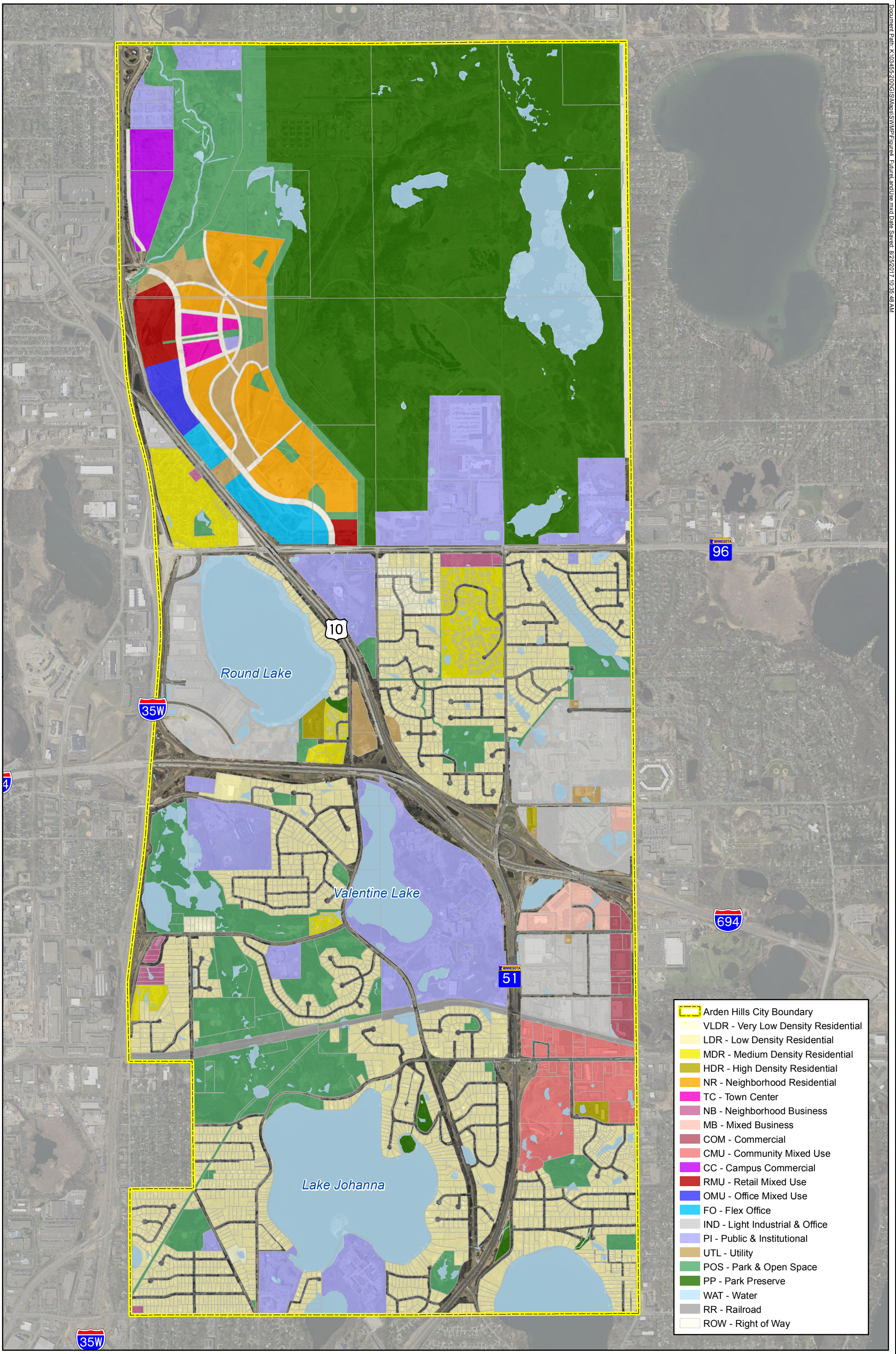
Arden Hills City Boundary
Single Family Attached
Single Family Detached
Multifamily
Manufactured Housing Parks
Mixed Use Residential
Retail and Other Commercial
Office
Mixed Use Industrial
Industrial and Utility
Park, Recreational, or Preserve
Institutitional
Undeveloped
Open Water
Railway

Arden Hills Surface Water Management Plan

Figure 3 - 2010 Existing Land Use
Arden Hills, MN

N

0 1,800 Feet
1 inch = 1,800 feet



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Arden Hills Surface Water Management Plan

Figure 4 - 2040 Future Land Use

Arden Hills, MN

N

0 1,800 Feet

1 inch = 1,800 feet

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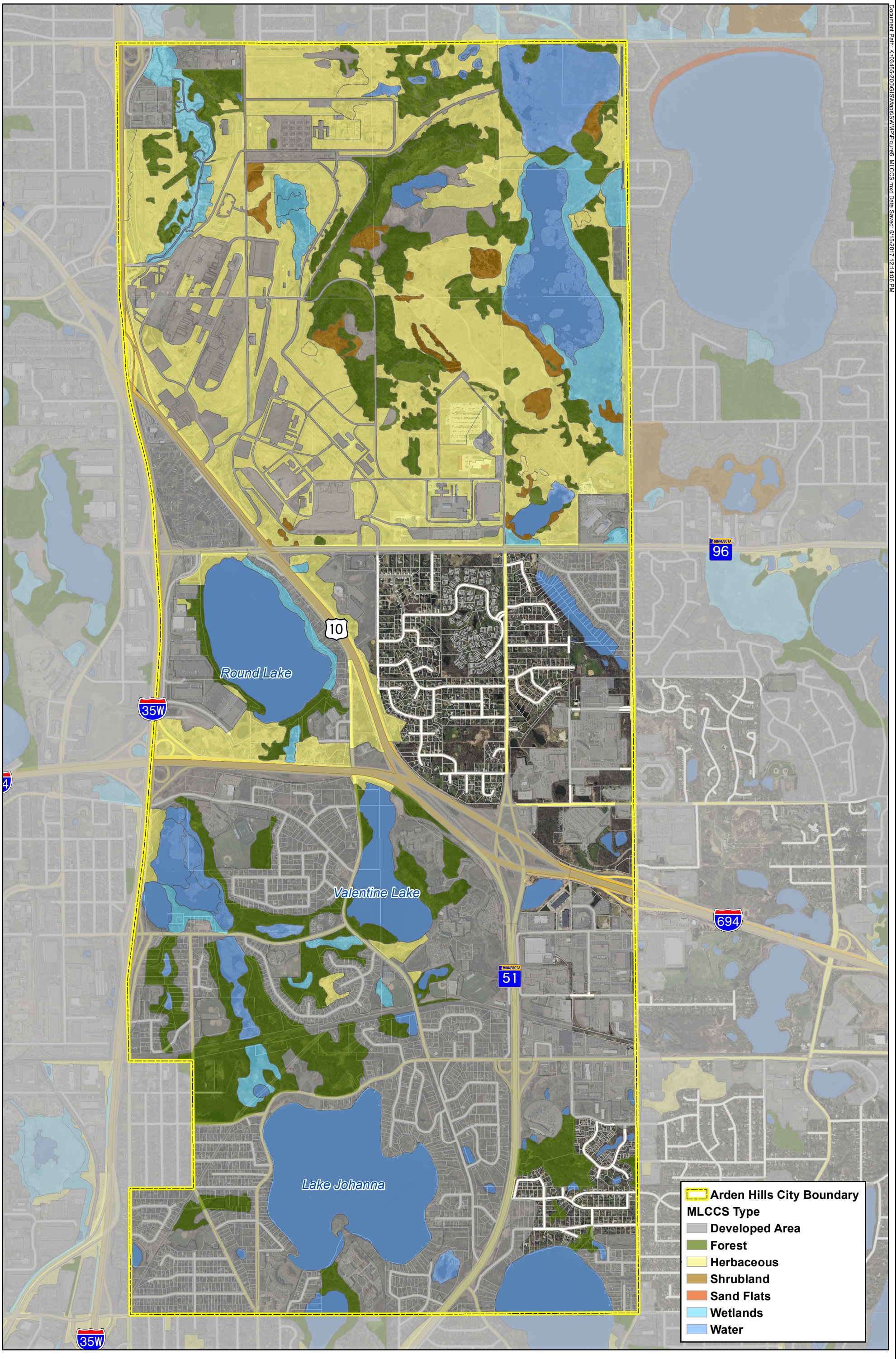

Arden Hills Surface Water Management Plan

Figure 5 - MLCCS
Arden Hills, MN

N

0 1,800 Feet
1 inch = 1,800 feet

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Round Lake

Valentine Lake

Lake Johanna

10

35W

96

694

51

Arden Hills City Boundary
Public Water Basin
Watercourse
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Riverine

Arden Hills Surface Water Management Plan

Figure 6 - Protected Waterbodies
Arden Hills, MN

N

0 1,800 Feet
1 inch = 1,800 feet

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Long
Turtle
Marsden
Rush
Rush
Round
10
96
Karth
35W
Valentine
694
51
Island
Pike
Johanna
Jones
Josephine
Little
Johanna
Langton
35W

Storm Sewer
Storm Structure
Subwatershed Area
Pond
Pond Drainage Areas
Arden Hills City Boundary

Arden Hills Surface Water Management Plan

Figure 7 - Subwatersheds and Drainage System

Arden Hills, MN

N

0 1,800 Feet

1 inch = 1,800 feet

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Arden Hills Surface Water Management Plan

Figure 8 - Flood Hazard Areas Map

Arden Hills, MN

N

0 1,800 Feet

1 inch = 1,800 feet

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Round Lake

Valentine Lake

Lake Johanna

10

35W

96

694

51

Arden Hills City Boundary

Well Vulnerability

- Very High
- High
- Moderate
- Low
- Very Low

Arden Hills Surface Water Management Plan

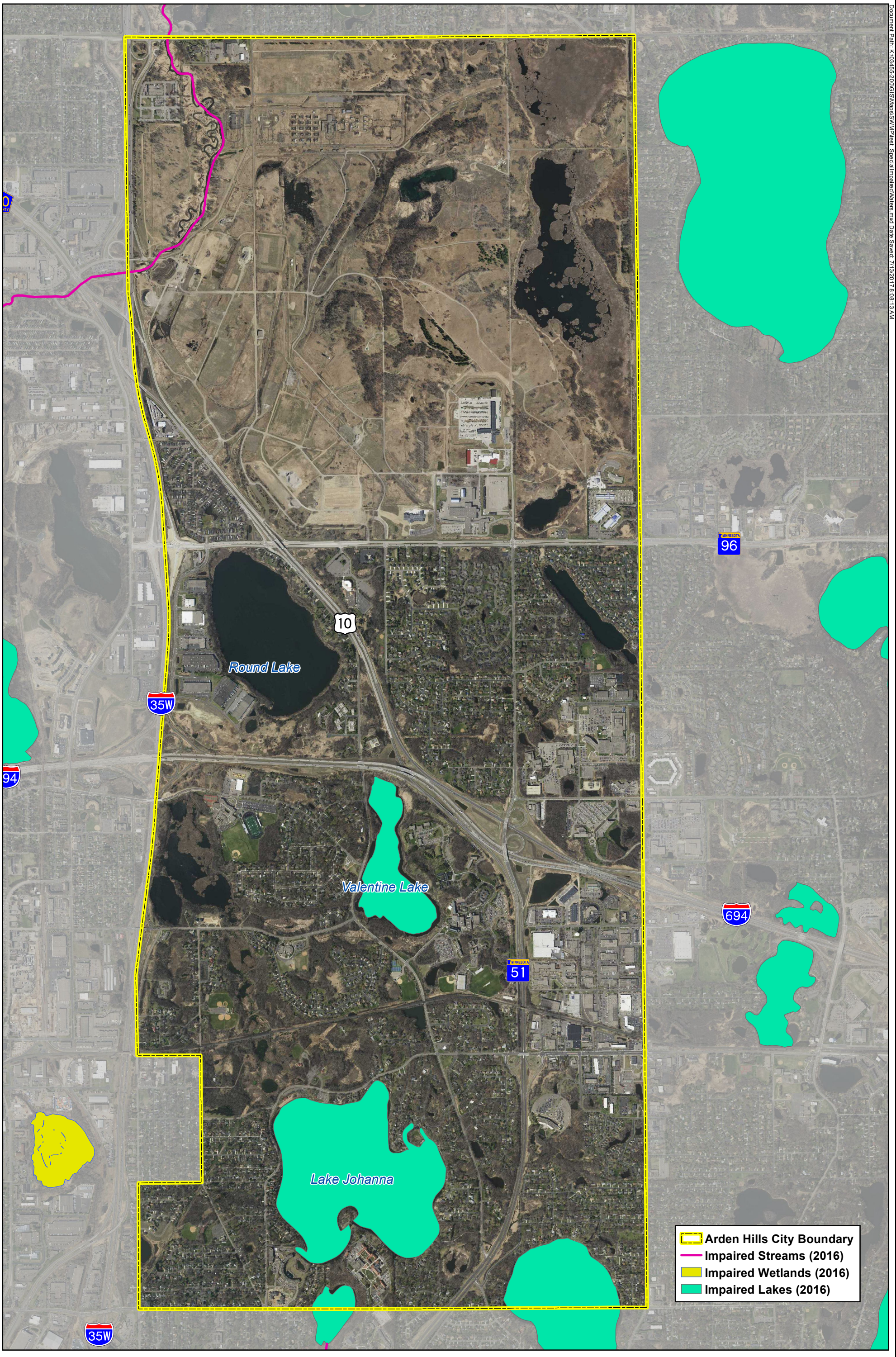
Figure 9 - Drinking Water Supply Management Areas (DWSMA)

Arden Hills, MN

N

0 1,800 Feet

1 inch = 1,800 feet



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Arden Hills Surface Water Management Plan

Figure 10 - Special and Impaired Waters Map

Arden Hills, MN

N

0 1,800 Feet

1 inch = 1,800 feet

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Round Lake

Valentine Lake

Lake Johanna

35W

10

96

694

51

- Arden Hills City Boundary
- Air Conditioning
- Non-Crop Irrigation
- Special Categories
- Temporary
- Water Level Maintenance
- Waterworks
- Industrial Processing

Arden Hills Surface Water Management Plan

Figure 11 - Groundwater Appropriations

Arden Hills, MN

N

0 1,800 Feet

1 inch = 1,800 feet

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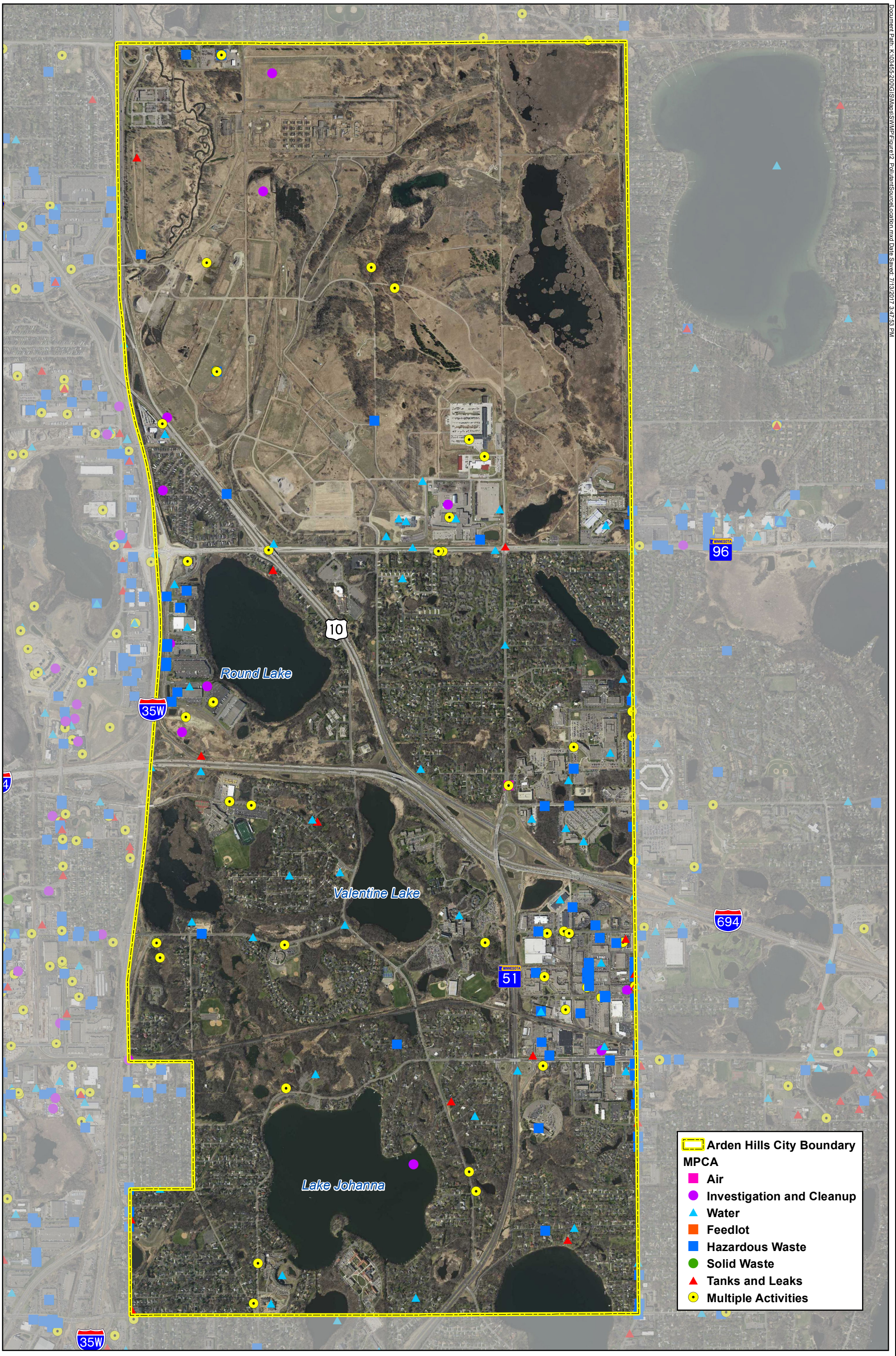

Arden Hills Surface Water Management Plan

Figure 12 - Pollutant Source Location Map

Arden Hills, MN

N

0 1,800 Feet

1 inch = 1,800 feet

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Long
Turtle
Marsden
Rush
Round
Karth
Valentine
Pike
Jones
Johanna
Josephine
Little Johanna
Langton
Island

10
35W
96
694
51

Legend
Subwatershed Area
Arden Hills City Boundary

ARDEN HILLS

Arden Hills Surface Water Management Plan

Figure 13 - Subwatershed Areas
Arden Hills, MN

N

0 1,800 Feet
1 inch = 1,800 feet

WSB

APPENDIX B
Relevant City Ordinances

Print

Arden Hills, MN Code of Ordinances

Section 1330 - Shoreland Regulations

1330.01 General Provisions.

Subd. 1 Intent. The uncontrolled use of shorelands within the City of Arden Hills affects the public health, safety and general welfare not only by contributing to pollution of public waters, but also by impairing the local tax base. Therefore, it is in the best interest of the public health, safety and welfare to provide for the wise development of shorelands of public waters. The Legislature of Minnesota has delegated responsibility to the municipalities of the State to regulate the subdivision, use, and development of the shorelands of public waters and thus preserve and enhance the quality of surface waters, preserve the economic and natural environmental values of shorelands, and provide for the wise utilization of waters and related land resources. This responsibility shall hereby be recognized by the City of Arden Hills.

Subd. 2 Purpose. To achieve the policies described in the City's Comprehensive Plan and State and Federal policies and statutes, the City intends to determine, control and guide future development within and surrounding those land areas which are contiguous to designated bodies of public water and areas of as herein defined and regulated. Specifically, the City of Arden Hills Purports to:

A. Regulate the placement of sanitary and storm water disposal facilities on lots;

B. Regulate the area of a lot, the length of water frontage suitable for a building site, and setbacks;

C. Regulate alteration of the shorelands and wetlands of public waters;

D. Control natural environment areas of ecological value to maintain existing aquatic, vegetation, and wildlife conditions to the maximum extent possible;

E. Promote the use of native vegetation as a means to increase stormwater infiltration, provide natural view sheds, and screen structures and parking areas as viewed from public waters.

1. Statutory Authorization. This Section is adopted pursuant to the authorization contained in furtherance of the policies declared in Minnesota Statutes Chapters 105 and 462 and Minnesota Regulations Parts 6120.2500-6120.3900.

2. Abrogation and Greater Restrictions. It shall not be intended by this Section to repeal, abrogate or impair any existing easements, covenants or deed restrictions. However, where this Section imposes greater restrictions, the provisions of this Section shall prevail.

3. Jurisdiction. This Section shall apply to all lands located within the boundaries of the shoreland.

1330.02 Shoreland Management Districts and Uses.

Subd. 1 Classification of Lakes. In order to guide the wise development and utilization of shorelands of protected waters for the preservation of water quality, natural characteristics, economic values and general health, safety and welfare, certain protected waters in the City have been given a shoreland management classification. These protected waters of the City have been classified below consistent with the criteria found in Minnesota Regulations, Part 6120.3300, and the Protected Waters Inventory Map for Ramsey County, Minnesota.

	DNR I.D. No.
General Development Lakes:	
Josephine	62-57

Johanna	62-78
Karth	62-72
Recreational Development Lakes:	
Little Johanna	62-58
Round Lake	62-70
Natural Environmental Lakes:	
Sunfish	62-65
Valentine	62-71

Subd. 2 Establishment of Shoreland Management Districts; Zoning Map. The boundaries of the Shoreland Management Districts are hereby continued as shown on the map entitled "Official Zoning Map of Arden Hills, Minnesota," which map shall be properly approved and filed in the office of the City Administrator. The shoreland management districts overlay existing zoning districts of the City also shown on the official zoning map pursuant to this Code and the City of Arden Hills Zoning Code. As indicated in this Section, certain portions of the shorelands in the shoreland management districts are classified general development, recreational development, or natural environment lakes. The map and all of the notations, references and other information shown thereon shall have the same force and effect as if set forth in this Section at length.

Subd. 3 Boundaries of Shoreland Management Districts. The boundaries of the shoreland management districts shall be determined by scaling distances on the official zoning map. Where interpretation is needed as to the exact location of the boundaries of a shoreland management district shown on the official zoning map, for example where there appears to be a conflict between a mapped boundary and actual field conditions, the City Council shall make the necessary interpretation based upon topographic elevations and other available technical data. Persons contesting the location of the shoreland management district boundaries shall be given a reasonable opportunity to present their case to the City Council and to submit technical evidence.

1330.03 General Provisions.

Subd. 1 District Requirements. The following standards shall apply to all shorelands of the protected waters listed in this Section. Where the requirements of the underlying zoning district as shown on the official zoning map are more restrictive than those set forth in this Section, then the more restrictive standards shall apply:

	Natural Environmental Waters	Recreational Development Waters	General Development Waters
Lot Area (square feet): Riparian Lot	40,000	20,000	14,000
Lot Area (square feet): Non-Riparian Lot	14,000	14,000	14,000 (for District R-1) 11,000 (for Districts R-2, R-3, R-4)
Minimum Water Frontage and Width at Building Line (feet)	125	75	75
Structure Minimum Setback from Ordinary High Water Level (feet)	150*	75*	50*
Structure Minimum Setbacks from Streets and Highways (feet)	40 for Districts R-1, R-2, R-3, R-4 50 for Districts B-1, B-2, I-2 55 for District I-1		
Structure Maximum Height (feet)	35 for District R-1, R-2, R-3, R-4, B-1, B-2, I-1 45 for District I-2		

Maximum Lot Area Covered by Impervious Surface (%)	35 for District R-1, R-2, R-3, R-4 65 for District I-1 75 for District B-1, B-2, I-2

*See Section 1330.03, Subd. 4 for Exceptions to the Structure Setback Requirement

Subd. 2 Roads and Parking Areas. Roads and parking areas shall be located to retard the runoff of surface waters and nutrients in accordance with the following criteria:

A. All roads and parking areas shall meet the setback requirements established for structures of this Section.

B. Natural vegetation or other natural materials shall be used to screen parking areas when viewed from the water.

Subd. 3 Elevation of Lowest Floor.

A. Structures shall be placed at an elevation consistent with the City's flood plain management controls as set forth in Section 1335 of this Code.

B. In areas not regulated by flood plain management controls, the elevation to which the lowest floor, including basements, shall be placed shall be determined as follows:

1. For lakes, ponds, and flowages, by (a) an elevation of available flood information and consistent with "Statewide Standards and Criteria for Management of Flood Plain Areas of Minnesota," or (b) placing the lowest floor at a level at least three (3) feet above the highest known water level. In those instances where sufficient data on known high water levels are not available, the ordinary high water level shall be used.

2. For streams, by an evaluation of available flood information and consistent with "Statewide Standards and Criteria for Management of Flood Plain Areas of Minnesota."

Subd. 4 Adjacent Lots. On any shoreland lot where the adjacent lots have existing dwellings that exceed the minimum setback from the OHW level, the shoreline setback for a new dwelling unit or an addition to an existing dwelling unit shall not be less than the average of the setbacks from the OHW level for such adjacent dwellings minus ten (10) feet subject to the following:

A. In no case shall the new structure or addition be within the minimum setback from the OWH level as stated in Section 1330.03 Subd 1.

B. In no case shall the new structure or addition be nearer to the OHW level than the nearest adjacent structure.

C. The minimum structure setback in Section 1330.03 Subd. 1 shall be used for the adjacent lot when calculating the setback if an adjacent lot is:

1. Vacant;

2. Has a use other than single or two-family residential; or,

3. Has a dwelling unit that encroaches on the minimum structure setback.

Subd. 5 Exceptions to Structure Setback Requirements. No structure shall be placed within the structure setback requirements of the shoreland management district. The following are not classified as structures for the purposes of this section:

A. Docks and Boatlifts. Setback requirements from the ordinary high water level shall not apply to docks and boatlifts. Location of docks and boatlifts shall be controlled by applicable State and local regulations.

B. Stairways, access lifts, and landings. Setback requirements from the ordinary high water level shall not apply to stairways, access lifts, or landings. Stairways and access lifts are the preferred alternative to major topographic alterations for achieving access up and down bluffs and steep slopes to shore areas. Stairways, access lifts and landings located within the Shore Impact Zone shall meet the following design standards:

1. Landings for stairways and lifts shall not exceed 40 square feet in area.

2. Canopies or roofs are not allowed on stairways, access lifts, docks, or landings.

C. Uncovered patios. At grade uncovered patios that have an underside surface that is entirely in contact with and wholly supported by the ground may be placed within the structure setback requirements from the ordinary high water level but shall not be placed within the Shore Impact Zone. Uncovered patios shall not be considered landscaped area when calculating lot coverage.

D. Fences. Chain link, or other types of fences with a transparency of at least 75 percent, may be placed within the structure setback requirements from the ordinary high water level but shall not be placed within the Shore Impact Zone.

E. Lakeshore lots may be permitted one (1) accessory storage shed within the required structure setback from the ordinary high water level, provided that it:

1. Is not located within the Shore Impact Zone.

2. Does not exceed 64 square feet in size and eight (8) feet in height, measured to the highest point of the structure.

3. Is not designed or used for human habitation and does not contain a water supply or sewage treatment facilities.

Subd. 6 Maintenance of shoreland. The shoreland shall be protected from adverse conditions affecting the public. Keeping the shoreland in a natural state and the use of native vegetation is encouraged.

A. Up to ten (10) percent of the shoreline of a property may be utilized for docks, but no property shall be limited to less than four feet of the shoreline for the utilization of a dock, subject to DNR regulations.

B. Docks shall be setback a minimum of five (5) feet from side property lines at the point of attachment to the shoreline. This requirement may be adjusted by the Zoning Administrator in cases where topography or lot width significantly limits the placement of docks.

C. Watercraft and other water equipment shall be stored in accordance with Section 1325.12, Recreational Vehicle, Utility Trailer, Riding Lawn Mower, and Watercraft Outdoor Storage, and be kept in a neat and orderly manner.

D. Boatlifts, docks, watercraft, accessory structures, and any other equipment that is in a state of disrepair, inoperable, or otherwise unusable shall not be stored outdoors.

E. Grading or otherwise removing natural cover from the Shore Impact Zone or cutting or filling which changes the natural shoreline shall be prohibited without proper permits.

F. The accumulation of debris, the creation or maintenance of safety hazards, and similar activities shall be prohibited.

Subd. 7 Shoreland Alterations.

A. Removal of Vegetation. The removal of vegetation shall be restricted to prevent erosion into protected waters, to consume nutrients in the soil, and to preserve shoreland aesthetics. Removal of vegetation in the shoreland management districts shall be subject to the following provisions:

1. In Shore Impact Zones and on steep slopes, limited clearing of trees and shrubs for access to the shoreline, and cutting, pruning, and trimming of trees is allowed provided that a minimum of seventy-five (75) percent of the Shore Impact Zone be left in its natural state.

2. The minimal amount of vegetation shall be altered and sufficient vegetative cover shall remain to screen cars, dwellings and other structures when viewed from public waters.

3. Except for the removal of invasive species, clear cutting of vegetation shall be prohibited.

4. Native vegetation shall be restored insofar as feasible after any construction project is completed to retard surface runoff and soil erosion.

5. All disturbed areas are restored to prevent soil erosion.

6. The above provisions are not applicable to the removal of trees, limbs, or branches that are dead, diseased, or pose safety hazards.

B. Grading and Filling. All land disturbance activity in the Shoreland Management District shall be subject to the provisions of Chapter 15 of the City Code, Erosion and Sediment Control.

C. Shoreline Alterations. Any work which shall change or diminish the course, current or cross section of a protected water or wetland, or shall alter the shoreline below the ordinary high water level, shall be subject to approval by the Commissioner of Natural Resources, and the approval shall be construed to mean the issuance by the Commissioner of Natural Resources of a permit under the procedures of Minnesota Statutes.

D. Permeable Surface Credit. At the discretion of the Zoning Administrator, up to five percent of a lot's required landscaped area, but not exceeding 700 square feet, may be covered with pervious hard surfaces subject to the approval of a Shoreland Mitigation Plan.

E. Shoreland Mitigation. A shoreland mitigation plan must be submitted for residential development that requires land use approval including, but not limited to, variances; conditional use permits; subdivisions; rezonings; or a permeable surface credit. The plan shall be designed to mitigate the adverse effects land development has on water quality and the lake environment. The mitigation plan shall be signed by the property owner, approved by the Zoning Administrator, and a Mitigation Affidavit recorded with the Register of Deeds prior to the commencement of development activity. Furthermore, mitigation plans shall be completed within one year of the plan's approval unless otherwise approved by the City. An escrow fee that shall be held for a minimum of two years shall also be submitted. The mitigation plan shall include at a minimum two of the following practices:

1. Vegetation Restoration. Vegetation restoration areas may be established which at a minimum shall include land within the shore and the bluff impact zones or steep slopes. Land area shall be restored from lawn, beach or other disturbances using native or natural landscaping.

a) Steep Slope/Bluff Restoration. Steep slopes and bluffs that are vegetated with turf may be restored with deciduous and ornamental trees, evergreens and shrubs that are native to the area.

b) Shoreline Buffer Restoration. A buffer zone of at least 25 feet from and parallel to the ordinary high water mark shall be planted or restored and maintained with vegetation native to the area to fullest practicable extent possible with effective erosion and sediment control. Existing natural beaches or beaches which have been permitted by the DNR shall be allowed to continue and be maintained. A minimum of 30 percent of the lot's shoreline area shall be restored. This restoration area shall be contiguous unless otherwise approved as part of the mitigation plan.

2. Architectural Mass. The use of natural color(s) and/or materials on the exterior of the structure shall be used to reduce the visual impact. Natural colors are shades of brown, gray, and green. Natural materials include wood or stone that complement the setting of the structure.

3. Removal of Nonconforming Structures. The mitigation plan may include the removal of structures that do not comply with the required structure setbacks from the ordinary high water line or are located within a shore impact zone or bluff impact zone.

4. Reduction of Impervious Surface Coverage. The mitigation plan may include a minimum five percent reduction of the existing impervious surface coverage. The preferable location of this reduction is within that portion of the lot that drains to the lake.

5. Other Practices. At the discretion of the Zoning Administrator, other restoration or protection activities may be approved as part of a mitigation plan provided they meet the objectives of this ordinance. Examples include the removal of artificial sand beaches, stormwater management and replacement of seawalls with bioengineering structures.

Subd. 8 Subdivisions. No land shall be subdivided which shall be held unsuitable by the City for the proposed use because of flooding, inadequate drainage, soil and rock formations with severe limitations for development, severe erosion potential, unfavorable topography, inadequate water supply or sewer access, or any other feature likely to be harmful to the health, safety, or welfare of future residents of the proposed subdivision or of the community.

Subd. 9 Planned Unit Developments. Planned Unit Developments may be permitted in accordance with this Code and the City of Arden Hills Zoning Code, provided that preliminary plans are approved by the Commissioner of Natural Resources prior to their approval by the City, and further provided that:

A. Open space is preserved through the use of restrictive deed covenants, public dedications, or other methods.

B. The following factors shall be carefully evaluated to ensure the increased density of development shall be consistent with the resource limitations of the protected water:

1. Suitability of the site for the proposed use;
2. Physical and aesthetic impact of increased density;
3. Level of current development;
4. Amount and ownership of undeveloped shoreland;
5. Levels and types of water surface use and public accesses;
6. Possible effects on overall public use.

1330.04 Notification of the Commissioner of Natural Resources.

Subd. 1 Variances. A copy of any request for a variance to the provisions of this Section or plats which propose any lots which require variances to the lot area and dimensional requirements of this Section or the notice of a public hearing to consider a conditional use permit or planned unit development permit shall be sent to the Commissioner of Natural Resources such that notice shall be received by the commissioner at least ten (10) days prior to the hearing or action on the request.

Subd. 2 Amendments. A copy of all amendments to this Section and final decisions granting variances or conditional uses within the shoreland management districts shall be sent to the Commissioner of Natural Resources within ten (10) days of the amendment or final action.

Subd. 3 Plats. Copies of all plats within the shoreland management districts shall be submitted to the Commissioner of Natural Resources within ten (10) days of final approval by the City.

Print

Arden Hills, MN Code of Ordinances

Section 1335 - Flood Plains

1335.01 Statutory Authorization.

The legislature of the State of Minnesota has, in Minnesota Statutes Chapter 103F and Chapter 462 delegated the responsibility to local government units to adopt regulations designed to minimize flood losses. Therefore, the City Council of the City of Arden Hills, Minnesota does ordain as follows:

1335.02 Findings of Fact.

Subd. 1 Hazards Exist. The flood hazard areas of the City are subject to periodic inundation which results in potential loss of life, loss of property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures or flood protection and relief, and impairment of the tax base, all of which adversely affect the public health, safety, and general welfare.

Subd. 2 Method Used to Analyze Flood Hazards. There regulations of this Section are based upon a reasonable method of analyzing flood hazards which is consistent with the standards established by the Minnesota Department of Natural Resources.

Subd. 3 National Flood Insurance Program Compliance. This Ordinance is adopted to comply with the rules and regulations of the National Flood Insurance Program codified as 44 Code of Federal Regulations Parts 59 -78, as amended, so as to maintain the community's eligibility in the National Flood Insurance Program.

1335.03 Statement of Purpose.

It shall be the purpose of this Section to promote the public health, safety, and general welfare and minimize those losses described in Section 1335.02 Subd 1.

1335.04 Zoning Code.

The City of Arden Hill's Zoning Code is adopted by reference and made a part of this Section as if set out in full.

1335.05 Regulatory Flood Protection Elevation.

The Regulatory Flood Protection Elevation shall be an elevation no lower than one foot above the elevation of the regional flood plus any increases in flood elevation caused by encroachments on the flood plain that result from designation of a floodway.

1335.06 Lands to Which Regulations Apply.

These regulations of this Section shall apply to all lands within the City as shown on the Official Zoning Map and/or the attachments thereto as being located within the boundaries of the Floodway, Flood Fringe, or General Flood Plain Districts.

1335.07 Establishment of Official Zoning Map.

The Official Zoning Map together with all materials attached thereto shall be adopted by reference and declared to be a part of this Section as if set out here in full. The attached material shall include the Flood Insurance Study for Ramsey County, Minnesota (All Jurisdictions) and Flood Insurance Rate Map panels therein numbered 27123C0004G, 27123C0005G, 27123C0010G, 27123C0012G, 27123C0016G and 27123C0020G, all dated June 4, 2010, and prepared by the Federal Emergency Management Agency. The Official Zoning Map shall be on file in the Office of the City Administrator.

1335.08 Interpretation.

Subd. 1 Minimum Standards. In their interpretation and application, these regulations of this Section shall be held to be minimum requirements and shall be liberally construed in favor of the City and shall not be deemed a limitation or repeal of any other powers granted by State Statutes.

Subd. 2 Boundaries. The boundaries of the zoning districts shall be determined by scaling distances on the Official Zoning Map. Where interpretation is needed as to the exact location of the boundaries of the district as shown on the Official Zoning Map, as for example where there appears to be a conflict between a mapped boundary and actual field conditions and there is a formal appeal of the decision of the Zoning Administrator, the Board of Adjustment shall make the necessary interpretation. All decisions shall be based on elevations on the regional (100-year) flood profile, the ground elevations that existed on the site at the time the City adopted its initial floodplain ordinance or on the date of the first National Flood Insurance Program map showing the 100-year floodplain if earlier, and other available technical data. Any person contesting the location of the district boundaries shall be given a reasonable opportunity to present his or her case to the Board and to submit technical evidence.

1335.09 Abrogation and Greater Restrictions.

It is not intended by this Ordinance to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this Ordinance imposes greater restrictions, the provisions of this Ordinance shall prevail. All other ordinances inconsistent with this Ordinance are hereby repealed to the extent of the inconsistency only.

1335.10 Warning and Disclaimer of Liability.

This Ordinance does not imply that areas outside the flood plain districts or land uses permitted within such districts will be free from flooding or flood damages. This Ordinance shall not create liability on the part of the City of Arden Hills or any officer or employee thereof for any flood damages that result from reliance on this Ordinance or any administrative decision lawfully made there under.

1335.11 Severability.

If any section, clause, provision, or portion of this Ordinance is adjudged unconstitutional or invalid by a court of competent jurisdiction, the remainder of this Ordinance shall not be affected thereby.

1335.12 Annexations.

The Flood Insurance Rate Map panels adopted by reference into Section 1335.07 above may include floodplain areas that lie outside of the corporate boundaries of the City of Arden Hills at the time of adoption of this Ordinance. If any of these floodplain land areas are annexed into the City of Arden Hills after the date of adoption of this Ordinance, the newly annexed floodplain lands shall be subject to the provisions of this Ordinance immediately upon the date of annexation into the City of Arden Hills.

1335.13 Establishment of Zoning Districts.

Subd. 1 Floodway District. The floodway District shall include those areas designated as floodway on the Flood Insurance Rate Map adopted in this Section. For lakes, wetlands and other basins, the Floodway District shall include those areas designated as Zone AE (that do not have a floodway designated) and Zone A on the Flood Insurance Rate Map panels adopted in this Section that are below the ordinary high water level as defined in Minnesota Statutes, Section 103G.005, subdivision 14.

Subd. 2 Flood Fringe District. The Flood Fringe District shall include those areas designated as floodway fringe, which shall include the areas shown on the Flood Insurance Rate Map, adopted in this Section, as being within Zone AE but being located outside of the floodway. For lakes, wetlands and other basins, the Flood Fringe District shall include those areas designated as Zone AE (that do not have a floodway designated) and Zone A on the Flood Insurance Rate Map panels adopted in this Section that are below the 1% annual chance flood elevation (100-year flood elevation) but above the ordinary high water level as defined in Minnesota Statutes, Section 103G.005, subdivision 14.

Subd. 3 General Flood Plain District. The General Flood Plain District shall include those areas designated as Zone A and Zone AE (without a floodway designation) on the Flood Insurance Rate Map adopted in this Section, which are not subject to the criteria in Subd 1 and Subd 2 above.

1335.14 Compliance with District Regulations.

No new structure or land shall be used and no structure shall be constructed, located, extended, converted, or structurally altered without full compliance with the terms of this Section and other applicable regulation. Within the Floodway, Flood Fringe and General Flood Plain Districts, all uses not listed as permitted uses or Conditional Uses shall be prohibited. In addition, a caution shall be provided here that:

Subd. 1 New manufactured homes, replacement manufactured homes and certain travel trailers and travel vehicles shall be subject to the general provisions of this Zoning Code.

Subd. 2 Modifications, additions, structural alterations, normal maintenance and repair, or repair after damage to existing nonconforming structures and nonconforming uses of structures or land are regulated by the general provisions of this Section; and

Subd. 3 As-built elevations for elevated or flood proofed structures shall be certified by ground surveys and flood proofing techniques shall be designed and certified by a registered professional engineer or architect as specified in the general provisions of this Section.

1335.15 Floodway District.

Subd. 1 Permitted Uses.

A. General farming, pasture, grazing, outdoor plant nurseries, horticulture, truck farming, forestry, sod farming, and wild crop harvesting.

B. Industrial-commercial loading areas, parking areas, and airport landing strips.

C. Private and public golf courses, tennis courts, driving ranges, archery ranges, picnic grounds, boat launching ramps, swimming areas, parks, wildlife and nature preserves, game farms, fish hatcheries, shooting preserves, target ranges, trap and skeet ranges, hunting and fishing areas, and single or multiple purpose recreational trails.

D. Residential lawns, gardens, parking areas, and play areas.

Subd. 2 Standards for Floodway Permitted Uses.

A. The use shall have low flood damage potential.

B. The use shall be permissible in the underlying zoning district if one exists.

C. The use shall not obstruct flood flows or increase flood elevations and shall not involve structures, fill, obstructions, excavations or storage of material or equipment.

Subd. 3 Conditional Uses. Structures accessory to the uses listed as permitted uses, and the specific uses listed below:

A. Structures accessory to the uses listed in Section 1335.16.

B. Extraction and storage of sand, gravel, and other materials.

C. Marinas, boat rentals, docks, piers, wharfs, and water control structures.

D. Railroads, streets, bridges, utility transmission lines, and pipelines.

E. Storage yards for equipment, machinery or materials.

F. Placement of fill or construction fences.

G. Recreational vehicles either on individual lots of record or in existing or new subdivisions or condominium type campgrounds, subject to the exemptions and provisions of this Section.

H. Structural works for flood control such as levees, dikes and floodwalls constructed to any height where the intent shall be to protect individual structures and levees or dikes where the intent shall be to protect agricultural crops for a frequency flood event equal to or less than the 10-year frequency flood event.

Subd. 4 Standards for Floodway Conditional Uses.

A. No structure (temporary or permanent), fill (including fill for roads and levees), deposit, obstruction, storage of materials or equipment, or other uses may be allowed as a conditional use that will cause any increase in the stage of the one hundred (100) year or regional flood or cause an increase in flood damages in the reach or reaches affected

B. All floodway conditional uses shall be subject to the procedures and standards contained in this Section.

C. The conditional use shall be permissible in the underlying zoning district if one exists.

D. Fill.

1. Fill, dredge spoil and all other similar materials deposited or stored in the flood plain shall be protected from erosion by vegetative cover, mulching, riprap or other acceptable method.

2. Dredge spoil sites and sand and gravel operations shall not be allowed in the floodway unless a long term site development plan is submitted which includes an erosion/sedimentation prevention element to the plan.

3. As an alternative, and consistent with Paragraph 2 above, dredge spoil disposal and sand and gravel operations may allow temporary, onsite storage of fill or other materials which would have caused an increase to the stages of the one hundred (100) year or regional flood

but only after the City has received an appropriate plan which assures the removal of the materials from the floodway based upon the flood warning time available. The Conditional Use Permit shall be title registered with the property in the Office of the County Recorder.

E. Accessory Structures.

1. Accessory structures shall not be designed for human habitation.

2. Accessory structures, if permitted, shall be constructed and placed on the building site so as to offer the minimum obstruction to the flow of flood waters.

a) Whenever possible, structures shall be constructed with the longitudinal axis parallel to the direction of flood flow; and

b) So far as practicable, structures shall be placed approximately on the same flood flow lines as those of adjoining structures.

3. Accessory structures shall be elevated or fill or structurally dry flood proofed in accordance with the FP-1 or FP-2 flood proofing classifications in the State Building Code. As an alternative, an accessory structure may be flood proofed to the FP-3 or FP-4 flood proofing classification in the State Building Code provided the accessory structure constitutes a minimal investment, does not exceed five hundred (500) square feet in size at its largest projections, and for a detached garage, the detached garage shall be used solely for parking of vehicles and limited storage. All flood proofed accessory structures shall meet the following additional standards:

a) The structure shall be adequately anchored to prevent flotation, collapse or lateral movement of the structure and shall be designed to equalize hydrostatic flood forces on exterior walls; and

b) Any mechanical and utility equipment in a structure shall be elevated to or above the Regulatory Flood Protection Elevation or properly flood proofed.

c) To allow for the equalization of hydrostatic pressure, there must be a minimum of two "automatic" openings in the outside walls of the structure having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding. There must be openings on at least two sides of the structure and the bottom of all openings must be no higher than one foot above the lowest adjacent grade to the structure. Using human intervention to open a garage door prior to flooding will not satisfy this requirement for automatic openings.

F. Storage of Materials and Equipment.

1. The storage or processing of materials that are, in time of flooding, flammable, explosive, or potentially injurious to human, animal, or plant life shall be prohibited.

2. Storage of other materials or equipment may be allowed if readily removable from the area within the time available after a flood warning and in accordance with a plan approved by the City Council.

G. Structural works for flood control that will change the course, current or cross section of protected wetlands or public waters shall be subject to the provisions of Minnesota Statute, Section 103G. Community-wide structural works for flood control intended to remove areas from the regulatory flood plain shall not be allowed in the floodway.

H. A levee, dike or floodwall constructed in the floodway shall not cause an increase to the 100-year or regional flood and the technical analysis shall assume equal conveyance or storage loss on both sides of a stream.

1335.16 Flood Fringe District.

Subd. 1 Permitted Uses. Permitted uses shall be those uses of land or structures listed as Permitted Uses in the underlying zoning use district(s). If no preexisting, underlying zoning use districts exist, then any residential or non-residential structure or use of a structure or land shall be a Permitted Use in the Flood Fringe District provided such use does not constitute a public nuisance. All Permitted Uses shall comply with the standards for Flood Fringe "Permitted Uses" listed in this Section and the "Standards for all Flood Fringe Uses" listed in this Subsection.

Subd. 2 Standards for Flood Fringe Permitted Uses.

A. All structures, including accessory structures, shall be elevated on fill so that the lowest floor including any basement floor is at or above the Regulatory Flood Protection Elevation. The finished fill elevation for structures shall be no lower than one (1) foot below the Regulatory Flood Protection Elevation and the fill shall extend at an elevation of at least fifteen (15) feet beyond the outside limits of the structure erected thereon.

B. As an alternative to elevation on fill, accessory structures that constitute a minimal investment and that do not exceed five hundred (500) square feet at its largest projection for the outside dimension at ground level may be internally flood proofed in accordance with this Section.

C. The cumulative placement of fill where at any one time in excess of one thousand (1,000) cubic yards of fill is located on the parcel shall be allowable only as a conditional use, unless the fill is specifically intended to elevate a structure in accordance with this Section.

D. The storage of any materials or equipment shall be elevated on fill to the Regulatory Flood Protection Elevation.

Subd. 3 Conditional Uses. Any structure that is not elevated on fill or flood proofed in accordance with this Section or any use of land that does not comply with the standards in this Subsection shall only be allowable as a conditional use. An application for a conditional use shall be subject to the standards and criteria and evaluation procedures specified in this Section.

Subd. 4 Standards for Flood Fringe Conditional Use

A. Alternative elevation methods other than the use of fill may be utilized to elevate a structure's lowest floor above the Regulatory Flood Protection Elevation. These alternative methods may include the use of stilts, pilings, parallel walls, etc., or above-grade, enclosed areas such as crawl spaces or tuck under garages. The base or floor of an enclosed area shall be considered above-grade and not a structure's basement or lowest floor if:

1. The enclosed area is above-grade on at least one side of the structure;

2. It is designed to internally flood and is constructed with flood resistant materials; and

3. It is used solely for parking of vehicles, building access or storage.

B. The above-noted alternative elevation methods shall be subject to the following additional standards:

1. Design and Certification. The structure's design and as-built condition shall be certified by a registered professional engineer or architect as being in compliance with the general design standards of the State Building Code and, specifically, that all electrical, heating, ventilation, plumbing and air conditioning equipment and other service facilities shall be at or above the Regulatory Flood Protection Elevation or be designed to prevent flood water from entering or accumulating within these components during times of flooding.

2. Specific Standards for Above-Grade, Enclosed Areas. Above grade, fully enclosed areas such as crawl spaces or tuck under garages shall be designed to internally flood and the design plans shall stipulate:

a) The minimum area of openings in the walls where internal flooding is to be used as a flood proofing technique. There shall be a minimum of two openings on at least two sides of the structure and the bottom of all openings shall be no higher than one-foot above grade. The automatic openings shall have a minimum net area of not less than one square inch for every square foot of enclosed area subject to flooding unless a registered professional engineer or architect certifies that a smaller net area would suffice. The automatic openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of flood waters without any form of human intervention; and

b) That the enclosed area shall be designed of flood resistant materials in accordance with the FP-3 or FP-4 classifications in the State Building Code and shall be used solely for building access, parking of vehicles or storage.

C. Basements, as defined by this Section, shall be subject to the following:

1. Residential basement construction shall not be allowed below the Regulatory Flood Protection Elevation.

2. Non-residential basements may be allowed below the Regulatory Flood Protection Elevation provided the basement is structurally dry flood proofed in accordance with this Section.

D. All areas of non-residential structures including basements to be placed below the Regulatory Flood Protection Elevation shall be flood proofed in accordance with the structurally dry flood proofing classifications in the State Building Code. Structurally dry flood proofing shall meet the FP-1 or FP-2 flood proofing classification in the State Building Code and this shall require making the structure watertight with the walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy. Structures flood proofed to the FP-3 and FP-4 classification shall not be permitted.

E. When at any one time more than one thousand (1,000) cubic yards of fill or other similar material is located on a parcel for such activities as on-site storage, landscaping, sand and gravel operations, landfills, roads, dredge spoil disposal or construction of flood control works, an erosion/sedimentation control plan shall be submitted unless the community is enforcing a State-approved shoreland management ordinance. In the absence of a State-approved shoreland ordinance, the plan shall clearly specify methods to be used to stabilize the fill on site for a flood event at a minimum of the 100-year or regional flood event. The plan shall be prepared and certified by a registered professional engineer or other qualified individual acceptable to the City. The plan may incorporate alternative procedures for removal of the material from the flood plain if adequate flood warning time exists.

F. Storage of Materials and Equipment.

1. The storage or processing of materials that are, in time of flooding, flammable, explosive, or potentially injurious to human, animal, or plant life shall be prohibited.

2. Storage of other materials may be allowed if readily removable from the area within the time available after a flood warning and in accordance with a plan approved by the City Council.

Subd. 5 Standards for All Flood Fringe Uses.

A. All new principal structures shall have vehicular access at or above an elevation not more than two (2) feet below the Regulatory Flood Protection Elevation. If a variance to this requirement is granted, the Board of Adjustment shall specify limitations on the period of use or occupancy of the structure for times of flooding and only after determining that adequate flood warning time and local flood emergency response procedures exist.

B. Commercial Uses. Accessory land uses, such as yards, railroad tracks, and parking lots may be at elevations lower than the Regulatory Flood Protection Elevation. However, a permit for such facilities to be used by the employees or the general public shall not be granted in the absence of a flood warning system that provides adequate time for evacuation if the area would be inundated to a depth and velocity such that when multiplying the depth (in feet) times velocity (in feet per second) the product number exceeds four (4) upon occurrence of the regional flood.

C. Manufacturing and Industrial Uses. Measures shall be taken to minimize interference with normal plans operations especially along streams having protracted flood durations. Certain accessory land uses such as yards and parking lots may be at lower elevations subject to requirements set out in Paragraph B above. In considering permit applications, due consideration shall be given to needs of an industry whose business requires that it be located in flood plain areas.

D. Fill shall be properly compacted and the slopes shall be properly protected by the use of riprap, vegetative cover or other acceptable method. The Federal Emergency Management Agency (FEMA) has established criteria for removing the special flood hazard areas designation for certain structures properly elevated on fill above the 100-year flood elevation - FEMA's requirements incorporate specific fill compaction and side slope protection standards for multi-structure or multi-lot developments. FEMA's standards should be investigated prior to the initiation of site preparation if a change of special flood hazard area designation will be requested.

E. Flood plain developments shall not adversely affect the hydraulic capacity of the channel and adjoining flood plain of any tributary watercourse or drainage system where a floodway or other encroachment limit has not been specified on the Official Zoning Map.

F. Standards for recreational vehicles are contained in Section 1325.12.

G. All manufactured homes shall be securely anchored to an adequately anchored foundation system that resists flotation, collapse and lateral movement. Methods of anchoring may include, but are not to be limited to, use of over-the-top or frame times to ground anchor. This requirement shall be in addition to applicable state of local anchoring requirements for resisting wind forces.

1335.17 General Flood Plain District.

Subd. 1 Permitted Uses.

A. The uses listed as permitted uses for Floodway Districts, shall be permitted uses in a General Flood Plain District.

B. All other uses shall be subject to the 1% annual chance flood (100-Year Flood Elevations) and/or Floodway and Flood Fringe determinations criteria pursuant to Subd 2 below. Section 1335.25 shall apply if the proposed use is in the Floodway District, and Section 1335.26 shall apply is the proposed use is in the Flood Fringe District.

Subd. 2 Procedures for 1% annual chance (100-Year Flood Elevations) and/or Floodway and Flood Fringe determinations for streams within the General Flood Plain District.

A. Upon receipt of an application for a Conditional Use Permit for a use within the General Flood Plain District, the applicant shall be required to furnish the following information as is deemed necessary by the City Administrator for the determination of the Regulatory Flood Protection Elevation and whether the proposed use is within the Floodway or Flood Fringe District.

1. A typical valley cross-section showing the channel of the stream, elevation of land areas adjoining each side of the channel, cross-sectional areas to be occupied by the proposed development, and high water information; and

2. Plan (surface view) showing elevations or contours of the ground; pertinent structure, fill, or storage elevations; size, location, and spatial arrangement of all proposed and existing structures on the site, and location and elevations of streets.

3. Photographs showing existing land uses and vegetation upstream and downstream; and soil types; and

4. Profile showing the slope of the bottom of the channel or flow line of the stream for at least five hundred (500) feet in either direction from the proposed development.

B. The applicant shall be responsible to submit one (1) copy of the above information to a designated engineer or other expert person or agency for technical assistance in determining whether the proposed use is in the Floodway or Flood Fringe District and to determine the Regulatory Flood Protection Elevation. Procedures consistent with Minnesota Regulations 1983, Parts 6120.5000-6120.6200 and 44 Code of Federal Regulations Part 65 shall be followed in this expert evaluation. The designated engineer or expert is strongly encouraged to discuss the proposed technical evaluation methodology with the respective Department of Natural Resources' Area Hydrologist prior to commencing the analyst. The designated engineer or expert shall:

1. Estimate the peak discharge of the regional flood.

2. Calculate the water surface profile of the regional flood based upon a hydraulic analysis of the stream channel and overbank areas.

3. Compute the floodway necessary to convey or store the regional flood without increasing flood stages more than 0.5 foot. A lesser stage increase than 0.5 foot shall be required if, as a result of the additional State increase, increased flood damages would result. An equal degree of encroachment on both sides of the stream within the reach shall be assumed in computing floodway boundaries.

C. The City Administrator shall present the technical evaluation and findings of the designated engineer or expert to the City Council. The City Council shall formally accept the technical evaluation and the recommended Floodway and/or Flood Fringe District boundary or deny the permit application. The City Council, prior to official action, may submit the application and all supporting data and analyses to the Federal Emergency Management Agency, the Department of Natural Resources or the Planning Commission for review and comment. Once the Floodway and Flood Fringe Boundaries have been determined, the City Council shall refer the matter back to the City Administrator who shall process the permit application consistent with the applicable provisions of this Section.

1335.18 Zone A Lakes.

Procedures for determining 1% annual chance flood elevations (100-YR flood elevations) for lakes located in Zone A:

Subd. 1 Upon receipt of an application for a permit or other approval within a Zone A, the Zoning Administrator will use the 1% annual chance flood elevation for that basin that has previously been determined in accordance with approved FEMA methods, if available. If the 1% annual chance flood elevation has not been previously determined, the applicant shall be required to furnish all necessary information as deemed necessary by the Zoning Administrator for the determination for the 1% annual chance flood elevation in accordance with approved FEMA methods.

Subd. 2 The applicant shall be responsible to submit one copy of the above information to a designated engineer or other expert person or agency for technical assistance in determining whether the proposed use is in the Floodway or Flood Fringe District and to determine the 1% annual chance flood elevation (100-year flood elevation). Procedures consistent with Minnesota Regulations 1983, Parts 6120.5000 - 6120.6200 and 44 Code of Federal Regulations Part 65 shall be followed in this expert evaluation. The designated engineer or expert is strongly encouraged to discuss the proposed technical evaluation

methodology with the respective Department of Natural Resources' Area Hydrologist prior to commencing the analysis.

Subd. 3 Once the 1% annual chance flood elevation (100-year flood elevation) has been determined, the Zoning Administrator shall process the permit application consistent with the applicable provisions of this Section.

1335.18 Subdivisions.

Subd. 1 Review Criteria. No land shall be subdivided which is unsuitable for the reason of flooding, inadequate drainage, water supply or sewage treatment facilities. All lots within the flood plain districts shall be able to contain a building site outside of the Floodway District at or above the Regulatory Flood Protection Elevation. All subdivisions shall have water and sewage treatment facilities that comply with the provisions of this Section and have road access both to the subdivision and to the individual building sites no lower than two (2) feet below the Regulatory Flood Protection Elevation. For all subdivisions in the flood plain, the Floodway and Flood Fringe boundaries, the Regulatory Flood Protection Elevation and the required elevation of all access roads shall be clearly labeled on all required subdivisions drawings and platting documents.

Subd. 2 Floodway/Flood Fringe Determinations in the General Flood Plain District. In the General Flood Plain District applicants shall provide the information required to determine the one hundred (100) year flood elevation, the Floodway and Flood Fringe District boundaries and the Regulatory Flood Protection Elevation for the subdivision site.

Subd. 3 Removal of Special Flood Hazard Area Designation. The Federal Emergency Management Agency (FEMA) has established criteria for removing the special flood hazard area designation for certain structures properly elevated on fill above the one hundred (100) year flood elevation. FEMA's requirements incorporate specific fill compaction and side slope protection standards for multi-structure or multi-lot developments. These FEMA standards should be investigated prior to the initiation of site preparation if a change of special flood hazard area designation will be requested.

1335.19 Public Utilities, Railroads, Roads, and Bridges.

Subd. 1 All public utilities and facilities such as gas, electrical, sewer, and water supply systems to be located in the flood plain shall be flood proofed in accordance with the State Building Code or elevated to above the Regulatory Flood Protection Elevation.

Subd. 2 Public Transportation Facilities. Railroad tracks, roads, and bridges to be located within the flood plain shall comply with this code. Elevation to the Regulatory Flood Protection Elevation shall be provided where failure or interruption of the transportation facilities would result in danger to the public health or safety of where such facilities are essential to the orderly functioning of the area. Minor or auxiliary roads or railroads may be constructed at a lower elevation where failure or interruption of transportation services would not endanger the public health or safety.

Subd. 3 On-Site Sewage Treatment and Water Supply Systems. Where public utilities are not provided:

A. On-site water supply systems shall be designated to minimize or eliminate infiltration of flood waters in the systems; and

B. New or replacement on-site sewage treatment systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters and they shall not be subject to impairment of contamination during times of flooding. Any sewage treatment system designed in accordance with the State's current statewide standards for on-site sewage treatment systems shall be determined to be in compliance with this Section.

1335.21 Manufactured Homes.

The placement of new or replacement manufactured homes in existing manufactured home parks or on individual lots of record that are located in flood plain districts will be treated as a new structure and may be placed only if elevated in compliance with Section 5.0 of this Ordinance. If vehicular road access for pre-existing manufactured home parks is not provided in accordance with Section 5.51, then replacement manufactured homes will not be allowed until the property owner(s) develops a flood warning emergency plan acceptable to the Governing Body.

Subd. 1 New manufactured home parks and expansions to existing manufactured home parks shall be subject to the provisions placed on subdivisions by this code.

Subd. 2 All manufactured homes must be securely anchored to an adequately anchored foundation system that resists flotation, collapse and lateral movement. Methods of anchoring may include, but are not to be limited to, use of over-the-top or frame ties to ground anchors. This requirement is in addition to applicable state or local anchoring requirements for resisting wind forces.

1335.22 Recreational Vehicles.

Subd. 1 Exemption. Recreational vehicles are exempt from the provisions of this Ordinance if they are placed in any of the areas listed in Section 9.32 below and further they meet the following criteria:

A. Have current licenses required for highway use.

B. Are highway ready meaning on wheels or the internal jacking system, are attached to the site only by quick disconnect type utilities commonly used in campgrounds and recreational vehicle parks and the recreational vehicle has no permanent structural type additions attached to it.

C. The recreational vehicle and associated use must be permissible in any pre-existing, underlying zoning use district.

Subd. 2 Areas Exempted For Placement of Recreational Vehicles:

A. Individual lots or parcels of record.

B. Existing commercial recreational vehicle parks or campgrounds.

C. Existing condominium type associations.

Subd. 3 Recreational vehicles exempted in this Section lose this exemption when development occurs on the parcel exceeding $500 for a structural addition to the recreational vehicle or exceeding $500 for an accessory structure such as a garage or storage building. The recreational vehicle and all additions and accessory structures will then be treated as a new structure and shall be subject to the elevation/flood proofing requirements and the use of land restrictions specified in Sections 1335.4.0 and 5.0 of this Ordinance. There shall be no development or improvement on the parcel or attachment to the recreational vehicle that hinders the removal of the recreational vehicle to a flood free location should flooding occur.

Subd. 4 New commercial recreational vehicle parks or campgrounds and new residential type subdivisions and condominium associations and the expansion of any existing similar use exceeding five (5) units or dwelling sites shall be subject to the following:

A. Any new or replacement recreational vehicle will be allowed in the Floodway or Flood Fringe Districts provided said recreational vehicle and its contents are placed on fill above the regulatory flood protection elevation and proper elevated road access to the site exists in accordance with Section 5.51 of this Ordinance. No fill placed in the floodway to meet the requirements of this Section shall increase flood stages of the 100-year or regional flood.

B. All new or replacement recreational vehicles not meeting the criteria of (a) above may, as an alternative, be allowed as a conditional use if in accordance with the following provisions and the provisions of 10.4 of the Ordinance. The applicant must submit an emergency plan for the safe evacuation of all vehicles and people during the 100 year flood. Said plan shall be prepared by a registered engineer or other qualified individual, shall demonstrate that adequate time and personnel exist to carry out the evacuation, and shall demonstrate the provisions of Section 9.31 (a) and (b) of this Ordinance will be met. All attendant sewage and water facilities for new or replacement recreational vehicles must be protected or constructed so as to not be impaired or contaminated during times of flooding in accordance with Section 8.3 of this Ordinance.

1335.23 Administration.

The City Administrator or other official designated by the City Council shall administer and enforce this Section. If the City Administrator finds a violation of the provisions of this Section the City Administrator shall notify the person responsible for the violation in accordance with the procedures.

Subd. 1 Permit Required. A Permit issued by the City Administrator in conformity with the provisions of this Section shall be secured prior to the erection, addition, modification, rehabilitation (including normal maintenance and repair), or alteration of any building, structure, or portion thereof; prior to the construction of a dam, fence, or on-site septic system; prior to the change or extension of a nonconforming use; prior to the repair of a structure that has been damaged by flood, fire, tornado, or any other source; and prior to the placement of fill, excavation of materials, or the storage of materials or equipment within the flood plain.

Subd. 2 Application for Permit. Application for a Permit shall be made in duplicate to the City Administrator on forms furnished by the City Administrator and shall include the following where applicable: plans in duplicate drawn to scale, showing the nature, location, dimensions, and elevations of the lot; existing or proposed structures, fill, or storage of materials; and the location of the foregoing in relation to the stream channel.

Subd. 3 State and Federal Permits. Prior to granting a Permit or processing an application for a Conditional Use Permit or Variance, the City Administrator shall determine that the applicant has obtained all necessary State and Federal Permits.

Subd. 4 Certificate of Zoning Compliance for a New, Altered, or Nonconforming Use. It shall be unlawful to use, occupy, or permit the use or occupancy of any building or premises or part thereof hereafter created, erected, changed, converted, altered, or enlarged in its use or structure until a certificate of zoning compliance shall have been issued by the Zoning Administrator stating that the use of the building or land conforms to the requirements of this Ordinance.

Subd. 5 Construction and use to be as provided on applications, plans, permits, variances and certificates of zoning compliance. Permits, conditional use permits, or certificates of zoning compliance issued on the basis of approved plans and applications authorize only the use, arrangement, and construction set forth in such approved plans and applications, and no other use, arrangement, or construction. Any use, arrangement, or construction at variance with that authorized shall be deemed a violation of this Ordinance, and punishable as provided by this Section of this Ordinance.

Subd. 6 Certification. The applicant shall be required to submit certification by a registered professional engineer, registered architect, or registered land surveyor that the finished fill and building elevations were accomplished in compliance with the provisions of this Section. Flood proofing measures shall be certified by a registered professional engineer or registered architect.

Subd. 7 Record of First Floor Elevation. The Zoning Administrator shall maintain a record of the elevation of the lowest floor (including basement) of all new structures and alterations or additions to

existing structures in the flood plain. The Zoning Administrator shall also maintain a record of the elevation to which structures or alterations and additions to structures are flood proofed.

Subd. 8 Notifications for Watercourse Alterations. The Zoning Administrator shall notify, in riverine situations, adjacent communities and the Commissioner of the Department of Natural Resources prior to the community authorizing any alteration or relocation of a watercourse. If the applicant has applied for a permit to work in the beds of public waters pursuant to Minnesota Statute, Chapter 103G, this shall suffice as adequate notice to the Commissioner of Natural Resources. A copy of said notification shall also be submitted to the Chicago Regional Office of the Federal Emergency Management Agency (FEMA).

Subd. 9 Notification to FEMA When Physical Changes Increase or Decrease the 100-year Flood Elevation. As soon as is practicable, but not later than six (6) months after the date such supporting information becomes available, the Zoning Administrator shall notify the Chicago Regional Office of FEMA of the changes by submitting a copy of said technical or scientific data.

1335.24 Board of Adjustment.

Subd. 1 Rules. The Board of Adjustment shall adopt rules for the conduct of business and may exercise all of the powers conferred on such Boards by State law.

Subd. 2 Administrative Review. The Board of Adjustment shall hear and decide appeals where it is alleged there is error in any order, requirement, decision, or determination made by an administrative official in the enforcement or administration of this Ordinance.

Subd. 3 Variances. The City may authorize in specific cases such relief or variance from the terms of this section and code in accordance with Section 1355. No variance shall have the effect of allowing in any district uses that are prohibited in that district, permit a lower degree of flood protection than the Regulatory Flood Protection Elevation for the particular area, or permit standards lower than those required by State law. The following additional variance criteria of the Federal Emergency Management Agency must be satisfied:

A. Variances shall not be issued by a community within any designated regulatory floodway if any increase in flood levels during the base flood discharge would result.

B. Variances shall only be issued by a community upon (i) a showing of good and sufficient cause, (ii) a determination that failure to grant the variance would result in exceptional hardship to the applicant, and (iii) a determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances.

C. Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

Subd. 4 Conditional Uses. The City Council shall hear and decide applications for conditional uses permissible under this Section. Applications shall be submitted to the City Administrator who shall forward the application to the City Council for consideration.

Subd. 5 Hearings. Upon filing with the Board of Adjustment of an appeal from a decision of the City Administrator, or an application for a variance or conditional use permit, the Board shall fix a reasonable time for a hearing and give due notice to the parties in interest as specified by law. The Board shall submit by mail to the Commissioner of Natural Resources a copy of the application for proposed variances sufficiently in advance so that the Commissioner shall receive at least ten (10) days notice of the hearing.

Subd. 6 Decisions. The Board shall arrive at a decision on the appeal, variance, or conditional use permit in accordance with Section 1355. In granting a variance or conditional use permit the City may prescribe appropriate conditions and safeguards, which shall be in conformity with the purposes of this

Section. Violations of such conditions and safeguards, when made a part of the terms under which the variance or conditional use permit is granted, shall be punishable as described in Section 1335.36. A copy of all decisions granting variances or conditional use permits shall be forwarded by mail to the Commission of Natural Resources within ten (10) days of the action.

Subd. 7 Appeals. Appeals from any decision of the Board may be made, as specified in the City's Official Controls and also Minnesota Statutes.

Subd. 8 Flood Insurance Notice. The City Administrator shall notify the applicant for a variance that:

A. The issuance of a variance to construct a structure below the base flood level will result in increased premium rates for flood insurance up to amounts as high as $25.00 for $100.00 of insurance coverage; and

B. Such construction below the 100-year or regional flood level increases risks to life and property. The notification shall be maintained with a record of all variance actions. A community shall maintain a record of all variance actions, including justification for their issuance, and report such variances issued in its annual or biennial report submitted to the Administrator of the National Flood Insurance Program.

Subd. 9 Procedures to be Followed by the City Council in Passing on Conditional Use Permit Applications within all Flood Plain Districts:

A. The applicant shall furnish the following information and additional information as deemed necessary by the City Council for determining the suitability of the particular site for the proposed used:

1. Plans in triplicate drawn to scale showing the nature, location, dimensions, and elevation of the lot, existing or proposed structures, fill, storage of materials, flood proofing measures, and the relationship of the above to the location of the stream channel.

2. Specifications for building construction and materials, flood proofing, filling, dredging, grading, channel improvement, storage of materials, water supply and sanitary facilities.

B. Transmit one copy of the information described above to a designated engineer or other expert person or agency for technical assistance, where necessary, in evaluating the proposed project in relation to flood heights and velocities, the seriousness of flood damage to the use, the adequacy of the plans for protection, and other technical matters.

C. Based upon the technical evaluation of the designated engineer or expert, the City Council shall determine the specific flood hazard at the site and evaluate the suitability of the proposed use in relation to the flood hazard.

Subd. 10 Factors upon Which the Decision of the City Council shall be based. In passing upon conditional use applications, the City Council shall consider all relevant factors specified in this Section, and:

A. The danger to life and property due to increased flood heights or velocities caused by encroachments.

B. The danger that materials may be swept onto other lands or downstream to the injury of others or they may block bridges, culverts or other hydraulic structures.

C. The proposed water supply and sanitation systems and the ability of these systems to prevent disease, contamination, and unsanitary conditions.

D. The susceptibility of the proposed facilities and its contents to flood damage and the effect of the damage on the individual owner.

E. The importance of the services provided by the proposed facility to the community.

F. The requirements of the facility for a waterfront location.

G. The availability of alternative locations not subject to flooding for the proposed use.

H. The compatibility of the proposed use with existing development and development anticipated in the foreseeable future.

I. The relationship of the proposed use to the comprehensive plan and flood plain management program for the area.

J. The safety of access to the property in times of flood for ordinary and emergency vehicles.

K. The expected heights, velocity, duration, rate of rise, and sediment transport of the flood waters expected at the site.

L. Any other factors which shall be relevant to the purposes of this Section.

Subd. 11 Time for Acting on Application. The City Council shall act on an application in the manner described above in accordance with Section 1355.

Subd. 12 Conditions Attached to Conditional Use Permits. Upon consideration of the factors listed above and the purpose of this Section, the City Council shall attach such conditions to the granting of Conditional Use Permits as it deems necessary to fulfill the purposes of this Section. The conditions may include, but shall not be limited to, the following:

A. Modifications of waste treatment and water supply facilities.

B. Limitations on period of use, occupancy, and operation.

C. Imposition of operational controls, sureties, and deed restrictions.

D. Requirements for construction of channel modifications, compensatory storage, dikes, levees, and other protective measures.

E. Flood proofing measures, in accordance with the State Building Code and this Section. The applicant shall submit a plan or document certified by a registered professional engineer or architect that the flood proofing measures are consistent with the Regulatory Flood Protection Elevation and associated flood factors for the particular area.

1335.35 Non-Conforming Uses.

A structure or the use of a structure or premises which was lawful before the passage or amendment of this Code but which shall not be in conformity with the provisions of this Section shall be subject to the following. Historic structures, as defined in Section 1305.04, Subd. 182, shall be subject to the provisions of Subds. 1 thru 5 of this Section

Subd. 1 No such use shall be expanded, changed, enlarged, or altered in a way that increases its nonconformity.

Subd. 2 Any structural alteration or addition to a nonconforming structure or nonconforming use which would result in increasing the flood damage potential of that structure or use shall be protected to the Regulatory Flood Protection Elevation in accordance with any of the elevation on fill or flood proofing techniques (i.e., FP-1 thru FP-4 floodproofing classifications) allowable in the State Building Code, except as further restricted in Subd 3 and Subd 5 below.

Subd. 3 The cost of all structural alterations or additions to any nonconforming structure over the life of the structure shall not exceed 50 percent of the market value of the structure unless the conditions of this Section are satisfied. The cost of all structural alterations and additions must include all costs such as construction materials and a reasonable cost placed on all manpower or labor. If the cost of all previous and proposed alterations and additions exceeds 50 percent of the market value of the structure, then the

structure must meet the standards of Sections 1335.25 and 1335.26 of this Ordinance for new structures depending upon whether the structure is in the Floodway or Flood Fringe District, respectively.

Subd. 4 If any nonconforming use is discontinued for l2 consecutive months, any future use of the building premises shall conform to this Ordinance. The Assessor shall notify the Zoning Administrator in writing of instances of nonconforming uses that have been discontinued for a period of l2 months.

Subd. 5 If any nonconforming use or structure is substantially damaged, as defined in this Ordinance, it shall not be reconstructed except in conformity with the provisions of this Ordinance. The applicable provisions for establishing new uses or new structures in Sections 1335.25, 1335.26, and 1335.27 will apply depending upon whether the use or structure is in the Floodway, Flood Fringe or General Flood Plain District, respectively.

Subd. 6 If a substantial improvement occurs, as defined in this Ordinance, from any combination of a building addition to the outside dimensions of the existing building or a rehabilitation, reconstruction, alteration, or other improvement to the inside dimensions of an existing nonconforming building, then the building addition and the existing nonconforming building must meet the requirements of Sections 1335.25 and 1335.26 of this Ordinance for new structures, depending upon whether the structure is in the Floodway or Flood Fringe District, respectively.

1335.36 Enforcement and Penalties for Violation.

Subd. 1 Misdemeanor. Violation of the provisions of this Ordinance or failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with grants of variances or conditional uses) shall constitute a misdemeanor and shall be punishable as defined by state law.

Subd. 2 Other Remedies. Nothing contained shall prevent the City from taking any other lawful action as is necessary to prevent or remedy any violation. Such actions may include but shall not be limited to:

A. In responding to a suspected Code violation, the City Administrator and City Council may utilize the full array of enforcement actions available to it, including but not limited to, prosecution and fines, injunctions, after-the-fact permits, orders for corrective measures or a request to the National Flood Insurance Program for denial of flood insurance availability to the guilty party. The City shall act in good faith to enforce these official controls and to correct Code violations to the extent possible so as not to jeopardize its eligibility in the National Flood Insurance Program.

B. When a Code violation is either discovered by or brought to the attention of the City Administrator, the City Administrator shall immediately investigate the violation of the official control. As soon as is reasonably possible, this information shall be submitted to the appropriate Department of Natural Resources' and Federal Emergency Management Agency Regional Office along with the City's plan of action to correct the violation to the degree possible.

C. The City Administrator shall notify the suspected party of the requirements of this Section and all other Official Controls and the nature and extent of the suspected violation of these controls. If the structure and/or use is under construction or development, the City Administrator may order the construction or development immediately halted until a proper permit or approval is granted by the City. If the construction or development is already completed, then the City Administrator may either:

1. Issue an order identifying the corrective actions that shall be made within a specified time period to bring the use of structure into compliance with the official controls, or

2. Notify the responsible party to apply for an after-the-fact permit/development approval within a specified period of time not to exceed thirty (30) days.

D. If the responsible party does not appropriately respond to the City Administrator within the specified period of time, each additional day that lapses shall constitute an additional violation of this Section and shall be prosecuted accordingly. The City Administrator shall also upon the lapse of the specified response period notify the land owner to restore the land to the condition which existed prior to the violation of this Section.

1335.37 Amendments.

Subd. 1 Designation Removal. The flood plain designation of the Official Zoning Map shall not be removed from flood plain areas unless it can be shown that the designation is in error or that the area has been filled to or above the elevation of the regulatory flood protection elevation and is contiguous to lands outside the flood plain. Special exceptions to this rule may be permitted by the Commissioner of Natural Resources if he or she determines that, through other measures, lands are adequately protected for the intended use.

Subd. 2 Agency Approval. All amendments to this Section, including amendments to the Official Zoning Map, shall be submitted to and approved by the Commissioner of Natural Resources prior to adoption. Changes in the Official Zoning Map shall meet the Federal Emergency Management Agency's (FEMA) Technical Conditions and Criteria and shall receive prior FEMA approval before adoption. The Commissioner of Natural Resources shall be given ten (10) days written notice of all hearings to consider an amendment to this Section and the notice shall include a draft of the Section amendment or technical study under consideration.

Print

Arden Hills, MN Code of Ordinances

Chapter 15 - Erosion and Sediment Control

Section 1500 - Purpose and Scope

1500.01 Purpose.

The purpose of this regulation is to control or eliminate soil erosion and sedimentation within the City of Arden Hills. The regulation establishes standards and specifications for conservation practices and planning activities which minimize soil erosion and sedimentation and work to protect the City's natural resources for the health, safety, and welfare of the public.

1500.02 Scope.

Except as exempted by the definition of the term "land disturbance activity" in Section 1510.01, any person, firm, sole proprietorship, partnership, corporation, state agency, or political subdivision thereof proposing land disturbance activity within the City shall apply to the Public Works Director or appointed designee (herein called "PWD") for the approval of the Erosion and Sediment Control Plan. No land shall be disturbed until the Plan is approved by the PWD and conforms to the standards set forth in this article.

Section 1510 - Definitions

1510.01 Definitions.

For the purposes of this ordinance, the following terms have the meanings given them in this section:

· Best Management Practices (BMP). Schedules of activities, prohibitions of practices, general good housekeeping practices, pollution prevention and educational practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants directly or indirectly to stormwater, receiving waters, or stormwater conveyance systems. BMPs also include treatment practices, operating procedures, and practices to control site runoff, spillage or leaks, sludge or water disposal, or drainage from raw materials storage.

· Non-structural BMP: Practices that focus on preserving open space, protecting natural systems, and incorporating existing landscape features such as wetlands and stream corridors to manage storm water at its source. Other practices include clustering and concentrating development, minimizing disturbed areas, and reducing the size of impervious areas.

· Structural BMP: a physical device that is typically designed and constructed to trap or filter pollutants from runoff, or reduce runoff velocities.

· Bluff. A topographic feature such as a hill, cliff, or embankment having the following characteristics (an area with an average slope of less than 18 percent over a distance for 50 feet or more shall not be

considered part of the bluff):

- Part or all of the topographic feature is located in a shoreland area;
- The slope rises at least twenty five (25) feet above the ordinary high water level of the waterbody;
- The grade of the slope from the toe, or bottom, of the bluff to a point twenty five (25) feet or more above the ordinary high water level averages thirty percent (30%) or greater; and
- The slope must drain toward the waterbody.

- Certificate of Completion. The certificate issued after the final inspection of the site has been completed, temporary erosion control has been removed and the site has been fully restored.
- Clearing and grubbing. The cutting and removal of trees, shrubs, bushes, windfalls and other vegetation including removal of stumps, roots, and other remains in the designated areas.
- Erosion. Any process that wears away the surface of the land by the action of water, wind, ice, gravity and/or land disturbance activities. Erosion can be accelerated by the activities of man and nature.
- Erosion and Sediment Control Plan (Plan) is a plan which includes a set of best management practices or equivalent measures designed to control surface runoff and erosion and to retain sediment on a particular site during the period in which pre-construction and construction related land disturbances, fills, and soil storage occur, and before final improvements are completed, all in accordance with the specific requirements set forth in Section 1520. This Plan shall also include permanent measures and Best Management Practices to control post-construction surface runoff and sediment.
- Erosion and sediment control practice specifications and erosion and sediment control practices. The management procedures, techniques, and methods to control soil erosion and sedimentation as officially adopted by the City.
- Excavation. The mechanical removal of earth material.
- Fill. The deposit of soil or other earth materials placed by artificial means.
- General Storm Water Permit. The Minnesota Pollution Control Agency's (MPCA) general National Pollutant Discharge Elimination System (NPDES) construction storm water permit covering anyone conducting a land disturbing activity which disturbs one (1) or more acres of total land area.
- Grading. Excavation or fill of material, including the resulting conditions thereof.
- Land Disturbance Activity. Any land change greater than 5,000 square feet or 50 cubic yards, or land change on a parcel of land located within a shoreland area or adjacent to a surface water that may result in soil erosion from wind, water and/or ice and the movement of sediments into or upon waters or lands of the city, including but not limited to construction, clearing and grubbing, grading, excavating, transporting and filling of land. Land Disturbance Activity does not mean the following:
  - Minor land disturbance activities such as home gardens and an individual's home landscaping, repairs and maintenance work;
  - Additions or modifications to existing single-family dwellings or accessory structures that will result in creating under 2,500 square feet of exposed soil and/or impervious surface and less than 50 cubic yards in a shoreland area;
  - Construction, installation and maintenance of electric, telephone, and cable television utility lines or individual service connection to these utilities, except where a minimum of 5,000 square feet of land disturbance can be anticipated;
  - Tilling, planting or harvesting of agricultural, horticultural, or silvicultural crops;

· Installation of fence, sign, telephone, and electric poles and other kinds of posts, bollards or poles; and

· Emergency work to protect life, limb, or property and emergency repairs. However, if the land disturbing activity would have required an approved Erosion and Sediment Control Plan except for the emergency, then the land area disturbed shall be shaped and stabilized in accordance with the requirement of the PWD when applicable.

· Outfall. The point source where a storm sewer system discharges from a pipe, ditch, or other discrete conveyance to receiving waters, or to a storm sewer system owned and operated by another party.

· Permittee. A person, firm, sole proprietorship, partnership, corporation, state agency or political subdivision thereof engaged in a land disturbance activity who submits an application to the PWD for a permit pursuant to this ordinance.

· Phasing. Clearing a parcel of land in distinct phases, with the stabilization of each phase before the clearing of the next.

· Ramsey Conservation District. The Ramsey Soil and Water Conservation District.

· Rice Creek Watershed District. An organization which oversees the activities in the Rice Creek watershed as defined by Minnesota Statutes, Sections 103B,and 103D.

· Runoff. Rainfall, snowmelt, or irrigation water flowing over the ground surface.

· Sediment. Solid mineral or organic material that, in suspension, is being transported, or has been moved from its original site by air, water, gravity, or ice, and has been deposited at another location.

· Sedimentation. The process or action of depositing sediment, caused by erosion.

· Site. The entire area of land on which the land disturbance activity is proposed in the permit application.

· Site Plan. A plan or set of plans showing the details of any land disturbance activity of a site including but not limited to the construction of: structures, open and enclosed drainage facilities, stormwater management facilities, parking lots, driveways, curbs, pavements, sidewalks, bike paths, recreational facilities, ground covers, plantings, and landscaping.

· Shoreland. The land located within the following distances from protected waters:

· One thousand (1,000) feet from the ordinary high water mark of a lake, pond, or flowage;

· Three hundred (300) feet from a river or stream, or the landward extent of a flood plain on such rivers or streams, whichever is greater; and,

· The practical limits of shorelands may be less than the statutory limits where the limits are designated by natural drainage divides at lesser distances, as shown on the official map of the City.

· Stabilization. The use of measures which protect soil from the erosion forces of wind, rain and flowing water.

· Steep Slope. Land where agricultural activity or development is either not recommended or described as poorly suited due to slope steepness and the site's soil characteristics, as mapped and described in available county soil surveys or other technical reports, unless appropriate design and construction techniques and farming practices are used in accordance with the provisions of this chapter. Where specific information is not available, steep slopes are lands having average slopes over twelve percent (12%), as measured over horizontal distances of fifty (50) feet or more, that are not bluffs.

· Surface Water or Waters. All streams, lakes, ponds, marshes, wetlands, reservoirs, springs, rivers, drainage systems, waterways, watercourses, and irrigation systems whether natural or artificial, public or

private.

· Utility. The owner/operator of any underground facility including an underground line, facility, system, and its appurtenances used to produce, store, convey, transmit, or distribute communications, data, electricity, power, heat, gas, oil, petroleum products, water (including stormwater), steam, sewage and other similar substances.

· Watercourse. Any natural or improved stream, river, creek, ditch, channel, canal, conduit, gutter, culvert, drain, gully, swale, or wash in which waters flow either continuously or intermittently.

· Watershed. A region draining to a specific river, river system, or body of water.

· Wetlands. A lowland area such as a marsh, that is saturated with moisture, as defined in Sec. 404, Federal Water Pollution Control Act Amendments of 1987, or the Minnesota Wetland Conservation Act of 1991.

Section 1520 - Erosion and Sediment Control Plans and Review

1520.01 Erosion and Sediment Control Plan.

Subd. 1 Required. An Erosion and Sediment Control Plan must be submitted to the PWD for every project involving a land disturbance activity. No building permit, site plan approval, subdivision approval, or permit to allow land disturbing activities shall be issued and no earth disturbing activity shall commence until approval of the Erosion and Sediment Control Plan.

Projects coordinated by Ramsey County or Mn/DOT do not require a permit; however, the PWD shall be notified of the project and be provided a copy of the Erosion and Sediment Control Plan, as well as an estimated schedule for commencement and completion. The PWD shall notify the designated contact if erosion control measures should fail or require maintenance with the expectation that the deficiencies will be corrected.

If no permit has been obtained, a stop work order may be issued on the construction and a fine may be issued in an amount equal to twice the required permit fee. A completed Erosion and Sediment Control Plan and permit application shall be submitted before construction will be allowed to resume.

Obtaining a permit does not exempt the Permittee from obtaining permits required by other governmental agencies.

Subd. 2 Application Fee. The Permittee shall submit an application fee as specified on the City's Fee Schedule as adopted and revised annually by the City Council by ordinance. The fee is non-refundable and shall cover any review costs accrued within one (1) year of the date of payment.

Subd. 3 Criteria. The Erosion and Sediment Control Plan shall minimize soil erosion or sediment from damaging adjacent land. A Permittee engaged in a Land Disturbance Activity shall submit an Erosion and Sediment Control Plan that will minimize soil erosion or sediment from damaging adjacent land, bodies of water, watercourses or wetlands to the PWD for approval.

The Erosion and Sediment Control Plan shall address the following criteria:

A. Conform to the natural limitations presented by topography and soil so as to create the least potential for soil erosion.

B. Stabilize all exposed soils and soil stockpiles;

C. Establish permanent vegetation;

D. Prevent sediment damage to adjacent properties and other designated areas;

E. Schedule of erosion and sediment control practices;

F. Use of temporary sedimentation basins;

G. Stabilization of steep slopes and bluffs;

H. Control the storm water leaving a site;

I. Stabilize all waterways and outlets;

J. Protect storm sewers and outfalls from the entrance of sediment, debris and trash;

K. Control waste, such as discarded building materials, concrete truck washout, chemicals, litter and sanitary waste that may adversely impact water quality;

L. When working in or crossing water bodies, take precautions to contain sediment;

M. Re-stabilize utility construction areas as soon as possible;

N. Protect paved roads from sediment and mud brought in from access routes;

O. Dispose of temporary erosion and sediment control measures;

P. Maintain all temporary and permanent erosion and sediment control practices; and,

Q. Removal of sediment from streets at the end of each day

Subd. 4 Plan Content. The Erosion and Sediment Control Plan content shall include the following unless waived by the PWD:

A. Contact information for the Permittee;

B. Address of site where the land disturbing activity is proposed;

C. Signature(s) of the owner(s) of the site or an authorized representative;

D. Project description including the nature and purpose of the land disturbing activity and the amount of grading involved;

E. Phasing of construction and timeline;

F. Existing and proposed site conditions, including topography, vegetation, and drainage;

G. Adjacent areas, neighboring streams, lakes, wetlands, residential areas, roads, etc., which might be affected by the land disturbing activity;

H. Soil data including soil names, mapping units, erodibility;

I. Critical erosion areas, which are areas on the site that have potential for serious erosion problems;

J. Erosion and sediment control measures to be used on the site, both during and after the construction process;

K. Temporary and Permanent stabilization to show how the site will be stabilized during and after construction (is completed), including specifications;

L. Storm water management to show how storm runoff will be managed, including methods to be used if the development will result in increased peak rates or volume of runoff;

M. Maintenance and schedule of regular inspections and repair of erosion and sediment control structures; and,

N. Any calculations that were made for the design of such items as sediment basins, diversions, waterways, and other applicable practices.

O. A land disturbance activity equal to or greater than one (1) acre is required to comply with the conditions of the NPDES/SDS Construction Stormwater General Permit, Part IV – Construction Activity Requirements.

1520.02 Review of Permit Application

Subd. 1 General. The PWD shall review the Erosion and Sediment Control Plan to ensure compliance with the erosion and sediment control practice specifications and erosion and sediment control practices.

Subd. 2 Permit Approval. If the PWD determines that the Erosion and Sediment Control Plan meets the requirements of this ordinance, the PWD shall issue a permit, valid for a specified period of time that authorizes the land disturbance activity contingent on the implementation and completion of the Erosion and Sediment Control Plan.

Subd. 3 Permit Denial. If the PWD determines that the Erosion and Sediment Control Plan does not meet the requirements of this article, the PWD shall not issue a permit for the land disturbance activity. The Erosion and Sediment Control Plan must be resubmitted for approval before the land disturbance activity begins. No land use and building permits shall be issued until the Permittee has an approved Erosion and Sediment Control Plan.

1520.03 Escrow Requirement.

After approval of an Erosion and Sediment Control Plan, the PWD may require the Permittee to escrow a sum of money sufficient to ensure the installation, completion, maintenance, inspection, and enforcement of the Erosion and Sediment Control Plan and practices. Escrow amounts shall be set by Ordinance in the City fee schedule. Upon project completion, the remaining escrow shall be returned to the Permittee.

1520.04 Modification of Plan.

An approved Erosion and Sediment Control Plan may be modified upon submission of an application for modification to the PWD and subsequent approval by the PWD. In reviewing such application, the PWD may require additional reports and data.

Section 1530 - Implementation and Maintenance

1530.01 Implementation and Maintenance of Plan.

All storm water pollution controls noted on the approved Erosion and Sediment Control Plan shall be installed before commencing the land disturbing activity and shall not be removed without PWD approval or approval of a Certificate of Completion. Noncompliance with the Erosion and Sediment Control Plan shall constitute grounds for an order from the PWD to halt all construction.

1530.02 Implementation.

The plan implementation shall incorporate the following:

Subd. 1 Existing vegetation shall be retained whenever feasible.

Subd. 2 Land shall be disturbed in increments of workable size such that adequate erosion and sediment control can be provided and maintained as construction progresses. The area exposed shall be stabilized in conformance with best management practices and with the maintenance requirements in the NPDES General Construction Permit. Soil stabilization measures should be selected to be appropriate for the time of year, site conditions, and estimated duration of use.

Subd. 3 The location of areas not to be disturbed shall be identified with flags, stakes, signs, silt fence, etc. before construction begins.

Subd. 4 Down-gradient sediment controls shall be in place before up-gradient land disturbing activity begins.

Subd. 5 All storm drains, inlets and outfalls shall be protected until all sources of potential discharge are stabilized.

Subd. 6 Temporary stockpiles shall have effective sediment control and cannot be placed in surface waters or storm water conveyance systems.

Subd. 7 Vehicle tracking from the site shall be minimized with the use of stone pads, concrete or steel wash racks, or equivalent systems.

Subd. 8 Street sweeping shall be used if BMPs are not adequate to prevent sediment from being tracked into the street.

1530.03 Responsibility.

The Permittee shall be responsible for proper operation and maintenance of all stormwater pollution controls and soil stabilization measures in conformance with best management practices and with the maintenance requirements in the NPDES General Construction Permit. The Permittee is responsible for the operation and maintenance of temporary erosion at the site. The Permittee is responsible until another Permittee has assumed control over all areas of the site that have not been finally stabilized or the site has undergone final stabilization, and has received an approved Certificate of Completion. The Permittee is responsible for maintenance, clean-up and all damages caused by flooding of the site or surrounding area due to in-place erosion or sediment control.

Section 1540 - Enforcement

1540.01 Erosion and Sediment Control Permit Enforcement.

If the PWD determines that erosion and sedimentation control is not being implemented or maintained according to the approved Plan, the Permittee will be notified and provided with a list of corrective work to be performed. Notification may be given by personal delivery upon the Permittee, or an officer, partner, manager or designated representative of the Permittee, or by e-mail or facsimile by sending such notice to the e-mail address or facsimile number provided by the Permittee. Upon the receipt of a Non-Compliance Notice from the PWD, the Permittee shall undertake a corrective action.

Subd. 1 Types of Corrective Actions.

A. Violations Contained on the Construction Site. Permittee shall complete clean-up and restoration within forty-eight (48) hours of receipt of the Non-Compliance Notice.

B. Violation Impacting Adjoining Property. Permittee shall develop and complete a clean-up and restoration plan within forty-eight (48) hours of receipt of a Non-Compliance Notice unless the affected adjoining property owner refuses Permittee access to the adjoining property. In all cases, clean-up and restoration shall be completed within seven (7) days of receipt of the Non-Compliance Notice, unless an extension is granted by the PWD.

C. Violations Impacting Streets, Wetlands, or Water Bodies. Permittee shall develop and implement a clean-up and restoration plan immediately upon receipt of a Non-Compliance Notice.

Subd. 2 Failure to Comply. If Permittee fails to implement the Plan or complete any required corrective action in a timely manner, the City may pursue one or more of the remedies specified herein. All costs incurred by the City shall be paid by Permittee. Escrow funds may be used by the City for this purpose and, if such funds do not adequately cover the City's cost, the Permittee shall reimburse the City for any deficiency before continuing work on the construction site. The City may:

A. Withhold the scheduling of inspections and/or the issuance of a Certificate of Occupancy.

B. Issue a stop work order, ceasing all land disturbance activity on the site until such time as corrective measures are completed to the satisfaction of the PWD.

C. Revoke any permit issued by the City to the Permittee for the Site.

D. Direct the correction of the deficiency by City forces or by a separate contract.

E. Obtain a Compliance Order from the appropriate court.

APPENDIX C
Regulatory Responsibilities and Developer Guidelines

APPENDIX C: REGULATORY RESPONSIBILITIES AND DEVELOPER GUIDELINES

The City of Arden Hills developed a Local Stormwater Management Plan to analyze and minimize the impact of existing and future development on the City's natural resources. It is important to the City to have consistent analysis and data collection. Therefore, all hydrologic, hydraulic, and water quality analysis should be prepared in a common format. Data shall be submitted in a consistent format consistent with Rice Creek Watershed District guidelines that will allow for a timely review by City staff.

KEY POINTS

When preparing your engineering calculations, please remember these key points:

- A pre-design meeting with the City and the appropriate Water Management Organization is encouraged before ANY data will be accepted. The purpose of the meeting is to specifically address approvals and permits, pond requirements, trunk storm drain analysis, wetland impacts, water quality treatment, erosion control and discharge to lakes and sensitive wetland resources.
- Rate control is not required IF downstream systems (ponds and storm drains) can be shown to adequately detain/retain the runoff.
- Regional sedimentation ponds may be used for some developments.

ADMINISTRATIVE RESPONSIBILITIES

Several entities will have administrative responsibilities within the planning area. For a local water management effort to be successful, each entity's commitment and role must be clearly understood. Those currently having some level of administration responsibility include the City, Rice Creek Watershed District, Ramsey County, MnDNR, MPCA, the U.S. Army Corps of Engineers, and BWSR.

City of Arden Hills

The City of Arden Hills is responsible for issuing building permits for all land alteration thereby enforcing the policies and standards of this plan. The City is responsible for inspecting the construction sites within its boundaries which may impact water quantity and quality. The City is also responsible for the maintenance and repair of ditches within their own boundaries.

The City's administrative responsibilities include, but are not limited to the following:

- Comprehensive plan update(s);
- Land use regulation;
- Ordinance review and amendment;
- Local plat review and amendments;
- Building permits;
- Sediment and erosion control (subdivision ordinance);
- Groundwater - wells;
- Participation and cooperation with the programs of the WMOs, DNR and Ramsey County;
- Hydrologic model update with comprehensive plan changes;
- Financing Alternatives;
- Capital improvements; and
- Conveyance system/pond maintenance.

Watershed Management Organizations (WMOs)
Responsibilities of Rice Creek Watershed District (RCWD) include:

- Water resources regulation;
- Monitoring;
- Local plan review and approval;
- Projects of regional significance;
- Verification of local plan implementation;
- Wetland Management as LGU;
- Stormwater Permitting; and
- Inter-City concerns.

Metropolitan Council: Comprehensive Plan Amendment
Metropolitan Council has a regional review authority regarding surface water management including:

- Local Plan Review; and
- Regional controls related to nonpoint source pollution.

This plan and all subsequent amendments will become part of the City's Comprehensive Plan (adopted by reference), in accordance with Environmental Review 21040, 1995 revisions to Minnesota Statutes 103B.235, Subd. 3A and 473.859, Subd. 2 (Chapter 176, Laws of Minnesota 1995), as part of the adoption process for this plan.

Metropolitan Council review of this plan is concurrent with the watershed review. Comments are forwarded to the WMOs. According to Metropolitan Council staff, the plan does not have to be resubmitted as a formal comprehensive plan amendment, subject to additional review, at a later date. The adopted City plan will meet Metropolitan Council's requirements and will be thereby recognized as a comprehensive plan amendment.

Federal and State Agencies
Federal and state agencies will continue to have certain administrative responsibilities. These responsibilities include, but are not limited to:

- Wetland alteration:
    - Department of National Resources for all issues relating to state protected waters and wetland; and
    - U.S. Army Corps of Engineers, U.S. EPA, and U.S. Fish and Wildlife for all issues related to all wetland are not under the jurisdiction of the DNR.
- Groundwater Issues;
- Individual sewage treatment systems; and
- Hazardous waste/spill response.

LOCAL ORDINANCES
The City has most of the necessary official controls to implement this plan today. The following text includes a discussion of local controls as required by Rice Creek Watershed District and other agencies.

Shoreland Management
There is a DNR-approved shoreland ordinance in-place (Chapter 14 of the City's code).

Floodplain Management

The City of Arden Hills currently does participate in the National Flood Insurance Program. A minimum requirement for elevations of new structures is currently included in an existing City ordinance (ordinance number 331), Chapter 13 of the City's code. In areas not regulated by floodplain management control, the lowest floor elevation shall be determined by an elevation of available flood information or placing the lowest floor at a level at least three feet above the highest known water level.

Groundwater (Wellhead) Protection

The groundwater protection ordinance would establish overlay districts for wellhead protection areas and any areas of spring activity or groundwater/surface water interaction. It would also address permitted uses in the various protection zones and could be further developed to address abandonment of wells.

Wellhead Protection

Wetland protection is provided by the Minnesota Wetland Conservation Act administrated by Rice Creek Watershed District acting as Local Government Unit (LGU).

Erosion Control

Arden Hills has adopted an erosion and sediment control ordinance (City Code Chapter 15). The regulation establishes standards and specifications for conservation practices and planning activities which minimize soil erosion and sedimentation.

APPENDIX D
Karth Lake Improvement District

ARDEN HILLS

CITY OF ARDEN HILLS
COUNTY OF RAMSEY
STATE OF MINNESOTA
RESOLUTION NO. 03-60

RESOLUTION ESTABLISHING THE KARTH LAKE IMPROVEMENT DISTRICT AND ADOPTING THE BOARD BYLAWS

WHEREAS, pursuant to Minnesota Statutes 459.20 and Minnesota Statutes 103B.501-103B.581, the City of Arden Hills has the authority to establish a Lake Improvement District; and

WHEREAS, the engineering report prepared by the City's Consulting Engineer identified the need for the construction and maintenance of a lake elevation control structure for Karth Lake; and

WHEREAS, Karth Lake is located wholly within the boundaries of the City of Arden Hills; and

WHEREAS, pursuant to Minnesota Statute 103B.501 to 103B.581 and the Minnesota Department of Natural Resources rules part 6115.0900 to 6115.0980 the City of Arden Hills has prepared a document proposing the establishment and the administration of a Lake Improvement District with the purpose of constructing and maintaining a lake elevation control structure; and

WHEREAS, a public hearing for the establishment of the Karth Lake Improvement District was held on the 29th day of September, 2003.

NOW, THEREFORE, BE IT RESOLVED by the Arden Hills City Council

1. That **Attachment A**, the Order Establishing the Karth Lake Improvement District, is hereby approved and made a part hereof.

2. That **Attachment B**, the Karth Lake Improvement District Bylaws are hereby approved and made a part hereof.

3. That the boundaries for the Karth Lake Improvement District, are hereby approved and made a part hereof.

CITY OF ARDEN HILLS

By: _____
Beverly Aplikowski, Mayor

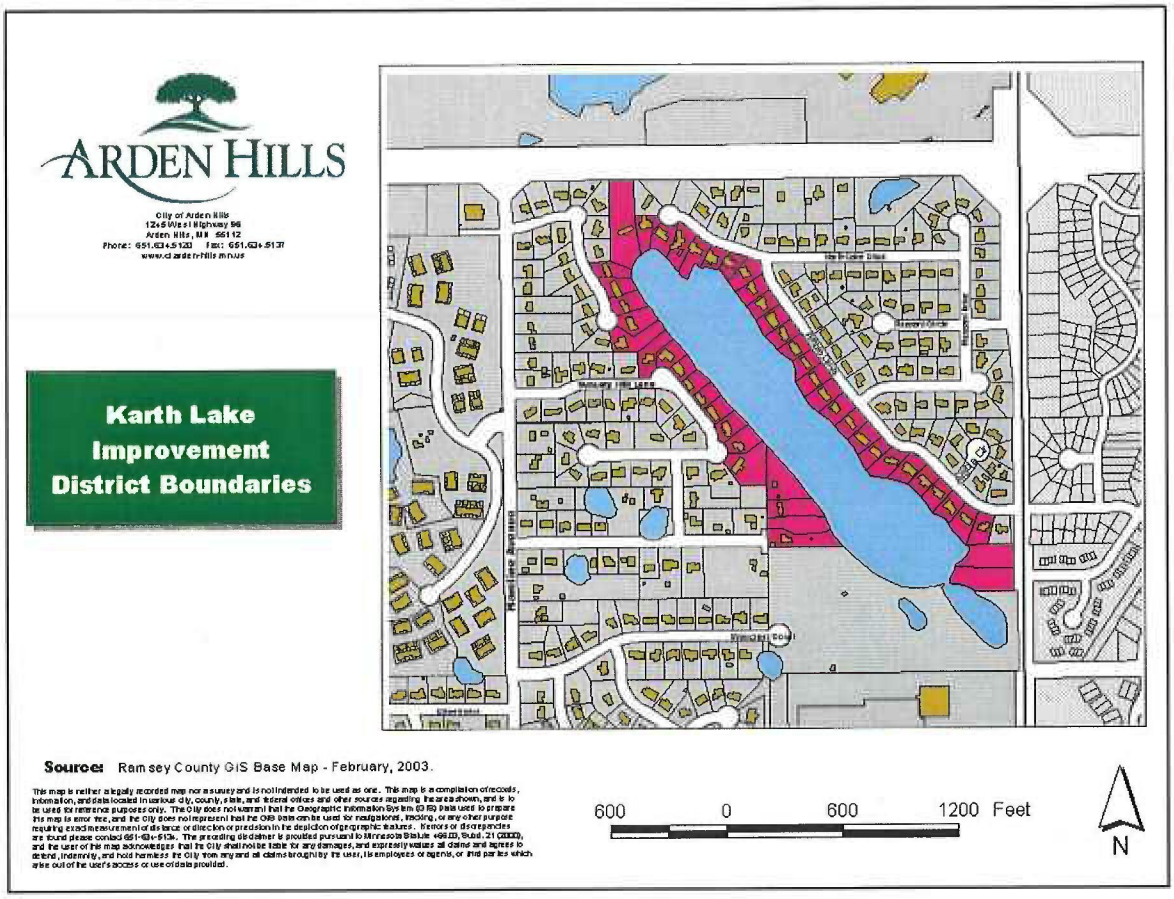
Dated the 29th day of September, 2003.

ATTEST:

_____
Michelle Wolfe, City Administrator

\\Earth\Admin\Council\Resolutions\2003\03-60, Establishing the Karth Lake Improvement District.doc

Exhibit #1: Karth Lake Improvement District Boundaries



The following tax parcels are included in the boundaries of the Karth Lake Improvement District:

223023140031	223023140020
223023140032	223023140025
223023120036	223023140004
223023120039	223023130037
223023140033	223023120032
223023120035	223023140030
223023120054	223023120034
223023140034	223023140023
223023130036	223023110007
223023110006	223023140019
223023110008	223023140024
223023140022	223023120016
223023110067	223023140021
223023120038	223023120033
223023120018	223023120040
223023120014	223023140018
223023120037	223023120030
223023110003	223023110005
223023120015	223023120058
223023120031	223023110004
223023140035	223023120043
223023140005	223023120042
	223023120017
	223023120041

Attachment A

ORDER ESTABLISHING THE KARTH LAKE IMPROVEMENT DISTRICT

1.0 **WHEREAS**, the Arden Hills City Council initiated the establishment of the Karth Lake Improvement District by adopting Resolution No. 03-55 which declared the City's intent to establish the District and which directly or by incorporation of supporting data:

A. Specified the boundaries of the proposed District which were as consistent as practical with the natural hydrologic boundaries;

B. Prescribed the water and related land resource management programs to be undertaken within the District;

C. Stated the manner in which proposed programs would be financed;

D. Designated the City officer or agency which would be responsible for supervising the programs; and

E. Set a date for a hearing on the establishment of the proposed Lake Improvement District.

2.0 **WHEREAS**, a public hearing, preceded by all notices required pursuant to Minnesota Statutes Chapter 103B.515 and Minnesota Rules 6115.0970, Subpart 3, was held on the 29th day of September, 2003 in order to receive public comment as to whether the Karth Lake Improvement District should be established; and

3.0 **WHEREAS**, based upon all data submitted and on all comments received, the Arden Hills City Council has determined:

A. That the proposed Lake Improvement District is necessary and that the public welfare will be promoted by the establishment of the Lake Improvement District;

B. That the property to be included within the Lake Improvement District will be benefitted by the establishment of the Lake Improvement District; and

C. That the formation of the Lake Improvement District will not cause or contribute to long range environmental pollution.

4.0 **NOW, THEREFORE, the Arden Hills City Council hereby orders**:

A. Name. The name of the Karth Lake Improvement District shall be the "Karth Lake Improvement District".

B. Boundaries. The boundaries of the Karth Lake Improvement District shall be as described on **Exhibit 1** attached hereto.

C. Resource Management Programs. The water and related land resources management programs and services to be undertaken shall include the following:

1. The construction and operation of a lake level control structure.

Attachment A

2. A water quality monitoring program.

D. Financing of Programs. The manner of financing such programs and services shall initially consist of the levy of ad valorem taxes solely on property within the Lake Improvement District, but may also include the imposition of service charges, the issuance of obligations as provided in Minnesota Statutes, Chapter 429.091, levy of special assessments pursuant to Minnesota Statutes 429, or a combination of any of the above.

E. Board of Directors. The Board of Directors of the Karth Lake Improvement District shall be an advisory body to the Arden Hills City Council. The Board shall make recommendations regarding the implementation of programs, projects and services but shall not have the authority to enter into contracts or levy taxes.

The Board shall consist of five members initially appointed by the Arden Hills City Council. The Board shall be appointed to staggered terms so that no more than two Board Members' terms will expire at one time. After the appointment of the initial Board, each Board Member shall serve a three year term subject to removal in the discretion of the City Council. Each Board Member shall reside within the City of Arden Hills. A majority of the Board Members shall own property within the Karth Lake Improvement District.

CITY OF ARDEN HILLS

By: Beverly Aplikowski
Beverly Aplikowski, Mayor

Dated the 29th day of September, 2003.

ATTEST:

Michelle Wolfe
Michelle Wolfe, City Administrator

Attachment B

KARTH LAKE IMPROVEMENT DISTRICT BYLAWS

1.0 **Establishment of Board of Directors**. The Karth Lake Improvement District was established pursuant to Order of the City Council dated the 29th day of September, 2003.

2.0 **Composition of Board of Directors**. The Karth Lake Improvement District Board of Directors shall consist of five members initially appointed by the Arden Hills City Council and thereafter elected by qualified voters and owners of property within the Karth Lake Improvement District. Board Members shall reside within the City of Arden Hills. A majority of the board members shall own property within the Karth Lake Improvement District.

3.0 **Terms of Office**. Board members shall be elected for a term of three years. The first appointed Board of Directors shall be composed of two members whose terms expire on the 31st day of December, 2004 ; two members whose terms expire on the 31st day of December, 2005 ; and one member whose term expires on the 31st day of December, 2006. Board members shall be elected at the annual meeting by a majority of the votes cast. Voting shall be by secret ballot. Absentee ballots shall be received at the offices of the Arden Hills City Administrator, 1245 west Highway 96, Arden Hills, MN, no later than 3:00 p.m. on the date of the annual meeting or such ballots shall be void.

4.0 **Vacancies**. In the case of a vacancy during the term of a Board member, a majority of the remaining Board members shall declare a vacancy and appoint a new member who shall serve until the next annual meeting of the Karth Lake Improvement District. A vacancy shall exist if any office following events occur:

A. Death of a Board member;

B. Inability to perform the duties of a Board member;

C. Failure of a Board member to attend at least eight (80%) percent of the meetings; or;

D. Loss of City residency by a Board member or sale of qualifying property within the Karth Lake Improvement District.

5.0 **Organization**. The Board of Directors shall annually elect one member to serve as chairperson. The chairperson is responsible for the agenda of the meetings, presiding at meetings, minutes of meetings, and reports and recommendations to the City Council. The Arden Hills Operations and Maintenance Department shall maintain all records of the Board.

6.0 **Meetings and Reports**. The Board of Directors shall hold at least one annual meeting. The first annual meeting of the elected Board shall be held during the month of April and in each April thereafter unless changed by vote at an annual meeting. The Board shall adopt Rules of Procedure for business and shall keep a public record of all motions, resolutions, findings, minutes and reports which shall be in writing and a copy forwarded to the City Council.

Attachment B

7.0 **Duties and Functions**. The Karth Lake Improvement District Board of Directors shall serve in an advisory capacity to the Arden Hills City Council and shall make recommendations to the City Council regarding the following:

A. The construction and operation of water control structures as approved by the Commissioner of Natural Resources.

B. The construction of projects to change the course, current or cross-section of the waters of Karth Lake.

C. The acquisition of property, equipment or other facilities as necessary to improve the navigation of the waters of Karth Lake.

D. The implementation of research projects to determine the condition and development of the waters of Karth Lake and the waters which enter Karth Lake.

E. The development and implementation of a comprehensive plan to eliminate pollution of the waters of Karth Lake.

F. The development and implementation of a comprehensive program to improve and conserve the waters of Karth Lake.

G. The sources of funding for various projects proposed by the Board of Directors.

H. An annual budget for the operation of the Karth Lake Improvement District.

I. The maintenance of public beaches, docks, and other public facilities for access to the waters of Karth Lake.

J. The adoption of water surface use regulations for Karth Lake.

K. The amendment of Bylaws for the Karth Lake Improvement District.

8.0 **Amendments**. Amendments to the Bylaws for the Karth Lake Improvement District shall be approved by a majority of the City Council.

CITY OF ARDEN HILLS

By: Beverly Aplikowski
Beverly Aplikowski, Mayor

Dated the 29th day of September, 2003.

ATTEST:

Michelle Wolfe
Michelle Wolfe, City Administrator

RECEIVED
NOV - 5 2003
CITY OF ARDEN HILLS

Affidavit of Publication

State of Minnesota } SS
County of Ramsey }

Keri Solseth, being duly sworn, on oath, says that he/she is the publisher or authorized agent and employee of the publisher of the newspaper known as SHOREVIEW BULLETIN, and has full knowledge of the facts which are stated below:

(A) The newspaper has complied with all of the requirements constituting qualification as a qualified newspaper, as provided by Minnesota Statute 331A.02, 331A.07, and other applicable laws, as amended.

(B) The printed RESOLUTION NO. 03-60

which is attached was cut from the columns of said newspaper, and was printed and published once each week, for 1 successive weeks; it was first published on WED., the 8TH day of OCT., 20 03, and was thereafter printed and published on every _____ to and including _____, the _____ day of _____, 20____; and printed below is a copy of the lower case alphabet from A to Z, both inclusive, which is hereby acknowledged as being the size and kind of type used in the composition and publication of the notice:

*ABCDEFGHIJKLMNOPQRSTUVWXYZ
*ABCDEFGHIJKLMNOPQRSTUVWXYZ
*abcdefghijklmnopqrstuvwxyz

BY: Keri Solseth
TITLE ACCOUNTING ASSOCIATE

Subscribed and sworn to before me on this 8TH day of OCT., 20 03.

Tonya R. Whitehead
Notary Public

*Alphabet should be in the same size and kind of type as the notice.

TONYA R. WHITEHEAD
NOTARY PUBLIC-MINNESOTA
My Comm. Expires Jan. 31, 20[illegible]

RATE INFORMATION

(1) Lowest classified rate paid by commercial users for comparable space.....$23.00 per col. inch

(2) Maximum rate allowed by law for the above matter.....$18.62 per col. inch

(3) Rate actually charged for the above matter.....$ per col. inch

CITY OF ARDEN HILLS
COUNTY OF RAMSEY
STATE OF MINNESOTA

RESOLUTION NO. 03-60

RESOLUTION ESTABLISHING THE KARTH LAKE IMPROVEMENT DISTRICT AND ADOPTING THE BOARD BYLAWS

WHEREAS, pursuant to Minnesota Statutes 459.20 and Minnesota Statutes 103B.501-103B.581, the City of Arden Hills has the authority to establish a Lake Improvement District; and

WHEREAS, the engineering report prepared by the City's Consulting Engineer identified the need for the construction and maintenance of a lake elevation control structure for Karth Lake; and

WHEREAS, Karth Lake is located wholly within the boundaries of the City of Arden Hills; and

WHEREAS, pursuant to Minnesota Statute 103B.501 to 103B.581 and the Minnesota Department of Natural Resources rules part 6115.0900 to 6115.0980 the City of Arden Hills has prepared a document proposing the establishment and the administration of a Lake Improvement District with the purpose of constructing and maintaining a lake elevation control structure; and

WHEREAS, a public hearing for the establishment of the Karth Lake Improvement District was held on the 29th day of September, 2003.

NOW, THEREFORE, BE IT RESOLVED by the Arden Hills City Council

1. That **Attachment A,** the Order Establishing the Karth Lake Improvement District, is hereby approved and made a part hereof.
2. That **Attachment B,** the Karth Lake Improvement District Bylaws are hereby approved and made a part hereof.
3. That the boundaries for the Karth Lake Improvement District, are hereby approved and made a part hereof.

Dated the 29th day of September, 2003.

CITY OF ARDEN HILLS
Beverly Aplikowski, Mayor
ATTEST:
Michelle Wolfe, City Administrator

Attachment A

ORDER ESTABLISHING THE KARTH LAKE IMPROVEMENT DISTRICT

1.0 WHEREAS, the Arden Hills City Council initiated the establishment of the Karth Lake Improvement District by adopting Resolution No. 03-55 which declared the City's intent to establish the District and which directly or by incorporation of supporting data:

A. Specified the boundaries of the proposed District which were as consistent as practical with the natural hydrologic boundaries;

B. Prescribed the water and related land resource management programs to be undertaken within the District;

C. Stated the manner in which proposed programs would be financed;

D. Designated the City officer or agency which would be responsible for supervising the programs; and

E. Set a date for a hearing on the establishment of the proposed Lake Improvement District.

2.0 WHEREAS, a public hearing, preceded by all notices required pursuant to Minnesota Statutes Chapter 103B.515 and Minnesota Rules 6115.0970, Subpart 3, was held on the 29th day of September, 2003 in order to receive public comment as to whether the Karth Lake Improvement District should be established; and

3.0 WHEREAS, based upon all data submitted and on all comments received, the Arden Hills City Council has determined:

A. That the proposed Lake Improvement District is necessary and that the public welfare will be promoted by the establishment of the Lake Improvement District;

B. That the property to be included within the Lake Improvement District will be benefitted by the establishment of the Lake Improvement District; and

C. That the formation of the Lake Improvement District will not cause or contribute to long range environmental pollution.

4.0 NOW, THEREFORE, the Arden Hills City Council hereby orders:

A. Name. The name of the Karth Lake Improvement District shall be the "Karth Lake Improvement District".

B. Boundaries. The boundaries of the Karth Lake Improvement District shall be as described on Exhibit 1 attached hereto.

C. Resource Management Programs. The water and related land resources management programs and services to be undertaken shall include the following:

1. The construction and operation of a lake level control structure.
2. A water quality monitoring program.

D. Financing of Programs. The manner of financing such programs and services shall initially consist of the levy of ad valorem taxes solely on property within the Lake Improvement District, but may also include the imposition of service charges, the issuance of obligations as provided in Minnesota Statutes, Chapter 429.091, levy of special assessments pursuant to Minnesota Statutes 429, or a combination of any of the above.

E. Board of Directors. The Board of Directors of the Karth Lake Improvement District shall be an advisory body to the Arden Hills City Council. The Board shall make recommendations regarding the implementation of programs, projects and services but shall not have the authority to enter into contracts or levy taxes.

The Board shall consist of five members initially appointed by the Arden Hills City Council. The Board shall be appointed to staggered terms so that no more than two Board Members' terms will expire at one time. After the appointment of the initial Board, each Board Member shall serve a three year term subject to removal in the discretion of the City Council. Each Board Member shall reside within the City of Arden Hills. A majority of the Board Members shall own property within the Karth Lake Improvement District.

Dated the 29th day of September, 2003.

CITY OF ARDEN HILLS
By: Beverly Aplikowski, Mayor
ATTEST:
Michelle Wolfe, City Administrator

Attachment B

KARTH LAKE IMPROVEMENT DISTRICT BYLAWS

1.0 Establishment of Board of Directors. The Karth Lake Improvement District was established pursuant to Ord[illegible] the City Council dated the 29th day of September, 2003.

2.0 Composition of Board of Directors. The Karth Lake Improvement District Board of Directors shall consist of five members initially appointed by the Arden Hills City Council and thereafter elected by qualified voters and owners of property within the Karth Lake Improvement District. Board Members shall reside within the City of Arden Hills. A majority of the board members shall own property within the Karth Lake Improvement District.

3.0 Terms of Office. Board members shall be elected for a term of three years. T[illegible] first appointed Board of Directors shall be composed of two members whose ter[illegible] expire on the 31st day of December, 2004; two members whose terms expire on the 31st day of December, 2005; and one member whose term expires on the 31st day of December, 2006. Board members shall be elected at the annual meeting by a majority of the votes cast. Voting shall be by secret ballot. Absentee ballots shall be received at the offices of the Arden Hills City Administrator, 1245 west Highway 96, Arden Hills, MN, no later than 3:00 p.m. on the date of the annual meeting or such ballots shall be void.

4.0 Vacancies. In the case of a vacancy during the term of a Board member, a majority of the remaining Board members shall declare a vacancy and appoint a new member who shall serve until the next annual meeting of the Karth Lake Improvement District. A vacancy shall exist if any office following events occur:

A. Death of a Board member;

B. Inability to perform the duties of a Board member;

C. Failure of a Board member to attend at least eight (80%) percent of the meetings; or;

D. Loss of City residency by a Board member or sale of qualifying property within the Karth Lake Improvement District.

5.0 Organization. The Board of Directors shall annually elect one member to serve as chairperson. The chairperson is responsible for the agenda of the meetings, presiding at meetings, minutes of meetings, and reports and recommendations to the City Council. The Arden Hills Operations and Maintenance Department shall maintain all records of the Board.

6.0 Meetings and Reports. The Board of Directors shall hold at least one annual meeting. The first annual meeting of the elected Board shall be held during the month of April and in each April thereafter unless changed by vote at an annual meeting. The Board shall adopt Rules of Procedure for business and shall keep a public record of all motions, resolutions, findings, minutes and reports which shall be in writing and a copy forwarded to the City Council.

7.0 Duties and Functions. The Karth Lake Improvement District Board of Directors shall serve in an advisory capacity to the Arden Hills City Council and shall make recommendations to the City Council regarding the following:

A. The construction and operation of water control structures as approved by the Commissioner of Natural Resources.

B. The construction of projects to change the course, current or cross-section of the waters of Karth Lake.

C. The acquisition of property, equipment or other facilities as necessary to improve the navigation of the waters of Karth Lake.

D. The implementation of research projects to determine the condition development of the waters of Karth Lake and the waters which enter Karth Lake.

E. The development and implementation of a comprehensive plan to eliminate pollution of the waters of Karth Lake.

F. The development and implementation of a comprehensive program to improve and conserve the waters of Karth Lake.

G. The sources of funding for various projects proposed by the Board of Directors.

H. An annual budget for the operation of the Karth Lake Improvement District.

I. The maintenance of public beaches, docks, and other public facilities for access to the waters of Karth Lake.

J. The adoption of water surface use regulations for Karth Lake.

K. The amendment of Bylaws for the Karth Lake Improvement District.

8.0 Amendments. Amendments to the Bylaws for the Karth Lake Improvement District shall be approved by a majority of the City Council.

Dated the 29th day of September, 2003.

CITY OF ARDEN HILLS
By: Beverly Aplikowski, Mayor
ATTEST:
Michelle Wolfe, City Administrator

(Bulletin: Oct. 8, 2003)

APPENDIX E
MPCA Listed Pollutant Sources

Site Name	Industrial Classification	ID	Type	Active
2009 Pavement Management Program		C00027566	Stormwater	N
2010 Pavement Managment Program		C00029408	Stormwater	N
2011 Pavement Mgmt Program		C00031972	Stormwater	N
2013 Pavement Management Program		C00035772	Stormwater	N
3M Filtration/Arden Hills Plant		A00001382	Stormwater	N
ABRA Auto Body & Glass - Arden Hills	Automotive Body, Paint, and Interior Repair and Maintenance	12300661; MN0000804492	Air Quality; Hazardous Waste	N
Adherent Laboratories Inc	Testing Laboratories	MNS000153833	Hazardous Waste	Y
Advantek Equipment Division		MND985753516	Hazardous Waste	N
AHATS Field Maintenance Shop	National Security	C00033050; MNS000177030; SUB0034458	Hazardous Waste; Stormwater	Y
Ahats Mnarng	National Security	MNS000149641	Hazardous Waste	Y
AHATS Readiness Center	National Security	C00029478; MNS000177048; SUB0032133	Hazardous Waste; Stormwater	Y
Alliant Ammunition Systems Co LLC	Small Arms, Ordnance, and Ordnance Accessories Manufacturing	12300238; 781714761	Air Quality; Stormwater	N
Alliant Techsystems Inc	Ammunition (except Small Arms) Manufacturing	MN7213820908; MND000819268; SA0008424; SR0000113; SR0000215; SR0000216; SR0000217; SR0000218; SR0000219; SR0000220; SR0000221; SR0000222; SR0000223; SR0000224; SR0000225; SR0000226; SR0000227; SR00002	Hazardous Waste; Investigation and Cleanup	Y
Aps		MND985714468	Hazardous Waste	Y
Arden Hills 2003 PMP		C00010413	Stormwater	N
Arden Hills Army Training Site Readiness Center	National Security	MNS000301840	Hazardous Waste	Y
Arden Hills city of	Other General Government Support	MND040968141; VP22660	Hazardous Waste; Investigation and Cleanup	N
Arden Hills Club Inc		MND039799960	Hazardous Waste	N
Arden Hills Eye Clinic	HMO Medical Centers	MNS000310576	Hazardous Waste	Y
Arden Hills Family Physicians		MNR000005009	Hazardous Waste	Y
Arden Hills Gateway Center		C00003979	Stormwater	N
Arden Hills Library		MND985759026	Hazardous Waste	N
Arden Hills Shell		LS0000102; TS0003938	Investigation and Cleanup; Tanks	Y
Arden Hills Truck Station		CS0000800; CS0001100; LS0002593; LS0002803; LS0013336; LS0014688; SA0000108; VP33300	Investigation and Cleanup	Y
Arden Hills Village Of		MND985682376	Hazardous Waste	N
Arden Medical Systems Inc	Measuring, Analyzing & Controlling Instrmts; Photogr, Medical & Optical Goods; Watches & Clocks	MND102281912	Hazardous Waste	N
Arden Plaza		BF0000125; C00033219	Investigation and Cleanup; Stormwater	Y
Arden Plaza - Phase I		C00033492	Stormwater	N
Arden Village		C00035247	Stormwater	Y
Army National Guard Bld Oms		LS0003609	Investigation and Cleanup	Y
ATC Group Services	Environmental Consulting Services	MNS000302016	Hazardous Waste	Y

Site Name	Industrial Classification	ID	Type	Active
ATS Steels Inc		MND985744242; VP19980	Hazardous Waste; Investigation and Cleanup	N
B & L Fabricating		MND982629396	Hazardous Waste	N
Bethel - Nelson Stair Entry Replacement		C00036005	Stormwater	N
Bethel College & Sem Residence Hall		C00012219; LS0014512; LS0015293; TS0003487	Investigation and Cleanup; Stormwater; Tanks	Y
Bethel University	Colleges, Universities, and Professional Schools	12300436; MND985685312	Air Quality; Hazardous Waste	Y
Bethel University - 2 Pine Tree Dr	Colleges, Universities, and Professional Schools	MND985667781	Hazardous Waste	N
Bethel University Commons - CSW		C00023000	Stormwater	N
Bethel University East		LS0019381; PB4490; TS0003680	Investigation and Cleanup; Tanks	N
Bethel University Maintenance Shop	Colleges, Universities, and Professional Schools	MNR000021667	Hazardous Waste	Y
Blue Fox Bar and Grill		LS0019041	Investigation and Cleanup	Y
Boston Scientific Building 3-10 Skyway		C00044056	Stormwater	Y
Butcher's Allotment		VP8240; VP8241; VP8242; VP8243	Investigation and Cleanup	Y
Cardiac Pacemakers Inc/Boston Scientific	Other Electronic Component Manufacturing	MND058320011; TR-gen	Hazardous Waste; Pollution Prevention	Y
Cardiac Pacemakers Inc/Boston Scientific	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	12300622; MNRNE3577; MNRNE3946; MNRNE3BXF	Air Quality; Stormwater	Y
Catholic Aid Association		MN0001024785	Hazardous Waste	N
Celestica	Printed Circuit Assembly (Electronic Assembly) Manufacturing	MNR000054445	Hazardous Waste	N
Ceridian Corp Computing		MNT280010604	Hazardous Waste	Y
Champion Charter		MNR000115089	Hazardous Waste	Y
City Of Arden Hills		LS0006037; TS0003946	Investigation and Cleanup; Tanks	N
Cleveland Avenue Bridge		VP10090	Investigation and Cleanup	Y
Clutch & U-Joint Proven Force - Arden Hills	General Automotive Repair	MNS000105072	Hazardous Waste	N
Continental Can Co Inc	Metal Can Manufacturing	MND052732732	Hazardous Waste	N
Country Insurance & Financial Services	Lessors of Nonresidential Buildings (except Miniwarehouses)	12300713	Air Quality	N
Crown Auto Inc	Auto and Home Supply Stores	MND982062036	Hazardous Waste	N
CRS Appliance	Household Appliance Stores	MNR000065920	Hazardous Waste	N
Cty Rd #10 Trail Segments 1-5 Mounds View		C00028334	Stormwater	N
Cub Foods 1641	Supermarkets and Other Grocery (except Convenience) Stores	MNS000154120	Hazardous Waste	Y
Cummings Park Drive		C00010395	Stormwater	Y
Delta Environmental Consultant		MND985769553	Hazardous Waste	N
Deluxe Corp - Arden Hills	Commercial Printing (except Screen and Books)	MND985768985	Hazardous Waste	Y
Driver License Examining Station		TS0003494	Tanks	N
Dynamark		C00001862	Stormwater	Y
E Street Flats		C00035615	Stormwater	Y
Ellis Properties, LLP	Nonresidential Property Managers	MNS000307368	Hazardous Waste	Y
Elmer L Andersen Memorial Trail Connections		C00028840	Stormwater	N

Site Name	Industrial Classification	ID	Type	Active
Empi Inc		MND985763788	Hazardous Waste	N
Expedite Direct Mail		MND985746601	Hazardous Waste	Y
F & M Dental	Health Services	MND985670223	Hazardous Waste	N
First Group America		LS0008592; LS0010142; TS0010228	Investigation and Cleanup; Tanks	Y
First Student Inc 11730	School and Employee Bus Transportation	MND982212334; MNR053555; MNR0538PK	Hazardous Waste; Stormwater	Y
Five Star Automotive	General Automotive Repair	MNS000165951	Hazardous Waste	Y
Floren Residence		LS0012785	Investigation and Cleanup	Y
Former Arden Hills Holiday Inn		VP27080	Investigation and Cleanup	Y
Former House & Office Building	Private Households	LS0018444; MNS000174615	Hazardous Waste; Investigation and Cleanup	Y
Fort Snelling ARC OMS UHS		C00029491	Stormwater	N
Fox Ridge		C00032229	Stormwater	N
Future Systems		MND985712587	Hazardous Waste	N
Gage Tool Co	Fabricated Metal Products, Except Machinery and Transportation Equipment	MND094044856	Hazardous Waste	N
Gateway Business Dist/ 14th St NE		C00004843	Stormwater	N
GE Security	Other Communications Equipment Manufacturing	MND981791437; MNRNE35BB; MNRNE38L3	Hazardous Waste; Stormwater	Y
Goodprinter The		MND001627363	Hazardous Waste	N
Grainger	Motor Vehicle Electrical and Electronic Equipment Manufacturing	MNS000167023	Hazardous Waste	N
Grey Fox Technical Services		MNR000023861	Hazardous Waste	N
Guidant Building N Addition		C00011166	Stormwater	N
Guidant Corp Parking Ramp 1		C00011801	Stormwater	N
Guidant Corporation		LS0008939; PB4820; TS0052451	Investigation and Cleanup; Tanks	Y
Harrison Property		LS0016376	Investigation and Cleanup	Y
HB Fuller Co - Data Center - Arden Hills	Data Processing, Hosting, and Related Services	12300697	Air Quality	Y
HealthPartners Arden Hills	Offices of Physicians	MND985700798	Hazardous Waste	Y
HealthPartners Arden Woods Clinic	HMO Medical Centers	MNS000303160	Hazardous Waste	Y
Hoigaards Inc		MND985681873	Hazardous Waste	N
Holiday Stationstore #368		LS0012545; LS0018894; TS0124073	Investigation and Cleanup; Tanks	N
Hood Packaging Corp - Arden Hills	Commercial Printing (except Screen and Books) ; Commercial Screen Printing ; Plastics Bag and Pouch Manufacturing ; Unlaminated Plastics Film and Sheet (except Packaging) Manufacturing	12300718; A00009561; MNR000102509; MNRNE338L; MNRNE38M6	Air Quality; Hazardous Waste; Stormwater	Y
Hood Packaging Corporation		PB3489; TS0124898	Investigation and Cleanup; Tanks	Y
Hwy 96 btwn Lexington & TH 10		C00010443	Stormwater	N
Hwy Corner Site		LS0014245	Investigation and Cleanup	Y
Infrastructure Upgrades & Improvements		C00041486	Stormwater	Y
International Paper Co	Corrugated and Solid Fiber Box Manufacturing	12300323; LS0005792; LS0005901; MND053417986; MNR05363F; MNR053B8F; SA0001010; TS0003490	Air Quality; Hazardous Waste; Investigation and Cleanup; Stormwater; Tanks	Y

Site Name	Industrial Classification	ID	Type	Active
IntriCon - Arden Hills	Electromedical and Electrotherapeutic Apparatus Manufacturing	MND980791370; MNRNE34S2; MNRNE397B	Hazardous Waste; Stormwater	Y
INX International Ink Co	Printing Ink Manufacturing	MND985694199; MNRNE35BX	Hazardous Waste; Stormwater	N
ISD 621 - Mounds View High School	Elementary and Secondary Schools	C00012085; LS0008703; MND982603177; TS0017436	Hazardous Waste; Investigation and Cleanup; Stormwater; Tanks	Y
Johanna Shores Brownstones		C00039556	Stormwater	Y
Johanna Shores Presbytarian Homes	Nursing Care Facilities (Skilled Nursing Facilities)	LS0013287; MND985672500; TS0003657	Hazardous Waste; Investigation and Cleanup; Tanks	Y
John Woitas Painting		MNS000100941	Hazardous Waste	N
Johnson Residence		LS0008021	Investigation and Cleanup	Y
Kennedy Transmission		TS0013838	Tanks	Y
Kennedy Transmission - Arden Hills	Automotive Transmission Repair	MND985676535	Hazardous Waste	N
Label Technologies		MN0000693283	Hazardous Waste	N
Laird Plastics		MND006211049	Hazardous Waste	N
Lake Johanna		SA0000280	Investigation and Cleanup	Y
Land O' Lakes - West Parking Expansion		C00033681	Stormwater	Y
Land O Lakes Inc		MND981530587	Hazardous Waste	N
Land O Lakes, Inc. Corporate Headquarters		MNRNE35Q6; MNRNE3BCK	Stormwater	Y
Land O'Lakes - Arden Hills	Creamery Butter Manufacturing ; Cheese Manufacturing ; Dry, Condensed, and Evaporated Dairy Product Manufacturing	006253835; 12300515; LS0000199; LS0020310; MND006253835; TS0003440	Air Quality; Hazardous Waste; Investigation and Cleanup; Stormwater; Tanks	Y
Lexington Station - Phase 2		C00046082	Stormwater	Y
Lexington Station LLC	All Other Professional, Scientific, and Technical Services	C00036310; MNS000194969	Hazardous Waste; Stormwater	Y
Lowry Avenue Bridge Demo - Minneapolis		C00027244	Stormwater	N
Maneuver Damage Repair & Gravel Storage		C00028853	Stormwater	N
McDonald's Restaurant		C00032088	Stormwater	N
Measuretech		MN0000017277	Hazardous Waste	N
Medtronic Arden Hills East & West	Electromedical and Electrotherapeutic Apparatus	A00016842	Stormwater	N
Metropolitan Mosquito Control District		MND985701366	Hazardous Waste	N
Middle Rice Creek		C00042272	Stormwater	Y
Midwest Brass & Aluminum Foundry Waste		SA0008406	Investigation and Cleanup	Y
Milton Demolition Dump		SA0008334	Investigation and Cleanup	Y
Minnesota Power Center - St Paul		MNR000031294	Hazardous Waste	N
Minute Clinic 26	Pharmacies and Drug Stores	MNS000219097	Hazardous Waste	Y
Misc Site Work, Paving, Lighting		C00038709	Stormwater	Y
MNDOT Arden Hills	Regulation and Administration of Transportation Programs	MND981948367	Hazardous Waste	Y
MNDOT TH 10/TCAAP ROW		VP26410	Investigation and Cleanup	Y
MNDOT Training Center Facility	Police Protection	MN0000134312	Hazardous Waste	Y
Morris Communication		VP14570	Investigation and Cleanup	Y
Mrc Tele Communications Inc		MNR000003558	Hazardous Waste	N
MRP Properties Facility 9137	Petroleum Refineries	MNG790123	Water Quality	N

Site Name	Industrial Classification	ID	Type	Active
National Surface Cleaning Inc	Polish and Other Sanitation Good Manufacturing	MND985712504	Hazardous Waste	N
Nestle Purina Petcare Co Arden Hills	Dog and Cat Food Manufacturing	MND134231679	Hazardous Waste	Y
New Brighton Oms Complex (tcaap)		LS0005753; TS0004032	Investigation and Cleanup; Tanks	Y
Nguyen Residence		LS0017456	Investigation and Cleanup	Y
North Heights Lutheran Church		C00004176	Stormwater	N
Northern Ingredients	Passenger Car Rental	LS0005106; LS0019342; MND982207060; TS0003578	Hazardous Waste; Investigation and Cleanup; Tanks	Y
Northwest Camera Repair Inc		MND985712439	Hazardous Waste	N
Nott Co - Arden Hills		MN0000060053	Hazardous Waste	Y
NTW LLC d/b/a National Tire & Battery #453	Automotive Mechanical and Electrical Repair and Maintenance; General Automotive Repair	MND985675958	Hazardous Waste	Y
Old Highway 8 and CSAH 3 Reconstruction / Old Highway 8 Extension		C00046870	Stormwater	Y
Old Highway Eight Site		VP1760	Investigation and Cleanup	Y
Painting Perfection Ltd - Arden Hills	Painting and Wall Covering Contractors	MNS000118422	Hazardous Waste	N
Polansky Trucking		SA0008404	Investigation and Cleanup	Y
Precision Painting	Fabricated Metal Products, Except Machinery and Transportation Equipment	MND087683512	Hazardous Waste	Y
Precision Painting Inc		12300339	Air Quality	Y
Presbyterian Homes & Services Redev 2011		C00032338	Stormwater	N
Proex 1517	Photofinishing	MND985765411	Hazardous Waste	N
Project Sapphire Sky		C00043741	Stormwater	Y
Qwest Communications - Arden Hills		MN0000900332	Hazardous Waste	N
Ramsey County Property Management		LS0017538; TS0123986	Investigation and Cleanup; Tanks	Y
Ramsey County Sheriff's Patrol Station	Police Protection	MNS000171876	Hazardous Waste	Y
Ramsey Cty Arden Hills Yard Waste - SW	Fertilizer (Mixing Only) Manufacturing ; Other Nonhazardous Waste Treatment and Disposal	A00015648; PBR000653	Stormwater; Solid Waste	Y
Ramsey Cty HHW Arden Hills Site		A00018380	Stormwater	N
Red Fox Business Center		C00040249	Stormwater	Y
Red Fox Road Improvements		C00035925	Stormwater	Y
Resolution Graphics Inc	Unlaminated Plastics Film and Sheet (except Packaging) Manufacturing	12300730; MND121198154; MNRNE33M4	Air Quality; Hazardous Waste; Stormwater	Y
Rice Creek Regional Trail		VP26640	Investigation and Cleanup	Y
Robert J Pugleasa Co Inc		MND982207011	Hazardous Waste	Y
Rockwood Capital Management	Offices of Other Holding Companies ; Corporate, Subsidiary, and Regional Managing Offices	MND985719186	Hazardous Waste	N
Round Lake Business Center		VP6880	Investigation and Cleanup	Y
Round Lake Road Improvements Project		C00037712	Stormwater	Y
Saint Paul Metalcraft Inc		TS0055661	Tanks	Y
Scherer Brothers Lumber Medberry Yard	Home Centers ; Other Building Material Dealers	A00009001; MND156397515	Hazardous Waste; Stormwater	Y

Site Name	Industrial Classification	ID	Type	Active
Sefar Printing Solutions Inc		MND985724368	Hazardous Waste	N
Sewall Bros Industrial Supply		MNR000104927	Hazardous Waste	N
Sewall Bros Industrial Supply Co	Hardware Stores	MNS000220111	Hazardous Waste	Y
Shaw Lumber Co		TS0003630	Tanks	N
Sherwin Williams Co	Painting and Wall Covering Contractors	MND982627150	Hazardous Waste	Y
Simply Self Storage		C00045611	Stormwater	Y
Site Investigation/Rem TCAAP Site		C00035287	Stormwater	Y
SMI Holdings Inc dba Stealth Mark	Passenger Car Leasing	MND985679869; MNRNE3393	Hazardous Waste; Stormwater	N
Smiths Medical ASD Inc - St Paul	Surgical and Medical Instrument Manufacturing	MND106712748; MNRNE357V; MNRNE3CLJ	Hazardous Waste; Stormwater	Y
SP 6281-47 TH 35E MNPASS MANAGED LANE		C00042889; CS-gen	Stormwater	Y
SP 6284-159 TH 35W		C00033770	Stormwater	N
SP 6285-135 (TH 694)		C00032813	Stormwater	N
SP 6285-142 - New Brighton		C00029215	Stormwater	N
SP 6285-150		C00033447	Stormwater	N
Specialty Lab The		MNR000033860	Hazardous Waste	N
Split Rock Studios	Independent Artists, Writers, and Performers	MNR000102624	Hazardous Waste	Y
St Jude Medical Inc		MND080232168	Hazardous Waste	N
St Paul Industrial Properties		MND050736701	Hazardous Waste	N
St Paul Metal Craft		MNR000004671	Hazardous Waste	N
St Paul Metalcraft		VP9210	Investigation and Cleanup	Y
State Emergency Operations Center		VP29470	Investigation and Cleanup	Y
state project # 6285-148		C00039440	Stormwater	Y
Streamworks		MNRNE3C7B	Stormwater	Y
TCAAP Bid Package #1 Rice Creek Remeander Construction		C00042127	Stormwater	Y
TCAAP Building 576		VP15710	Investigation and Cleanup	Y
TCAAP Redevelopment Project	Other General Government Support	MNS000190280; PB4302	Hazardous Waste; Investigation and Cleanup	Y
TH-10 & CSAH 96 Interchange		PB4210; VP29030	Investigation and Cleanup	Y
The Goodprinter		MND985709237; MNRNE36G6; MNRNE39CL	Hazardous Waste; Stormwater	Y
The Tavern Grill		C00043005	Stormwater	Y
Tony Schmidt County Park Site Improv		C00005805	Stormwater	N
Townhomes of Lake Valentine		C00003249	Stormwater	Y
Trailwood Warehouse LLC - Arden Hills		MNRNE363V	Stormwater	Y
Traverse Erosion Control Project		C00042621; CS-gen	Stormwater	Y
Trw Inc		MND092784156	Hazardous Waste	N
Twin Cities Army Ammunition Plant	Facilities Support Services	12300067; 213820908; LS0013886; MNR000112102	Air Quality; Hazardous Waste; Investigation and Cleanup; Stormwater	Y
Tyson Companies Inc		PB4655; TS0003316; TS0003471	Investigation and Cleanup; Tanks	N
US Army Reserve Center - Arden Hills	National Security	MN7210490564	Hazardous Waste	Y
US Army Reserve Ctr Arden Hills - SW		A00015651	Stormwater	N
US Army Reserve TCAAP Ctr		A00015765	Stormwater	N

Site Name	Industrial Classification	ID	Type	Active
US Army TCAAP	Facilities Support Services	CS0011730; LS0003188; LS0003635; LS0004852; LS0006996; LS0017797; MN7213820908; PB3668; PB4687; TS0004040; VP22890; VP22891; VP22892	Hazardous Waste; Investigation and Cleanup; Stormwater; Tanks	Y
Vacant Lot		LS0011360	Investigation and Cleanup	Y
Valentine Bluff		C00039854	Stormwater	Y
Valentine Park		C00033687	Stormwater	Y
Vandal Dump		SA0008402	Investigation and Cleanup	Y
Venture	Commercial Printing (except Screen and Books)	A00012241; MNR000116194; MNRNE35TB; MNRNE3CKJ	Hazardous Waste; Stormwater	Y
Vikings Stadium and Mixed Use Development		PB3967; VP27360	Investigation and Cleanup	Y
Walgreen's 15123	Pharmacies and Drug Stores	MNS000175117	Hazardous Waste	Y
West Round Lake Rd Improv Phase I		C00005769	Stormwater	N
Xcel Productions Inc	Paper Bag and Coated and Treated Paper Manufacturing	MNS000116079	Hazardous Waste	N

APPENDIX F
Previous Pond Modeling and Reference Materials

APPENDIX F

HYDRAULIC AND WATER QUALITY ANALYSES

Regional Stormwater Treatment Locations

There are thirteen proposed potential regional ponds in Arden Hills that were identified in a 1999 comprehensive drainage study by BRW Inc. (Dames and Moore Group Company). The Twin Cities Army Ammunition Plant (TCAAP) property was not considered or modeled as part of this Plan. Two ponds within TCAAP, P-1 and P-13, will be completed as part of the reconstruction of TH 96, and will not be discussed in this Plan. The TCAAP Reuse Plan will include a preliminary layout of the stormwater management for the TCAAP property, meeting RCWD and other agencies requirements.

The proposed regional ponds are mostly located in natural low lands or inlets to lakes. It should be noted that the City would need to further investigate the proposed regional pond locations with respect to jurisdictional wetlands and regulatory restrictions that may affect the construction of these facilities. Even though the BRW, Inc. study and this Plan evaluate the proposed construction of regional ponds, other stormwater treatment best management practices (such as infiltration BMP's) will be addressed in the feasibility study stage.

The Minnesota Urban Small Sites BMP Manual (Metropolitan Council, 2001) outlines a three-step process to select a BMP or combination of BMP's for sites less than five acres. This process looks at stormwater treatment suitability, physical feasibility factors, and community and environmental factors.

Summary Discharge Data

HydroCAD® modeling was completed for the eleven proposed regional ponds. At this stage the ponds are only concepts, and therefore the modeling consisted of the drainage districts identified in the 1999 comprehensive drainage study by BRW, Inc. and the proposed concept pond. The concept pond was assumed to be rectangular in shape, with a ten-foot shelf below the normal water level, side slopes of 3:l everywhere else, and a depth of six feet.

The 5, 10, and 100-year, 24-hour, storms were run, using antecedent moisture conditions II. The results of these models can be seen further in this Appendix.

The 100-year design storm was used to calculate a peak height of the pond and to determine if any potential damage or flooding could occur at the neighboring structures. Only one pond as calculated from this modeling, P-12, has the potential for flooding the low point on North Hamline Avenue and will need more detailed analysis during the feasibility study/design stage to ensure no damage to the surrounding structures will occur.

In addition to the HydroCAD modeling, stormwater quality and treatment modeling was undertaken using the P8 Urban Catchment model.

Water Quality Analyses

P-8 models were created for the proposed regional ponds. The ponds were designed to meet NURP (Nationwide Urban Runoff Program) standards, which are removal of 90% of total suspended solids (TSS) and 65% of total phosphorus (TP). As with the hydrologic modeling, no upstream drainage areas were used in the water quality modeling. The ponds were modeled using only the immediate drainage areas. Therefore, it is recommended to model the entire drainage system during either a feasibility study or final design to calculate the pollutant removal efficiencies of the entire system. The results from the P-8 models can be found in this Appendix.

APPENDIX F

Lakes and Ponds

The Minnesota Pollution Control Agency (MPCA) and Minnesota Department of Natural Resources (MDNR) maintain lake information databases on many lakes in Minnesota. The data is available on the web at http://www.pca.state.mn.us/water/lakequality.html and www.dnr.state.mn.us/lakefind.html.

Summary water quality data is available for all the lakes in Arden Hills except Sunfish Lake (no data) on the Arden Hills Army Training Site (AHATS) property. Table 5-1 provides summary data on the each of the lakes in Arden Hills.

Trophic State Index (TSI) combines measures of summer Secchi Disk transparency and epilimnetic (upper portion of lake characterized by warmer and lighter water) concentrations of chlorophyll-a and total phosphorus to come up with the value. The index ranges from 0 to 100, with the higher values indicating more eutrophic (over nourished) conditions in the lake. For the ecoregion Arden Hills is located in, typically a TSI value of less than 59 fully supports swimming. Swimming is partially supported between a TSI value of 60 and 65.

Josephine and Round lakes both fully support swimmable use classification, according to their TSI, although they are sensitive to increases in phosphorus nutrient loading. However, there is no access to Round Lake for swimming use. Lake Johanna only partially supports swimmable use classification due to algae blooms and low transparency for a significant portion of the summer. Karth, Little Lake Johanna and Valentine lakes do not support swimmable use classification due to severe and frequent algae blooms and low transparency for most of the summer. Round, Karth, Little Lake Johanna and Valentine lakes have either small surface areas or are quite shallow in average depth and therefore would not be considered likely candidates for swimmable use. However, water quality data in support or non-support of this use is important for wildlife management of these water bodies.

Lake Josephine Assessment Report
The MPCA along with MDNR, Ramsey County Public Works, RCWD and Josephine Lake Association issued a Lake Assessment Report for Josephine Lake in 1998. Pertinent portions from that report are as follows:

(page iii)

A good historical data base is available for assessing trends in water quality of Lake Josephine. These data include 22 years of Secchi data and several years of water chemistry data. Based on an analysis of 22 years of CLMP, MPCA, DNR, Met. Council, Ramsey County, and two environmental consulting firm's Secchi transparency data, Lake Josephine exhibited a significant improvement in transparency over time (RK = 0.52; p=0.0008). Summer mean Secchi transparency measures ranged from 2.3 to 4.3 feet from 1975-1979. In contrast, from 1981-1989 summer-mean Secchi ranged from 3.0 to 10.2 feet and from 1990-1998 summer-mean Secchi ranged from 5.2 to 12.1 feet. Summer-mean total phosphorus and chlorophyll-a concentrations exhibited a decline over this time period as well.

(page 3)

Lake Josephine's watershed is relatively small at about 734 acres, excluding the lake. The vast majority (96%) of the watershed is in urban/residential lake use. This percentage, although not typical for lakes in the North Central Hardwood Forest ecoregion, is rather typical for lakes in the Twin Cities metro area.

APPENDIX F

Little Lake Josephine is about 12 acres in size, much of which is covered by cattails and emergent vegetation; however, the open water portion has maximum depth of 25 feet. Originally, about 260 acres drained through Little Lake Josephine prior to entering Lake Josephine. In 1980, a project conducted by the RCWD, in consultation with E.A Hickok Engineering, resulted in an additional 220 acres of direct drainage from Lake Josephine watershed.

Summary of Hydrologic Modeling Results

Drainage ID	Area (acres)	CN	Tc (min)	NWL (ft)	Surface Area (acres)	5-year event*		10-year event**		100-year event***		Comments
						Q (cfs)	Peak Elevation (ft)	Q (cfs)	Peak Elevation (ft)	Q (cfs)	Peak Elevation (ft)	
P-1	49.1	81	20	903.2	2.78	9.84	904.6	14.28	905.1	22.18	906.4	
P-2	57.6	78	20	896	2.62	10.41	897.5	15.15	898	23.99	899.5	
P-3	46.7	77	20	879.2	3.32	5.28	880.2	8.59	880.5	17.19	881.5	
P-4	58.0	79	25	879.6	2.46	8.62	880.9	13.08	881.3	21.41	882.6	
P-5	31.4	89	15	924	2.46	11.32	925.4	15.54	925.8	22.93	926.7	
P-6	30.1	77	15	886.3	2.02	5.2	887.3	8.58	887.6	17.2	888.6	
P-7	77.8	77	35	871.2	3.32	11.13	872.8	15.9	873.3	25.16	875	
P-8	24.0	82	15	878.1	1.62	7.48	879.3	11.25	879.7	18.85	880.7	
P-9	64.9	72	30	907.2	2.94	6.52	908.3	11.05	908.7	21.02	910.1	
P-10	28.0	74	15	879.8	1.62	4.7	880.7	8.16	881.1	17.35	882.1	
P-11	28.0	76	20	877.3	1.64	5.65	878.3	9.37	878.7	18.18	879.7	
P-12	43.7	81	20	880	2.46	9.68	881.4	14.1	881.9	21.96	883.1	Possible flooding

*The 5-year, 24-hour rainfall is 3.5 inches

**The 10-year, 24-hour rainfall is 4.15 inches

***The 100-year, 24-hour rainfall is 5.9 inches

Summary of Water Quality Analysis

Pond	NWL Surface Area (Ac)	Dead Storage Volume (ac-ft)	Flood Storage Volume (ac-ft)	Total Suspend Solids (TSS) Removal Efficiency (%)	Total Phosphorous Solids (TP) Removal Efficiency (%)	Comments
P-2	2.28	11.12	9.82	93.3	67.1	
P-3	2.91	14.52	12.45	95.3	69.4	
P-4	2.91	14.52	12.45	95.4	69.7	
P-5	2.1	10.14	9.12	93.3	67	
P-6	1.69	7.97	7.41	93.4	67.1	
P-7	2.91	14.52	12.45	94.9	69	
P-8	1.33	5.06	5.89	96.1	70.8	
P-9	2.55	12.6	10.97	95.2	69.7	
P-10	1.33	6.02	5.89	95.2	69.7	
P-11	1.35	6.14	4.41	95.4	70	
P-12	1.44	10.14	9.12	95.1	69.3	

CITY OF ARDEN HILLS

DRAINAGE REPORT

COMPREHENSIVE DRAINAGE SURVEY MAINTENANCE PLAN AND PONDING RECOMMENDATIONS

MAY, 1999

DCM GROUP

BRW

A DAMES & MOORE GROUP COMPANY

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TABLE OF CONTENTS

INTRODUCTION 2

OVERVIEW OF CITY DRAINAGE PATTERNS 3

AREAS OF CONCERN/SUGGESTED REPAIRS 5

TABLE 1.1 (IDENTIFIED DRAINAGE ISSUES)

ESTIMATED COSTS 8

PROJECT SCHEDULE 9

REGIONAL POND CONSIDERATIONS 10

TABLE 1.2 (PROPOSED FUTURE STORM WATER TREATMENT PONDS)

SUMMARY 11

APPENDIX:

A. PHOTO OF INGERSON ROAD
B. ARDEN HILLS COMPREHENSIVE DRAINAGE MAP

OVERVIEW OF CITY DRAINAGE PATTERNS

The City's watersheds are centered around its major lakes which are in turn connected to each other by large wetland complexes, ditches or drainage ways.

The Round Lake District generally includes the areas between Old Highway 10 and I-35W north of I-694. The Arden Manor Mobile Home Park and portions of TCAAP also drain into Round Lake. The majority of the Gateway Business District does not drain to Round Lake but is routed to a new storm water treatment pond between the Minnesota Commercial Railroad property and 13th St. NE. This pond discharges into the MnDOT drainage system along I-35W which drains into Long Lake in New Brighton. A storm water treatment pond is currently under construction at the north end of the Gateway Business District which will treat runoff from West Round Lake Road, Highway 96 (after reconstruction), the Nott Company property and the 4 acre parcel created from the purchase of the Indykiewicz property. This pond will discharge into Round Lake.

Round Lake overflows to the southeast into a ditch along Old Highway 10 which empties into Valentine Lake. Valentine Lake also receives a large portion of City drainage from a geographical area roughly bordered by County Road E to the South, Lexington Avenue to the East, Old Highway 10 to the west and a line approximately 300 feet south of Highway 96 to the north. Valentine Lake also receives runoff from the Valentine Hills area to the west of Old Highway 10 centered on Valentine Lake Road.

Valentine Lake overflows to the west under Old Highway 10 just north of McCracken Lane into a ditch and wetland complex which extends along County Road E2 and heads north until it leaves the City limits at a weir located near the Valentine Lake Road bridge over I-35W. This drainage enters Long Lake in New Brighton via the I-35W drainage system.

Lake Josephine receives runoff from the adjacent lake properties and the neighborhoods around Ingerson Road and Edgewater Avenue extending to Lexington Avenue. A good portion of Lake Josephine is located within the boundaries of the City of Roseville which also generates the majority of runoff entering this lake.

Lake Johanna receives a very large amount of runoff from Roseville to the south via Little Johanna Lake as well as the overflow from Lake Josephine. In addition, Lake Johanna receives runoff from Arden Hills neighborhoods bordered by New Brighton Road to the west, Lexington Avenue to the east and County Road E/Lake Johanna Blvd. to the north. Lake Johanna overflows into the wetland complex located in the Ramsey County open space between County Road E and County Road E2 where it joins up with the overflow from Valentine Lake to proceed towards Long Lake.

Karth Lake is a land-locked body of water with a relatively small tributary watershed located in the Cities of Arden Hills and Shoreview. Some high-water conditions have existed on Karth Lake in the past however a permanent means to regulate the lake level was considered and rejected by the adjacent landowners.

Sunfish Lake overflows into Marsden Lake, which drains directly to Rice Creek via a drainage way located within the TCAAP site. The existing properties fronting Highway 96 between

AREAS OF CONCERN/SUGGESTED REPAIRS

Considering the extensive drainage system in the city relatively few problem areas were encountered during the field survey. Most of the drainage ways and wetland areas are in locations where problems caused by potential flooding are relatively low in severity. The majority of drainage ways are in ravines or channels, which are well below the elevation of any development or roadways. The vast majority of problems discovered are minor in nature and consist of replacing culvert end aprons, removing debris or sediment from culverts, etc. A few cases would involve a significant investment on the part of the city to remedy or keep in functioning order. The following are short descriptions of the more significant problem areas encountered during the survey.

McClung Drive

Problem

The primary area of concern is a ditch that runs behind McClung Drive and Colleen Avenue. A resident at 1519 McClung drive has called the city reporting that the ditch has flooded numerous times in the last few years. The resident has stated that when the creek floods the water inundates their backyard and has come to within a foot of entering their walkout basement. The flooding can be attributed to a few reasons:

* The walkout basement elevation is low compared to the creek bed and the backyard grade from the walkout to the creek is nearly flat.

* The ditch bed behind the house up to the culvert outlet approximately 100 yards down stream is flat. As a result of the flat slope, flow velocity in the ditch bed is slow causing sediment to build-up, which fills in the stream channel.

* The steep hill on the north side of the creek (Royal Hills Drive/Arden Vista Court) is lacking in vegetation, which tends to slow down storm water runoff flows.

This ditch was cleaned by city crews a few years ago and has silted in and new vegetation has developed in the channel. The vegetation and sediment also acts to slow down storm water runoff flow rates.

Potential Mitigation Measures

* The primary mitigation measure is to clean the channel of sediment and debris to increase flow through the section. The inlet and outlet of the downstream culvert should also be cleaned out to maximize the flow capacity of the culvert. The steep slope on the north side of the channel should be stabilized to eliminate slope erosion and reduce the amount of sediment flow into the creek. It is likely that a periodic cleaning of this ditch will always be needed to maintain its usefulness.

* Small check dams with stilling basins could be built along the ditch upstream of the problem area. The stilling basins would be constructed to hold more water upstream and reduce the flow through the area of the stream in question. This measure would require multiple stilling basins.

Karth Lake Inlet

Problem
Stilling basins were installed a few years ago in a ravine on the south end of the lake that enters into Karth Lake. In many cases the stilling basins, constructed of rip rap, are beginning to silt-in and are clogging the culvert outlets. A corrugated metal drop manhole at the end of this drainage system is being washed out as a result of the last stilling basin running over and from runoff from the nearby bituminous pathway.

Potential Mitigation Measures
* The stilling basins should be cleaned out to ensure that they are functioning properly and that the outlets operate at the proper flow capacity.

* Rip rap or vegetation to prevent additional scouring can be used to stabilize the slope around the drop manhole.

* Some reconstruction of the structures may be necessary as well.

Ingerson Road

Problem
Ingerson Road has a history of frequent flooding. Because the street is relatively flat and there is no curb and gutter or ditches to direct the runoff, water has a tendency to pond in the street and adjacent yards.

Potential Mitigation Measures
* Ingerson Road is in poor condition and is a priority candidate for street reconstruction. Ingerson Road would be constructed with an urban pavement section, which would include curb and gutter and storm sewer.

* Because Ingerson drains directly into Lake Josephine, a storm water retention pond should be considered for any reconstruction project to improve runoff water quality and control runoff flow rates into Lake Josephine.

The existing poor drainage condition of Ingerson Road will be factored into the priority ranking system for reconstruction as a part of the comprehensive street condition review scheduled for spring of 1999. The cost table does not include costs for mitigating the Ingerson Road condition as it is assumed that the costs would be borne as a part of a street reconstruction project.

Summary Table 1.1 "Identified Drainage Issues" lists the drainage issues identified during the field survey. This table describes the identified problem, its location, maintenance responsibility, maintenance priority and an estimated maintenance cost. Table 1.1 also includes the drainage issues identified above as well as the lesser problem areas around the City.

Table 1.1

IDENTIFIED DRAINAGE ISSUES

Number	Location	Problem	Description	Maintenance Responsibility	Priority	Cost Estimate
LJ-1	3520 Siems Ct.	Overflow from Ridgewood washes over slope	Under sized drain can not handle runoff	Arden Hills	High	$ 29,100.00
LJ-2	Forest Ln. 100' E. of Snelling	Catchbasin Broken	Broken curb catchbasin	Arden Hills	Med	$ 3,000.00
LJ-3	Glen Arden Ct. 200' S. of Skiles Ln.	Ditch outlet is silting in	Requires cleaning out	Arden Hills	Low	$ 1,500.00
LJ-4	Glen Arden Rd. 200' S. of Skiles Ln.	Slope at culvert outlet is washing out	Catchbasins are running over and washing out slope	Arden Hills	Med	$ 3,000.00
LJ-4	Glen Arden Rd. 200' S. of Skiles Ln.	Catchbasins not operating properly	Both catchbasins need to be rebuilt	Arden Hills	Med	$ 5,000.00
LJ-5	Glen Arden Ct. 50' E. of Snelling	Culvert outlet obstructed ditch is silting in	12" RCP clogged with debris Ditch collecting sediment	Arden Hills	Med	$ 500.00
LJ-6	Tiller Ln N. Hamline Ave.	End of pipe damaged, Needs FES	36" RCP	Arden Hills	Med	$ 4,000.00
LJ-6	Tiller Ln N. Hamline Ave.	Ditch along E. side of N. Hamline requires cleaning	From Tiller Ln. to Ingerson	Arden Hills	Med	$ 1,500.00
LJ-7	Benton Way	FES pulled away from pipe	36" RCP no ties holding FES on	Arden Hills	Low	$ 2,000.00
LJ-8	Benton Way	Pond south inlet requires cleaning	Sediment is beginning to fill the pond inlet	Arden Hills	Low	$ 1,000.00
LJ-9	Hunters Ct.	Clean Pond Inlet	Sediment needs to be removed around the inlet	Arden Hills	Low	$ 500.00
LJ-11	Between Hwy. 51 and N. Hamline	Ditch requires cleaning	Water is backing up to wetland E. of N. Hamline	MnDot.	Med	$ 5,000.00

Total Estimated Cost **$ 175,375.00**

NOTES

1) All cost estimates include 10% for contingency and 26% for administrative costs

2) Ingerson Road, Fairview Ave. and Pascal Ave. drainage issues are not included in the total.
It is assumed Ingerson, Fairview and Pascal storm sewer construction would be included in respective street reconstruction projects.

3) RL - Round Lake Drainage District
KL - Karth Lake Drainage District
VL - Valentine Lake Drainage District
LL - Long Lake Drainage District
LJ - Lake Johanna/Josephine Drainage Districts

Karth Lake

Item	Unit	Unit Price	Quantity	Total Amount
Mobilization	LS	$ 1,000.00	1	$ 1,000.00
Ditch/Culvert Cleaning	CY	$ 12.00	350	$ 4,200.00
Culvert Repair	LF	$ 20.00	80	$ 1,600.00
Seeding	SY	$ 0.50	1,000	$ 500.00
Slope Stabilization	LS	$ 6,000.00	1	$ 6,000.00
Structure Reconstruction	LS	$ 5,000.00	1	$ 5,000.00
10% Contingency				$ 1,800.00
Total				$ 20,100.00
26% Administration				$ 5,200.00
Total Estimated Cost (Karth Lake)				**$ 25,300.00**

PROJECT SCHEDULE

The City has budgeted $50,000.00 for 1999 and 2000 and $25,000.00 per year after that to address these storm drainage issues. If the Council elects to proceed with the projects, the City Engineer will prepare a bid package of work to be accomplished in 1999 in accordance with the budget. The total amount of work identified as a part of this field review is approximately $175,000.00. Based upon the proposed City budgets, the work identified in this report could be completed in five years. Table 1.1 has the problems ranked as High, Medium and Low which can be used as a guide in scheduling the work priority for City forces-accomplished items and bid package groupings for contracts to be let. Geographical location and estimated cost will also be used to determine which projects are accomplished first.

TABLE 1.2

PROPOSED FUTURE STORM WATER TREATMENT POND LOCATIONS

Plan ID #	Location	Drainage Area (Acres)	Approx. Pond Size (Acres)	Tributary To	Potentially Constructed as Part of
P-1	S.E. corner of CSAH 96 and TH 10	48.6	2.4	Round Lake	CSAH 96 Reconstruction
P-2	W. of Snelling Ave. and Royal Hills Dr.	36.1	1.8	Round Lake	Independent Project
P-3	E. of Brueberry Ln. and Old Hwy 10	45.3	2.3	Valentine Lake	Independent Project
P-4	Valentine Park in S.W. corner of Old Hwy 10 and Valentine Lake Rd.	67.3	3.4	Valentine Lake	Independent Project
P-5	S. of Dunlap Ave and Grey Fox Rd.	31.4	1.6	Valentine Lake	Independent Project/Dunlap Rd. Reconstruction
P-6	S.E. corner of New Brighton Rd and Railroad	30.1	1.5	Long Lake	New Brighton Rd. Reconstruction
P-7	N.W. corner of Cty. Rd. E and Lake Johanna Blvd.	77.8	3.9	Long Lake	Lake Johanna Blvd. or Cty. Rd. E Reconstruction
P-8	S.W. corner of Lake Johanna Blvd. and Siems Ct.	27.4	1.4	Lake Johanna	Lake Johanna Blvd./Siems Ct. Reconstruction
P-9	Wetland in the N.E. corner of Cty. Rd. D and Cleveland Ave.	23.3	1.2	Jones Lake/New Brighton	Glenpaul Ave. Reconstruction
P-10	S. corner of Sandeen Rd. (Presbyterian Homes)	24.3	1.2	Lake Johanna	Independent Project
P-11	N.E. corner of Glenhill Rd. and Ridgewood Rd.	28.2	1.4	Lake Johanna	Reconstruction of Roads in the neighborhood
P-12	End of Ingerson Court	27.3	1.4	Lake Josephine	Reconstruction of Ingerson
P-13	N.W. Quadrant of Hamline Ave and CSAH96	50	2.5	Sunfish Lake	CSAH 96 Reconstruction

INGERSON ROAD FLOODING
MARCH 30, 1998

EXAMPLE AGREEMENT

(REGARDING STORM WATER MANAGEMENT PRACTICES WATER QUALITY TREATMENT POND)

I. THIS AGREEMENT made this _____ day of _____, 200__ by and among the City of Arden Hills, Minnesota (hereinafter referred to as the "City") and, _____, a _____ corporation (hereinafter referred to as "_____") with reference to the following facts and circumstances:

A. (*)_____ is the fee owner of certain real property situated in the City of _____, legally described as follows: (Legal)_____, (*) CAPS_____(_____) (hereinafter referred to as the "Subject Property").

B. As a condition of its approval of the development for the Subject Property, the City of Arden Hills has required that the parties hereto enter into an agreement, which makes provision for the maintenance of the Storm Water Management Practice located within the boundaries of the Subject Property as the same is described and depicted in those certain construction plans drawn by _____, approved by the City and constructed by _____. The Storm Water Management Practice is located in the platted drainage and utility easement in _____.

C. The parties hereto desire to set forth their agreement with respect to the maintenance of the Storm Water Management Practice and the costs of such maintenance.

II. NOW THEREFORE, in consideration of the foregoing facts and circumstances, and for other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the parties hereto hereby agree as follows:

A. For the purposes of this Agreement, maintenance of the Storm Water Management Practice shall mean the annual inspection and certification by a qualified individual that the pond is functioning in accordance with the approved plans and, if necessary, the periodic dredging of the silt buildup in the Storm Water Management Practice as necessary to maintain function, as established for the Storm Water Management Practice in the construction plans and to maintain the proper operation of the treatment function of the Storm Water Management Practice.

B. (*)_____ shall be solely responsible for the maintenance of the Storm Water Management Practice, and shall bear all costs of such maintenance, until such time as _____ (hereinafter referred to as the "Association") is activated pursuant to Article _____, Section _____, of the Declaration of Covenants for _____, whereupon the Association shall bear the sole responsibility for such maintenance and shall bear all costs of such maintenance. If (*)_____, or after its

incorporation, the Association, does not undertake the necessary maintenance within 30 days of notification by the City, or within 30 days provide the City with a schedule for undertaking the necessary maintenance, the City may undertake such maintenance, and the costs reasonably incurred by the City for performing such maintenance shall be reimbursed to the City within 30 days by the party responsible for such maintenance and, if the responsible party does not timely reimburse the City, then the City may recover its costs by levying a special assessment against all single family house lots in the Subject Property, each lot to bear an equal share.

C. (*)_____, as present owner of the Subject Property, for itself and respective successors and assigns, hereby waives any statutory right which it may have to contest any such assessment by the City of its maintenance costs on the basis of the benefit to portions of the Subject Property.

D. Notwithstanding anything contained in this Agreement to the contrary, in the event the city shall establish a policy for maintenance by the City of Storm Water Management Practices located elsewhere in the City of Arden Hills, Minnesota under which policy the costs of such maintenance are to be paid either out of general City revenues or by collection of utility or service fees or charges, then any owner of any portion of the Subject Property shall be entitled to petition the City for the inclusion of the Storm Water Management Practice under such maintenance program, and the City shall consent to such request and thereupon authorize the termination of this Agreement. The recording of a certified copy of the Resolution of the City Council of the City which sets forth the consent and authorization described in the foregoing sentence shall serve the terminate this Agreement, without further action on the part of any party hereto.

E. The terms and conditions of this Agreement shall be binding upon, and shall insure to the benefit of, the parties hereto and their respective successors and assigns.

III. IN WITNESS WHEREOF, the parties hereto have caused this document to be executed as of the day and year first above written.

THIS INSTRUMENT DRAFTED BY _____

Table 8

Planning Region Peak Discharges and Runoff Volumes.

Planning Region	2 year, 24 hour precipitation event		10 year, 24 hour precipitation event		100 year, 24 hour precipitation event		100 year, 10 day snowmelt runoff event	
	Peak Discharge (cfs)	Volume* (ac-ft)	Peak Discharge (cfs)	Volume* (ac-ft)	Peak Discharge (cfs)	Volume* (ac-ft)	Peak Discharge (cfs)	Volume* (ac-ft)
Upper Rice Creek	178.3	925	289.3	1,734	413.5	2,978	439.4	7,068
Hardwood Creek	195.0	517	303.2	922	422.0	1,724	413.1	6,003
Clearwater Creek	91.6	657	180.8	1,436	491.4	3,182	907.5	9,392
Middle Rice Creek	111.2	1,165	272.6	2,967	575.6	6,315	1,207.2	18,136
Lower Rice Creek	349.2	2,705	743.5	6,247	1285.7	11,881	1534.7	27,413

*Volume for 24 hour event is the volume over a 7 day period following start of a 24-hr event, and 13 days following the start of the 10 day event

4.3.3 Intercommunity Flows

The final category identified in the WMP as Regional Assessment Locations are intercommunity flows. The public drainage systems of the Rice Creek Watershed District convey much of the stormwater discharge between the cities within the District, and are relatively easy locations to quantify, assess, and manage stormwater discharge. **Figure 10** shows the locations of intercommunity flows along the public drainage systems and public waterways of the District. A summary of modeled peak discharges for each of these locations is provided in **Table 9**. These discharges are based upon current land uses and provide a benchmark for evaluating potential intercommunity issues. In the future, the conveyance capacity of these locations can be compared to current and projected flows, and subsequently be assessed for any potential deficiencies. These values may also be used by the cities to assess the adequacy of capacity within the conveyance system.

Table 9
Intercommunity Flows.

Discharging City	Receiving City	Watercourse	Peak Flows (cfs)			
			2-Year, 24-Hour Rainfall	10-Year, 24-hour Rainfall	100-Year, 24-hour Rainfall	100-Year, 10-Day Snowmelt
Arden Hills	Mounds View	Rice Creek	225	460	761	1377
Arden Hills	New Brighton	Lake Johanna Outlet	40	72	96	109
Arden Hills	Shoreview	RCD 1 Main Trunk	3	9	12	29
Blaine	Circle Pines	ACD 53-62 Main Trunk	48	88	132	153
Blaine	Lino Lakes	ACD 53-62 overflow to ACD 10-22-32 (Sunset Ave.)	3	5	13	24
Blaine	Mounds View	ARJD 1 Main Trunk	53	72	89	83
Blaine	Shoreview	Rice Creek	68	145	632	1326
Centerville	Lino Lakes	AWJD 3 Main Trunk	195	303	422	413
Circle Pines	Blaine	Rice Creek	113	284	632	1325
Columbus	Lino Lakes	Rice Creek	158	265	443	426
Columbus	Lino Lakes	ACD 10-22-32 Branch 4	1	3	7	7
Columbus	Lino Lakes	ACD 10-22-32 Main Trunk	2	6	14	15
Dellwood	White Bear Twp.	RWJD 1 Main Trunk	38	101	254	248
Forest Lake	Columbus	AWJD 4 Branch 4	5	13	20	30
Forest Lake	Columbus	AWJD 4 Branch 3	4	6	13	28
Forest Lake	Columbus	AWJD 4 Main Trunk	31	73	140	148
Forest Lake	Columbus	Rice Creek	11	21	36	37
Forest Lake	Hugo	AWJD 2 Main Trunk	83	235	713	1044
Grant	Dellwood	Private Open Channel	34	49	59	64
Grant	Dellwood	Private Open Channel	2	4	7	13
Hugo	Forest Lake	AWJD 2 Main Trunk	36	100	469	673
Hugo	Grant	Private Open Channel	26	47	54	33
Hugo	Lino Lakes	AWJD 2 Main Trunk	92	186	497	945
Hugo	Lino Lakes	AWJD 3 Main Trunk	145	245	341	346
Lino Lakes	Centerville	AWJD 3 Main Trunk	160	266	439	394
Lino Lakes	Circle Pines	RCD 8 Main Trunk	6	14	29	36
Lino Lakes	Circle Pines	Rice Creek	111	273	570	1206
Lino Lakes	Hugo	AWJD 3 Branch 4	25	40	66	34
Lino Lakes	Hugo	AWJD 3 Branch 1	8	14	25	24
Mounds View	New Brighton	Rice Creek	243	480	782	1376
Mounds View	Shoreview	ARJD1 Main Trunk	75	126	202	142
New Brighton	Fridley	Rice Creek	338	715	1093	1530
Roseville	Arden Hills	RCD 4 Main Trunk	290	423	594	298
Roseville	New Brighton	RCD 5 Main Trunk	36	35	36	31
Shoreview	Arden Hills	Rice Creek	195	397	667	1379
Shoreview	Lino Lakes	RCD 8 Main Trunk	3	8	19	28
St. Anthony	New Brighton	RCD 3 Main Trunk	164	225	173	151
White Bear Lake	White Bear Twp.	RCD 11 Main Trunk	17	29	44	37

APPENDIX G
Southwest Urban Lakes Study – Arden Hills Lake Assessments and MAPs

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Southwest Urban Lakes Study

April 2009

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Table of Contents

1. Executive Summary 1
2. Introduction 2
A. RCWD, RMPs, Urban lakes 2
B. Lake Eutrophication Standards 3
C. Impaired Waters Program 4
3. Phosphorus Analysis 5
A. Nutrient Loading to Lakes 5
Purpose of analysis 5
Watershed loading 5
Internal loading 11
B. Lake Response Modeling 17
Purpose of modeling 17
Modeling approach 17
Results 19
4. Lake Management Action Plans 21
A. Purpose 21
B. Public Meetings 21
C. MAPs 21
5. Long-Term Management Strategy 22
A. Priorities 22
B. Recommended Actions for 2009 23
6. References 31

Appendix - Management Action Plans

1. Executive Summary

Over the past few years, the Rice Creek Watershed District has prioritized its efforts on Resource Management Plans in the developing portions of the District. The District's next focus is on more urbanized areas. Recently, RCWD has received numerous inquiries for assistance in cleaning up some fairly degraded urban lakes in the southwest portion of the watershed. These requests came from lake homeowners and/or associations on lakes that have been subjected to decades of concentrated urban runoff and are now showing the effects of that pollutant loading. The goal of this project is to assess the water quality of 24 lakes in the southwest portion of RCWD, particularly in relation to state standards, and to develop management action plans for each lake. The intent of the management action plans is to give the District a prioritized list of projects for further investigation. The prioritization exercise is NOT intended to make a final determination on the merits of a particular project. For most projects further feasibility assessments would be needed before the District proceeds with a particular project.

The phosphorus loads to each lake were estimated in order to develop lake response models and to determine the magnitude of the load reductions that are needed for the lakes to achieve water quality standards. The watershed loads were estimated using an urban runoff model (P8), and the internal loads were modeled using sediment data, in-lake nutrient concentrations, and basic lake morphometry to predict internal loads due to anoxic release. Lake response models were developed for each lake in order to integrate the watershed loading with the internal loading into a predictive model.

The Lake Management Action Plans (MAPs) presented here summarize lake characteristics and existing lake data, provide a diagnostic assessment of the data, summarize public input, identify water quality issues, and recommend remedial strategies on a lake-watershed basis. As such, each MAP provides a concise summary of the known issues and recommended management approaches for each lake. It is envisioned that the MAPs will be used to further define management strategies, guide development of the District's Third Generation Plan, and serve as the basis for seeking project partners and grant funding for retrofit water quality improvements.

Over 200 potential retrofit BMPs are identified in the MAPs. In order to prioritize further assessment and implementation feasibility, a simplified cost/benefit assessment was performed to assign each BMP as a Tier 1, 2 or 3 BMP (Tier 1 having the best cost-benefit ratio). Based on this prioritization, the recommended implementation strategy for 2009 includes:

- Initiation of feasibility studies on three Tier 1 BMPs
- Coordination with parks departments on six Tier 1 BMPs within community parks
- Solicitation of private party interest in potential cost share on nineteen Tier 1 BMPs
- Landowner notification of needed maintenance at three Tier 1 BMPs

2. Introduction

A. RCWD, RMPs, URBAN LAKES

Over the past few years, the Rice Creek Watershed District has prioritized its efforts on Resource Management Plans (RMPs) in the developing portions of the District. The RMP projects to date include topics such as wetland management, water quality to meet TMDL goals, and ditch repairs. Since RMPs are either approved or in the process of being written for the developing areas, RCWD's next focus is on more urbanized areas.

Recently, RCWD has received numerous inquiries for assistance in cleaning up some fairly degraded urban lakes in the southwest portion of the watershed. These requests come from lake homeowners and/or associations on lakes that have been subjected to decades of concentrated urban runoff and are now showing the effects of that pollutant loading. Some of the lakes in question include Little Johanna, Pike, Long, and Spring.

The goal of this project is to assess the water quality of 24 lakes (Figure 1, Table 1) in the southwest portion of RCWD, particularly in relation to state standards, and to develop management action plans for each lake:

Table 1. Study Lakes

Lake Name	DNR Lake ID
Hart	02-0081
Island	62-0075
Johanna	62-0078
Jones	62-0076
Josephine	62-0057
Karth	62-0072
Langton	62-0049
Little Johanna	62-0058
Little Josephine	62-0201
Locke	02-0077
Long	62-0067
Marsden	62-0059
Martha	62-0064
Moore	02-0075
Pike	62-0069
Poplar	62-0077
Round	62-0070
Rush	62-0068
Spring	02-0071
Sunfish	62-0065
Turtle	62-0061
Valentine	62-0071
Walsh	62-0214
Zimmerman	62-0053

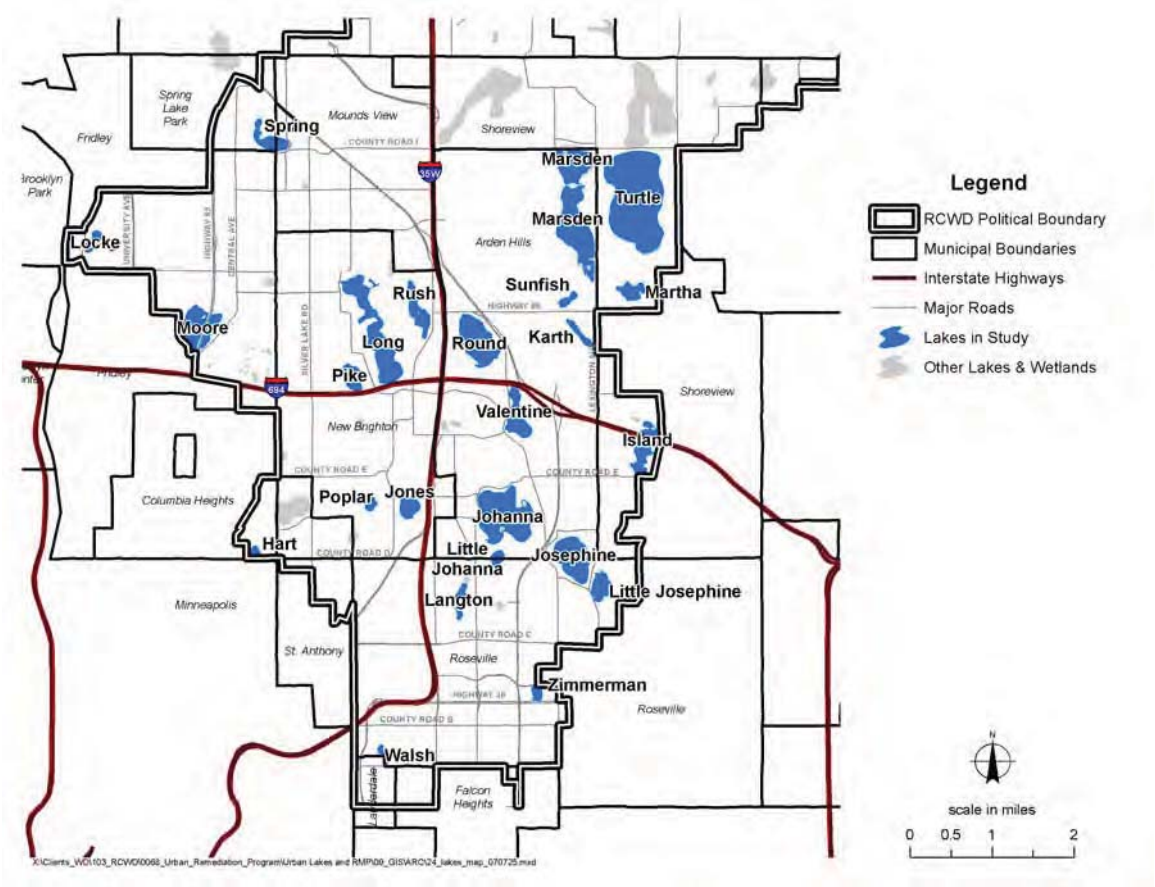

Figure 1. Location of Study Lakes

B. LAKE EUTROPHICATION STANDARDS

Water quality standards are established to protect the designated uses of the state's waters. Amendments to Minnesota's Rule 7050, approved in May 2008, include eutrophication standards for lakes (Table 2). *Eutrophication* is defined as "a process whereby water bodies receive excess nutrients that stimulate excessive plant growth" (USGS). "Excessive plant growth" often refers to algae blooms that can result in deceased water clarity (green, soupy appearance) or surface scums. Excessive algae growth can lead to a loss of native aquatic plants, decreased recreational use, unpleasant odors and appearance, and altered fish communities favoring undesirable species (rough fish). Eutrophication standards were developed for lakes in general, and for shallow lakes in particular. Standards are less stringent for shallow lakes, due to naturally higher levels of phosphorus in shallow lakes and different ecological characteristics.

According to the MPCA definition of shallow lakes, a lake is considered shallow if its maximum depth is less than 15 ft, or if the littoral zone (area where depth is less than 15 ft) covers at least 80% of the lake's surface area.

Table 2. MN Eutrophication Standards, North Central Hardwood Forests Ecoregion

Parameter	Eutrophication Standard, General	Eutrophication Standard, Shallow Lakes
Total Phosphorus (µg/l)	TP < 40	TP < 60
Chlorophyll-*a* (algae) (µg/l)	chl < 14	chl < 20
Secchi depth (clarity) (m)	SD > 1.4	SD > 1.0

C. IMPAIRED WATERS PROGRAM

Section 303(d) of the Federal Clean Water Act requires that states establish total maximum daily loads of pollutants to water bodies that do not meet water quality standards. The loading limits are to be calculated such that, if achieved, the water body would meet the applicable water quality standard. To comply with the Clean Water Act, the Minnesota Pollution Control Agency (MPCA) assesses the state's waters, lists those water bodies that are impaired (i.e. do not meet water quality standards), and conducts studies to determine the pollutant loading limits for the impaired water bodies. These studies are known as TMDL studies, or total maximum daily load studies. In Minnesota, the pollutant that is often the cause of eutrophication is phosphorus.

The MPCA sets target start and completion dates for individual TMDL studies. Studies are usually funded by either the MPCA or by local units of government. Each TMDL study describes the impairment, identifies the relevant pollutant(s), inventories the pollutant sources, calculates the capacity of the water body (i.e. the amount of pollutant the lake can process in its natural cycle), allocates the allowable loads to the different sources, and prescribes an implementation strategy to restore the water body to meet water quality standards.

Within a year of completing the TMDL study, the MPCA requires the completion of an implementation plan, which provides more specific management details than are provided in the initial TMDL study.

Several waters that are listed on the 303(d) list of impaired waters are located within the project area (Table 3).

Table 3. Impaired Lakes

Lake Name	DNR Lake ID	Year First Listed	Impairment	Target start/ completion dates
Island Lake	62-0075	2002	Nutrient/Eutrophication Biological Indicators	2010 / 2014
Jones Lake	62-0076	2008	Aquatic macroinvertebrate bioassessments	2010 / 2014
Little Lake Johanna	62-0058	2004	Nutrient/Eutrophication Biological Indicators	2010 / 2014
Long Lake	62-0067	2002	Nutrient/Eutrophication Biological Indicators	2010 / 2014
Moore Lake, East	02-0075	2002	Nutrient/Eutrophication Biological Indicators	2009 / 2013
Pike Lake	62-0069	2002	Nutrient/Eutrophication Biological Indicators	2010 / 2014
Lake Valentine	62-0071	2002	Nutrient/Eutrophication Biological Indicators	2010 / 2014

3. Phosphorus Analysis

A. NUTRIENT LOADING TO LAKES

Purpose of analysis

Phosphorus is the nutrient that, in excessive amounts, leads to eutrophication in lakes in Minnesota, and it is the nutrient that is used by the MPCA to set numeric standards for lakes. As such, phosphorus is the pollutant focused on in this report.

The phosphorus loads to each lake were estimated in order to develop lake response models and to determine the magnitude of the load reductions that are needed for the lakes to achieve water quality standards. The watershed loads and the internal loads were estimated independently.

Watershed loading

Approach

The general approach for determining the total phosphorus (TP) load entering each of the lakes in the study area was to estimate the load generated from each lake's direct watershed and to account for all additional loads coming from upstream lakes, ponds, or watersheds. Watershed TP loading was determined using a reconnaissance level P8 Urban Catchment Model. The model predicts loads generated from urban watersheds based primarily on their size and level of imperviousness. The P8 model allows the user to account for the degree to which impervious surfaces are connected throughout the watershed and, ultimately, to the receiving water body. The portion of the impervious surfaces directly connected to the receiving water body was set at 85% for each of the watersheds in the study area. The other 15% of the area is indirectly connected to the receiving water body through pervious areas such as lawns or natural areas. No attempt was made to characterize the water quality treatment being provided by small ponds or other BMPs, such as street sweeping, throughout the watersheds.

The P8 model was run using the 1995 water year (October 1994 through September 1995). This water year represents an average year for the Minneapolis-St. Paul area in terms of total precipitation and distribution of storm events. The NURP50 particle file was used in the P8 model. It represents the 50th percentile particle size distribution based on all NURP data and is recognized as the standard file for use in this type of analysis. General model parameters were established for all of the watersheds within the study area (Table 4).

Table 4. P8 Model input parameters

P8 model parameter		Setting
Pervious	Curve Number	61
	Load Factor	1
Impervious	Depression Storage	0.02 inches
	Runoff Coefficient	0.9
	Load Factor	1

Subwatersheds for the lakes were delineated from existing resources, based on best available data for the area. Data sources included:

- Ramsey County 2-foot topographic data
- USGS 10-foot topographic data (for Anoka and Hennepin County)
- 1998 RCWD Calibration Study subwatersheds
- City Local Plan subwatershed and stormsewer maps
- Institutional knowledge of the system

It was originally envisioned that these preliminary subwatersheds would be refined with the District-wide SWMM modeling effort originally scheduled for the southwest lobe of the District in 2008. Because this modeling effort was postponed, it is recommended that, when the District pursues detailed modeling of the southwest area of the District, the watersheds should be refined utilizing LIDAR and field survey data.

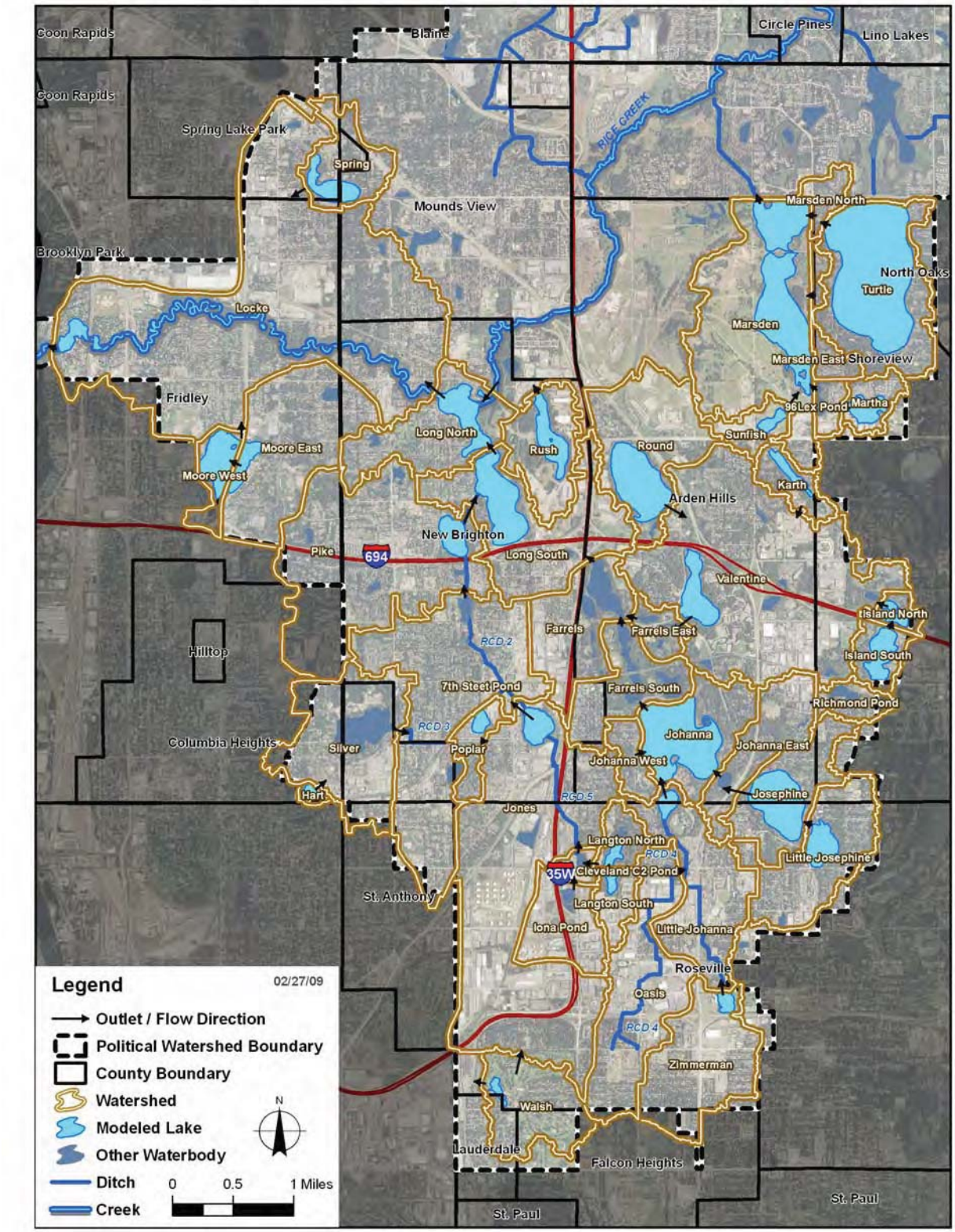

Figure 2. Subwatershed Boundaries and Drainage Direction

Impervious surface estimates for each watershed were extracted from QuickBird satellite imagery using digital image processing techniques. A supervised maximum likelihood classification using a sample priori probability was performed using 79 training samples representing urban, urban shadow, vegetation, vegetation shadow, and open water land cover types. Some urban and water features were burned into the classification manually to obtain a higher accuracy classification. Burned-in water features included modeled lake outlines as well as polygon areas representing open water MLCCS codes. Some areas classified as urban were also manually burned into the classification using polygons created by heads up digitizing. After manual edits were finished, the final classification consisted of urban (100% impervious), vegetation (0% impervious), and water (100% impervious) land cover types. Percent impervious weighted averages per subwatershed were then extracted using a zonal statistics routine.

The acreage and percent impervious for each lake's direct watershed are listed in Table 5 (see also Figure 2 for subwatershed boundaries). In some cases, additional areas drain to the lakes in the study area and these areas were modeled separately from the direct watershed area. These additional areas were separated from the direct lake watershed because they are either large, distinct areas or contain a significant water body that provides water quality treatment. The acreage and impervious percentage for these areas are also listed in Table 5.

Table 5. Watershed specific P8 Model input parameters

Direct Lake Watersheds		
Watershed Name	**Area (acres)**	**Percent Impervious**
Hart	15.9	55%
Island North	47.95	30%
Island South	91.58	32%
Johanna	207.21	22%
Jones	1699.73	50%
Josephine	279.76	27%
Karth	117.74	35%
Langton North	98.54	27%
Langton South	109.45	69%
Little Johanna	535.85	45%
Little Josephine	449.77	31%
Locke	2679.06	40%
Long North	400.62	27%
Long South	618.32	45%
Marsden	790.38	18%
Martha	76.76	43%
Moore East	701.19	36%
Moore West	47.27	40%
Pike	1228.12	38%
Poplar	108.49	43%
Round	465.07	36%
Rush	276.63	47%
Spring	302.88	35%
Sunfish	111.74	39%
Turtle	287.58	18%
Valentine	1655.41	38%
Walsh	372.2	18%
Zimmerman	531.23	46%
Additional drainage areas - no treatment		
Watershed Name	**Area (acres)**	**Percent Impervious**
Johanna East	325.45	35%
Johanna West	114.52	28%
Marsden East	116.41	26%
Marsden North	86.38	30%
Farrels	433.4	45%
Farrels East	104.59	24%
Farrels South	348.08	22%

Additional drainage areas - with treatment		
Watershed Name	**Area (acres)**	**Percent Impervious**
7th Street	1156.66	41%
96 & Lexington	71.86	47%
Cleveland & C2	53.7	63%
Iona	280.93	71%
Oasis	663.97	59%
Richmond	96.03	36%

The P8 Model was used to calculate the volume of stormwater and the total phosphorus loading from each lake's direct watershed as well as the additional areas that drain to the lakes. The model was also used to calculate the reduction in total phosphorus loading provided by the ponds located in the drainage areas with treatment shown in Table 5. Ponds in these drainage areas were modeled using configuration assumptions derived from their surface area shown in Table 6.

Table 6. Pond Configuration Assumptions

Pond	Permanent Pool		Flood Pool		Bottom
	Surface Area (known)	**Volume Surface Area x 2 feet deep**	**Area 110% of the permanent pool area**	**Volume Flood Pool area ½ foot deep**	**Area ~ 1/2 Permanent Pool**
	Acres	**Acre-feet**	**Acres**	**Acre-feet**	**Acres**
Oasis	6.94	13.88	7.63	3.82	3
Richmond Pond	11.59	23.18	12.75	6.37	6
Iona Pond	4.15	8.3	4.57	2.28	2
7th Street Pond	5.37	10.74	5.91	2.95	2.5
Cleveland C2 Pond	3.18	6.36	3.5	1.75	1.6
96Lex Pond	10.68	21.36	11.75	5.87	5.5

The volume of stormwater and the loading of total phosphorus to each lake were calculated as indicated in Table 7. In many cases, the direct drainage area was the only source of stormwater and TP loading. Other lakes have more complex drainage systems (see Figure 2 for subwatershed boundaries and drainage directions) and receive loading from upstream lakes, ponds, or drainage areas. The outflow volume and TP concentrations from upstream lakes were calculated using the Bathtub in-lake model as described in *Section B: Lake Response Modeling, Modeling Approach (#2)*. Volume and TP loads from upstream ponds were calculated using the P8 model as described above. .

Table 7. Source of TP Load Estimates to Lakes

Lake	TP Load Calculation Approach
Hart	Direct drainage area only
Island North	Direct drainage area only
Island South	Direct drainage area only
Johanna	Direct drainage area, Johanna West drainage area, Johanna East outflow, Little Johanna Lake outflow
Jones	Direct drainage area, Poplar Lake outflow, Cleveland C2 Pond outflow, Walsh Lake outflow
Josephine	Direct drainage area, Little Josephine Lake outflow
Karth	Direct drainage area only
Langton North	Direct drainage area only
Langton South	Direct drainage area only
Little Johanna	Direct drainage area, Oasis Lake outflow, Zimmerman Lake outflow
Little Josephine	Direct drainage area only
Locke	Direct drainage area, Rice Creek inflow (drainage area x 6 in. runoff x monitored Rice Creek TP conc of 117 µg/L)
Long North	Direct drainage area, Long Lake South outflow, Rice Creek inflow (drainage area x 6 in. runoff x monitored Rice Creek TP conc of 153 µg/L)
Long South	Direct drainage area, Pike Lake outflow, Farrels drainage area
Marsden	Direct drainage area, Marsden East drainage area, Marsden North drainage area, 96Lex Pond outflow, Turtle Lake outflow, Sunfish Lake outflow
Martha	Direct drainage area only
Moore East	Direct drainage area only
Moore West	Direct drainage area only
Pike	Direct drainage area, 7th Street Pond outflow
Poplar	Direct drainage area only
Round	Direct drainage area only
Rush	Direct drainage area only
Spring	Direct drainage area only
Sunfish	Direct drainage area only
Turtle	Direct drainage area only
Valentine	Direct drainage area, Karth Lake outflow, Round Lake outflow, North Island Lake outflow
Walsh	Direct drainage area only
Zimmerman	Direct drainage area only

Results

Results from the P8 watershed modeling are presented as part of the lake modeling discussion, *Section 2B. Lake Response Modeling*.

Internal loading

Internal loading in lakes refers to the phosphorus load that originates in the bottom sediments and is released back into the water column. The phosphorus in the sediments was originally deposited in the lake sediments through the settling of particulates (attached to sediment that

entered the lake from watershed runoff, or as phosphorus incorporated into biomass) out of the water column. Internal loading can occur through various mechanisms:

- Anoxic (lack of oxygen) conditions in the overlying waters. Water at the sediment-water interface may remain anoxic for a portion of the growing season, and low oxygen concentrations result in phosphorus release from the sediments. If a lake's hypolimnion (bottom area) remains anoxic for a portion of the growing season, the phosphorus released due to anoxia will be mixed throughout the water column when the lake loses its stratification at the time of fall mixing. Alternatively, in shallow lakes, the periods of anoxia can last for short periods of time; wind mixing can then destabilize the temporary stratification, thus releasing the phosphorus into the water column.
- Physical disturbance by bottom-feeding fish such as carp and bullhead. This is exacerbated in shallow lakes since bottom-feeding fish inhabit a greater portion of the lake bottom than in deeper lakes.
- Physical disturbance due to wind mixing. This is more common in shallow lakes than in deeper lakes. In shallower depths, wind energy can vertically mix the lake at numerous instances throughout the growing season.
- Phosphorus release from decaying curly-leaf pondweed (*Potamogeton crispus*). This is more common in shallow lakes since shallow lakes are more likely to have nuisance levels of curly-leaf pondweed.

Internal loading due to the anoxic release in the epilimnion of each lake was estimated in this study. Internal loading due to physical disturbance and decaying curly-leaf pondweed is difficult to estimate reliably and was therefore not included in the lake phosphorus analyses. In lakes where internal loading due to these sources is believed to be substantial, the internal load estimates presented here are likely an underestimate of the actual internal load.

Approach

Internal loads due to anoxic release in the hypolimnion were calculated based on an approach developed by Nürnberg (1988, 1995) in which an anoxic factor is calculated based on in-lake TP concentrations, lake surface area, and lake mean depth, and a sediment phosphorus release rate is calculated based on sediment phosphorus concentrations.

The internal load of a lake can be estimated by the following equation:

$$\text{Internal P loading rate} = AF \times RR$$

Where AF = anoxic factor, and RR = release rate (Nürnberg 1987). These two parameters were calculated as follows.

Anoxic Factor

The anoxic factor describes the length of time (in days) that a sediment area equal to the lake's surface area is anoxic (Nürnberg 1995). The correction for lake surface area makes the anoxic factor comparable among lakes of different sizes. The anoxic factor can be calculated by knowing the spatial extent and duration of anoxia. Nürnberg (1996) estimated the anoxic factor with the following equation, developed from a data set of lakes in central Ontario and eastern North America:

$$AF_{summer} = -36.2 + 50.1 \log(TP) + 0.762z / A^{0.5},$$

where Af_{summer} = summer anoxic factor (days/yr), TP = average summer in-lake TP concentration (µg/L), z = lake mean depth (m), and A = lake surface area (km^2).

Release Rate

The release rate of phosphorus from lake sediments can be predicted by the phosphorus concentrations within the sediments (Nürnberg 1988) with the following equation:

$$RR = -0.58 + 13.72(BD\text{-}P),$$

where RR = release rate (mg/m^2-day), and BD-P = bicarbonate dithionite extractable phosphorus (mg/g dry weight). BD-P analyzes iron-bound phosphorus, and has a better predictive ability than the total phosphorus in the sediment.

Sediment collection

Lake sediment samples were collected at each lake using a WaterMark Universal Core Head sediment corer.

At the lakes that had a well-defined deep hole, two to three locations in the vicinity of the deep hole were sampled. At each location, two to three replicates were taken. All of the samples taken from these lakes were composited before preserving on ice. The deep hole samples were composited since lake sediments tend to be concentrated over time in the deepest part of the lake.

At some of the more shallow lakes that did not have a well-defined deep hole, multiple samples were taken in different locations in the lake and were not composited, but rather were analyzed individually. This was done to examine spatial variability in the sediment phosphorus concentrations, since there is not one single location within the lake where the sediments tend to concentrate. At the remaining shallow lakes, sediment was sampled in only one location. When there was more than one sample analyzed per lake, the results were averaged for purposes of estimating the internal loading in the lake.

Sediment samples were analyzed for total phosphorus, aluminum-adsorbed phosphorus, calcium-adsorbed phosphorus, iron-adsorbed phosphorus, labile phosphorus, percent organic matter, and percent solids. The iron-adsorbed phosphorus fraction (also known as BD-P, or bicarbonate dithionite extractable phosphorus) was used to predict the phosphorus release rate of the sediments.

Results

The iron-adsorbed phosphorus ranged from 17 to 1400 mg P/kg sediment (dry weight), and was positively correlated with total phosphorus (R^2 = 0.91, Figure 3). The highest internal loading rates (anoxic factor x release rate) were in Little Lake Johanna, Little Lake Josephine, Long Lake North, and Pike Lake (Table 9). The lowest rates were in Langton Lake, Martha Lake, Moore Lake West, Spring Lake, and Turtle Lake.

Table 8. Sediment Laboratory Results

Lake Name	TP (mg/kg dry)	P, Aluminum Adsorbed (mg/kg dry)	P, Calcium Adsorbed (mg/kg dry)	P, Iron Adsorbed (mg/kg dry)	P, Labile (mg/kg dry)	Percent Organic (%)	% Solids
Hart	770	180	280	120	<19	7.7	20
Island N	670	300	89	120	<17	13.3	20
Island S	680	370	61	120	<30	18.5	13
Johanna	950	30	180	250	<30	16.5	12
Jones	1200	390	130	420	<36	27.3	11
Josephine	1600	370	160	560	<59	32.6	6.3
Karth	750	240	150	130	<20	9.7	19
Langton N	560	360	42	86	<15	14	24
Langton S	88	33	23	17	<5.9	1	64
Little Johanna	2700	780	230	1200	<24	18	16
Little Josephine	2100	550	220	1400	<41	23.2	9.7
Locke	770	120	330	300	<13	8.7	30
Long N	2300	450	90	1300	74	32.6	7.8
Long S	2500	700	240	1300	<30	16	13
Marsden	690	180	38	310	<61	56.6	6.4
Martha	610	160	23	72	<53	63.9	7.4
Moore E	870	290	280	220	<16	10.8	24
Moore W	610	190	53	66	<37	46.5	11
Moore W	540	220	42	48	<37	53.2	10
Moore W	680	270	56	69	<35	49.7	11
Pike	2400	540	280	1200	<22	14.3	17
Poplar	790	150	290	140	<23	8.7	17
Poplar	870	170	270	150	<21	7.4	18
Poplar	640	150	210	100	<20	10.1	20
Round	850	230	81	170	<47	33.7	8.2
Rush	1500	560	75	460	<69	40.7	5.3
Spring	470	260	23	55	<110	34.2	16
Sunfish	630	260	110	130	<18	9.5	21
Turtle	1100	200	59	85	<90	28.5	4.1
Valentine	1100	140	320	360	<62	33.6	6.3
Walsh	1000	370	130	290	<29	15.0	13
Walsh	840	99	22	300	<13	9.1	28
Zimmerman	920	310	280	190	<19	11.0	20

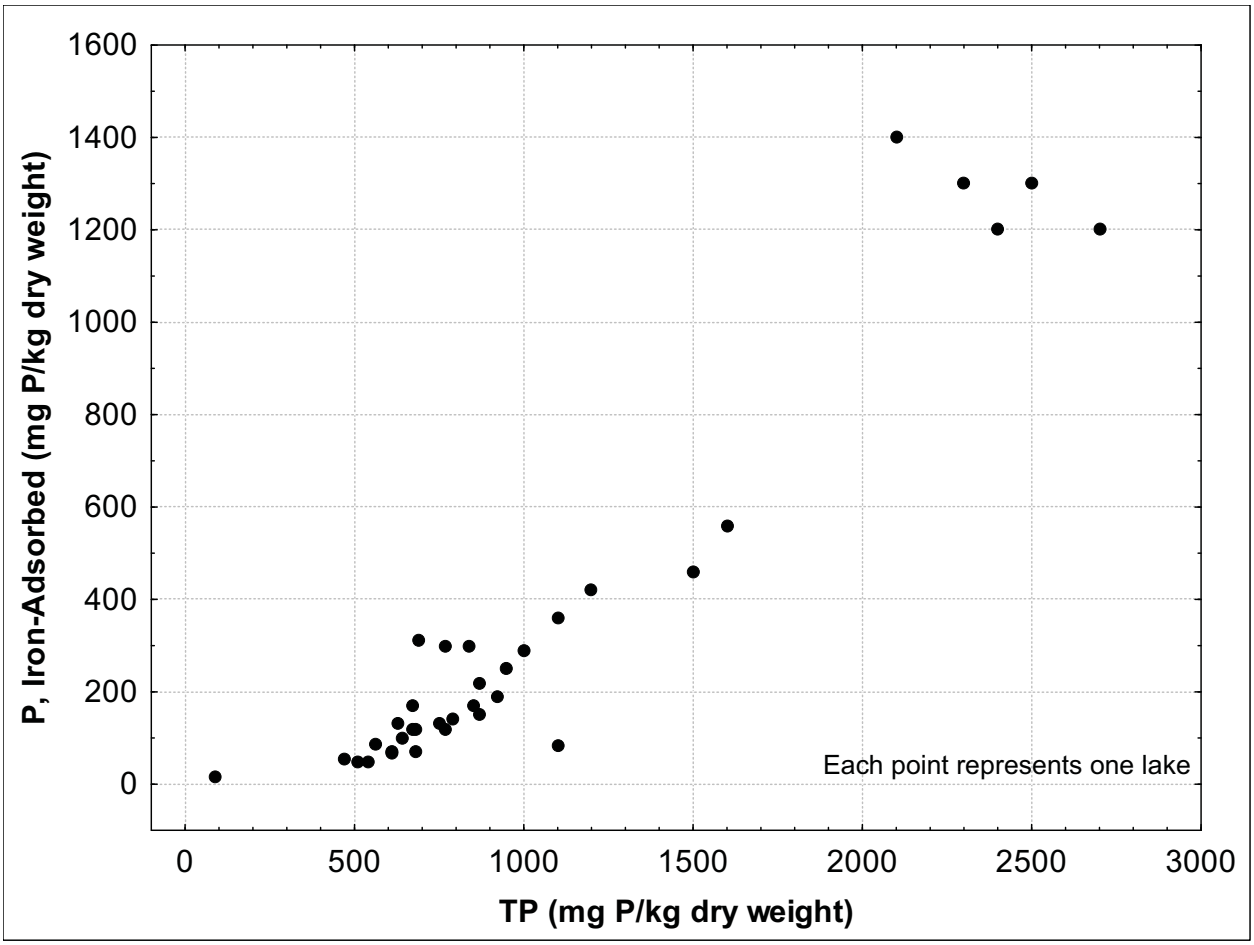

Figure 3. TP and Iron-Adsorbed Phosphorus Relationship.

Table 9. Internal Load Calculations

Lake Name	Release Rate Calculations		Anoxic Factor Calculations				AF x RR (mg/m^2-yr)	Internal load (lbs/yr)
	Iron-Adsorbed Phosphorus (mg/kg)	P Release Rate, RR (mg/m2-day)	Lake Area (ac)	Mean depth (m)	TP mean, GS (µg/L)	AF (days/ summer)		
Hart	120	1.07	8.1	0.61	168	77.9	83	6.
Island N	120	1.07	18.6	0.86	100	66.4	71	12
Island S	120	1.07	43.6	1.43	84	62.9	67	26
Johanna	250	2.85	213.5	4.92	33	44.0	125	239
Jones[1]	420	5.18	37.5	0.24	207	80.3	416	139
Josephine	560	7.10	116.4	3.22	36	45.3	322	334
Karth	130	1.20	20.5	1.50	54	54.6	66	12
Langton N	86	0.60	13.3	1.20	66	58.9	35	4
Langton S	17	-0.35	10.3	1.20	55	55.5	-19	-2[2]
Little Johanna	1,200	15.88	17.3	3.04	80	68.0	1,080	166
Little Josephine[1]	1,400	18.63	44.2	0.68	84	61.4	1,144	452
Locke[1]	300	3.54	22.4	1.20	117	70.5	249	50
Long N	1,300	17.26	73.1	1.65	145	74.4	1,284	838
Long S	1,300	17.26	118.9	3.44	54	54.4	938	995
Marsden[1]	310	3.67	271.5	0.50	61	53.6	197	477
Martha[1]	72	0.41	34.0	0.50	59	53.5	22	7
Moore E	220	2.44	29.5	1.66	44	49.9	122	32
Moore W	61	0.26	70.3	0.61	58	53.2	14	9
Pike	1,200	15.88	37.2	1.87	88	65.0	1,032	342
Poplar[1]	130	1.20	12.6	0.50	101	65.9	79	9
Round[1]	170	1.75	130.5	0.79	55	51.8	91	106
Rush[1]	460	5.73	54.7	0.50	85	61.3	351	172
Spring	55	0.17	46.4	1.50	29	39.4	7	3
Sunfish[1]	130	1.20	14.3	0.50	95	64.5	78	10
Turtle	85	0.59	447.7	3.21	21	31.9	19	75
Valentine	360	4.36	63.9	1.05	70	57.8	252	144
Walsh[1]	295	3.47	8.5	1.00	102	68.5	238	18
Zimmerman[1]	190	2.03	13.2	1.00	143	75.1	152	18

[1]In-lake phosphorus data not available and TP based on lake modeling; therefore internal loads should be considered preliminary.
[2]Low iron-adsorbed P lead to negative internal loading rate, assumed to be zero

B. LAKE RESPONSE MODELING

Purpose of modeling

Lake response models were developed for each lake in order to integrate the watershed loading with the internal loading into a predictive model. For those lakes that do not have in-lake monitoring data, the model was used to estimate the in-lake phosphorus concentrations. The model can also be used to predict the effect of phosphorus loading changes on the lakes' water quality.

Modeling approach

In-lake water quality models were developed using Bathtub (Version 6.1), an empirical model of reservoir eutrophication developed by the U.S. Army Corps of Engineers. The following steps were taken to calibrate the models. Table 10 indicates the lakes that followed the different types of calibration approaches described under step 4 below.

1) Summarize available monitoring data: The 1998-2007 averages of total phosphorus (TP), chlorophyll-*a*, and Secchi depth were used for model calibration.
2) Input watershed load: For those lakes that do not have another modeled lake in their watershed, the watershed load was determined from the P8 watershed model. For those lakes *with* another modeled lake in the watershed, the load from the direct drainage area was determined from the P8 watershed model. The load from the upstream lake and its watershed was determined by multiplying the volume of runoff draining to the lake (from the P8 model) by the observed in-lake phosphorus concentration. If there were no in-lake monitoring data, the volume was multiplied by the in-lake phosphorus concentration predicted by the Bathtub model of the upstream lake.
3) Select phosphorus sedimentation model: The phosphorus model that best predicted the in-lake TP concentration was selected. The models most frequently used were the following: Second Order, Available P; Second Order, Fixed; and Canfield & Bachmann, General.
4) Calibrate phosphorus model:
    - If the T-statistic (absolute value) was < 2.0, no changes were made to the phosphorus calibration coefficient (Approach A in Table 10). In some cases the predicted TP was quite different from the observed TP; this is acceptable for model calibration due the amount of variability in the monitoring data and the level of error in the models. However, if the observed TP was above the lake TP standard and therefore it was necessary to calculate the phosphorus load reductions needed to meet the standard, a closer match of observed and predicted values was needed:
        - If the predicted TP concentration was greater than the observed concentration, the inflow TP concentration (estimated in P8) was lowered (Approach B in Table 10).
        - If the observed TP concentration was greater than the predicted concentration, an additional internal load was added to the model (Approach C in Table 10).

- If the T-statistic (absolute value) was > 2.0, the phosphorus calibration coefficient was adjusted so that T < 2.0 (Approach D in Table 10). In one case it was still necessary to lower the inflow TP concentration in order to obtain a closer match of observed and predicted values to estimate the load reductions needed to attain the standard (Approach E in Table 10).
- If there were no in-lake monitoring data for model calibration, the phosphorus model most common in the lake set (Second Order, Fixed) was used and further adjustments were not made (Approach F in Table 10).

Table 10. Model Calibration Approaches

Approach*	Lakes
A	Island S, Johanna, Josephine, Karth, Long N, Moore W, Turtle
B	Langton, Little Johanna, Long S, Pike, Valentine
C	Island N
D	Spring
E	Moore E
F	Hart, Jones, Little Josephine, Locke, Martha, Marsden, Poplar, Round, Rush, Sunfish, Walsh, Zimmerman

*Approaches outlined in above modeling discussion

5) Incorporate internal loading: An average rate of internal loading is implicit in Bathtub since the model is based on empirical data. In the majority of the lake models, adjustments to internal loading were not necessary for model calibration. The internal loading estimate calculated from the lake sediment data was therefore not directly entered into the model, but was used to represent internal loading in the overall lake nutrient balance. In the case of Island N, an additional rate of internal loading was needed (Approach C above); this internal load was assumed to be in addition to the internal load calculated from the sediment data.
6) Calibrate chlorophyll and Secchi depth models: The chlorophyll and Secchi depth models that best predicted the observed concentrations were selected for each model. If there were no in-lake monitoring data for model calibration, the models most common in the lake set (chlorophyll: P, Linear; Secchi: vs. chl-a & turbidity) were used and further adjustments were not made.
7) Estimate watershed load reductions for lakes not currently meeting standards: After the model was calibrated to all parameters (TP, chlorophyll-*a*, and Secchi depth), the TP standard was then used as an endpoint, and the TP loads were adjusted until the model predicted that the in-lake TP standard would be reached. The model output also includes predictions of chlorophyll-*a* concentration and Secchi depth at the TP standard, in addition to predicted algal bloom frequencies, which are based on chlorophyll-*a* concentration.
8) Estimate internal load reductions for lakes not currently meeting standards: Since the internal loads were not directly incorporated into the lake response models, the internal load reductions weren't based on the lake response model but rather were based on a target phosphorus release rate, set to 7 mg/m^2-day for each lake. This rate is derived from the range of release rates in lakes of varying trophic state reported in Nürnberg (1988). The median release rate for mesotrophic lakes was approximately 5 mg/m^2-day, and the median release rate for eutrophic lakes was approximately 10 mg/m^2-day (Nürnberg 1988). The release rate goal of 7 mg/m^2-day was selected to be fall in

between the two medians. If the calculated release rate was less than 7 mg/m^2-day, then there were no recommended internal load reductions. If the rate was greater than 7 mg/m^2-day, the internal loading goal was estimated based on the difference between the calculated rate and 7 mg/m^2-day.

Results

Table 11. Lake Water Quality Data and Standard Summary

TP = total phosphorus, chl-a = chlorophyll-a (a measure of algae), Secchi = clarity or transparency

Lake	Water Quality Data Means, 1998-2007			Water Quality Standards			Meeting Standards		
	TP (µg/L)	Chl-a (µg/L)	Secchi (m)	TP (µg/L)	Chl-a (µg/L)	Secchi (m)	TP (µg/L)	Chl-a (µg/L)	Secchi (m)
Hart*	168	75	0.4	*	*	*	N	N	N
Island N	102	25	1.3	< 60	< 20	> 1.0	N	N	N
Island S	86	34	1.1	< 60	< 20	> 1.0	N	N	Y
Johanna	31	12	2.0	< 40	< 14	> 1.4	Y	Y	Y
Jones	ND	ND	ND	< 60	< 20	> 1.0	ND	ND	ND
Josephine	36	11	2.0	< 40	< 14	> 1.4	Y	Y	Y
Karth	54	18	1.0	< 60	< 20	> 1.0	Y	Y	Y
Langton N	60	17	1.1	< 60	< 20	> 1.0	Y	Y	Y
Langton S	60	14	1.2	< 60	< 20	> 1.0	Y	Y	Y
Little Johanna	80	25	1.5	< 40	< 14	> 1.4	N	N	Y
Little Josephine	ND	ND	ND	< 60	< 20	> 1.0	ND	ND	ND
Locke*	ND	ND	ND	*	*	*	ND	ND	ND
Long N	145	57	0.6	< 40	< 14	> 1.4	N	N	N
Long S	54	25	1.4	< 40	< 14	> 1.4	N	N	Y
Marsden	ND	ND	ND	< 60	< 20	> 1.0	ND	ND	ND
Martha	ND	ND	ND	< 60	< 20	> 1.0	ND	ND	ND
Moore E	44	18	1.7	< 40	< 14	> 1.4	N	N	Y
Moore W	58	11	1.3	< 60	< 20	> 1.0	Y	Y	Y
Pike	91	53	0.8	< 60	< 20	> 1.0	N	N	N
Poplar	ND	ND	ND	< 60	< 20	> 1.0	ND	ND	ND
Round	ND	ND	ND	< 60	< 20	> 1.0	ND	ND	ND
Rush	ND	ND	ND	< 60	< 20	> 1.0	ND	ND	ND
Spring	29	2.9	2.4	< 60	< 20	> 1.0	Y	Y	Y
Sunfish	37	ND	ND	< 60	< 20	> 1.0	Y	ND	ND
Turtle	20	4.9	2.4	< 40	< 14	> 1.4	Y	Y	Y
Valentine	70	18	1.7	< 60	< 20	> 1.0	N	Y	Y
Walsh*	ND	ND	ND	*	*	*	ND	ND	ND
Zimmerman*	ND	ND	ND	*	*	*	ND	ND	ND

*No bathymetric data available. Since water quality standards are based on depths, the standards are undefined at this time.

ND = No data available

Table 12. Existing Load and Load Goal Summary

Lake	Watershed TP load (lbs/yr)	Internal load (lbs/yr)	Total load (lbs/yr)	% Watershed Load	% Internal Load	Watershed Load Goal (lbs/yr)	Internal Load Goal (lbs/yr)	Watershed Load Percent Reduction	Internal Load Percent Reduction	Total Load Percent Reduction
Hart	13	6	19	68%	32%	2	6	88%	0%	60%
Island S	47	26	73	64%	36%	47	26	0%	0%	0%
Island N	23	96	120	20%	80%	23	18	0%	82%	66%
Island	70	122	193	36%	64%	70	44	0%	64%	41%
Johanna	670	239	908	74%	26%	lake meeting WQ standards				
Jones*	1,647	139	1,786	92%	8%	396	139	76%	0%	70%
Josephine	178	334	513	35%	65%	lake meeting WQ standards				
Karth	66	12	79	85%	15%	lake meeting WQ standards				
Langton N	21	4	25	84%	16%	lake meeting WQ standards				
Langton S	46	0	46	100%	0%	lake meeting WQ standards				
Langton	68	4	72	94%	6%	lake meeting WQ standards				
Little Johanna	625	166	791	79%	21%	226	73	64%	56%	62%
Little Josephine*	228	452	679	34%	66%	122	170	46%	62%	57%
Locke*	17,364	50	17,414	100%	0%	9,053	50	48%	0%	48%
Long N	19,129	836	19,966	96%	4%	6,832	340	64%	59%	64%
Long S	476	996	1472	32%	68%	476	404	0%	59%	40%
Long	19,606	1,832	21,438	91%	9%	7,308	743	63%	59%	62%
Marsden*	509	477	986	52%	48%					
Martha*	53	7	59	89%	11%					
Moore E	173	32	205	84%	16%	121	32	30%	0%	25%
Moore W	39	9	47	82%	18%	lake meeting WQ standards				
Moore	212	41	252	84%	16%	160	41	24%	0%	21%
Pike	1,605	342	1,947	82%	18%	951	151	41%	56%	43%
Poplar*	75	10	85	88%	12%	30	10	61%	0%	53%
Round*	268	106	374	72%	28%					
Rush*	210	172	381	55%	45%	108	172	48%	0%	27%
Spring	171	3	174	98%	2%	lake meeting WQ standards				
Sunfish*	69	10	79	88%	12%	lake meeting WQ standards				
Turtle	84	75	159	53%	47%	lake meeting WQ standards				
Valentine	575	144	719	80%	20%	429	144	25%	0%	20%
Walsh*	108	18	126	86%	14%	44	18	59%	0%	51%
Zimmerman*	394	18	412	96%	4%	105	18	73%	0%	70%

*Limited or no monitoring data available, loads are based on modeling only and should be considered preliminary.
Watershed loading values are summarized from Bathtub modeling output. Values may be slightly different from P8 output due to rounding in several unit conversion steps.

4. Lake Management Action Plans

A. PURPOSE

Lake Management Action Plans (MAPs) summarize lake characteristics and existing lake data, provide a diagnostic assessment of the data, summarize public input, identify water quality issues, and recommend remedial strategies on a lake-watershed basis. As such, each MAP provides a concise summary of the known issues and recommended management approaches for each lake. It is envisioned that the MAPs will be used to further define management strategies, guide development of the District's Third Generation Plan, and serve as the basis for seeking project partners and grant funding for retrofit water quality improvements.

B. PUBLIC MEETINGS

Two public input meetings for each lake were conducted during the development of the MAPs. The first series of meetings, held in the summer of 2008, solicited input from citizens and LGU staff and officials regarding water quality concerns to further define impairments. At the second series of public meetings, held in January 2009, draft MAPs were reviewed, impairments described, and in-lake and watershed management strategies were summarized. Input received during the meetings as well as comments from LGU in response to draft MAPs were incorporated into the final MAPs.

C. MAPS

The appendix of the report presents the finalized MAPs. For each MAP one will find:

- An overview of the lake and watershed characteristics
- A summary of existing water quality data and comparison to applicable water quality standards
- A summary of public input received
- Identification of water quality issues
- Recommended management approaches for both watershed and in-lake activities
- A listing of additional data to be collected to tailor the management recommendations

Because all 24 lakes are within fully or nearly fully developed watersheds, management of land in the watershed is a critical element in addressing the identified impairments. Therefore, the identification of opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs is a significant element of each MAP. To that end, a preliminary field reconnaissance for each watershed was conducted to identify likely regional, local, and site-specific retrofit opportunities. It should be noted that the assigned BMP classifications (regional, local or site-specific) are qualitative in nature, intended to give perspective to the relative scale of the feature and potential treatment area. Potential BMP locations identified during this field investigation are identified on Figure 1 of each MAP and detailed in the field reconnaissance supplement at the end of each MAP.

5. Long-Term Management Strategy

A. PRIORITIES

Over 200 potential retrofit BMPs are identified in the Field Reconnaissance Supplements appended to the Management Action Plans. The preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities that could be implemented to reduce watershed pollutant loading to downstream receiving waters. Again, it should be noted that the assigned BMP classifications (regional, local or site-specific) are qualitative in nature, intended to give perspective to the relative scale of the feature and potential treatment area.

In order to prioritize the projects, a simplified cost/benefit assessment was performed. The following criteria were used to prioritize the projects:

- Landownership – the ease of acquiring the needed permissions to utilize the land required to implement the proposed BMP.
- Studies/Planning – the amount of effort needed to assess the feasibility of a project and generate the requirements needed to implement.
- Construction Cost – the cost to construct the potential BMP.
- Pollutant Removal Potential – the amount of pollutants the proposed BMP would have the potential to remove.
- Pollutant Removal Potential relative to the Lake – the potential pollutant removal relative to the total subwatershed loading to the lake.

Qualitative rankings were based on the field investigations and institutional knowledge of the system. Projects within upstream lake subwatersheds were also considered as potential implementation projects for downstream lakes. The diminishing return of a potential project further upstream in the system was qualitatively taken into account when looking at upstream projects relative to a particular lake.

The intent of this exercise is to give the District a prioritized list of projects for further investigation. The prioritization exercise is NOT intended to make a final determination on the merits of a particular project. For most projects further feasibility assessments would be needed before the District proceeds with a particular project. Using the raw rankings as general guidance, projects were prioritized in three tiers by lake as described below:

Tier 1
Tier 1 projects consist of those projects that appear to have a very good cost benefit ratio based on the criteria described above. The projects included in Tier 1 for a particular lake are recommended as high priority for potential projects that could benefit that water body.

Tier 2
Tier 2 projects are projects that appear to have good cost benefit ratios; however, they either were projects that fell below other higher priority projects or are projects that are more suited to be implemented during road reconstruction or redevelopment projects.

Tier 3
Tier 3 projects are projects that appeared to have lower cost benefit ratios than Tier 1 or Tier 2 projects and would not be recommended as current priorities. However, these projects would still warrant investigation particularly during permit review related to redevelopment or road reconstruction projects. Also, should Tier 1 and Tier 2 projects be implemented or determined to be unfeasible, Tier 3 projects could then be assessed (as needed) to meet the water quality goals of a particular lake. Projects within upstream watersheds of other lakes were not considered as candidates for Tier 3 projects.

B. RECOMMENDED ACTIONS FOR 2009

1. For 2009 it is recommended that the District initiate feasibility studies on three of the projects included in Tier 1. These Tier 1 projects have the highest likely benefit, for a low level of additional feasibility.

    - Little Johanna 2
    - Moore 7 combined with Moore 10 & 11
    - Pike 2

2. Contact the Parks Departments and solicit interest in partnerships for the following Tier 1 projects:

    - Island 1 & 5
    - Langton 1
    - Long 17
    - Spring 2
    - Turtle 4

3. Solicit private party interest in cost shares through the Urban Stormwater Remediation Program for the following site-specific BMPs that were prioritized as Tier 1 projects.

    - Jones 22
    - Karth 5 & 7
    - Josephine 3
    - Little Josephine 9
    - Langton 3 & 6
    - Locke 19 & 24
    - Long 14
    - Marsden 2 & 3
    - Moore 12
    - Pike 11
    - Poplar 4
    - Valentine 11
    - Walsh 7
    - Zimmerman 5 & 8

4. Landowners should be notified of needed maintenance/attention at the following facilities.

    - Karth 6
    - Little Johanna 17
    - Turtle 3

The following tables include all of the projects broken down by tiers for each lake. These tables can be used a guide for future planning and implementation of CIP projects. Estimated cost ranges for Tier 1 projects were included to give a general feel for the magnitude of the projects. Further feasibility assessment and cost estimates will be needed as the District moves towards implementation of a particular project.

Lake	Tier	Project ID	Range of Probable Cost ($)	Description / Notes
Hart	No Projects Identified			
Island	Tier 1	Island 1	5-15k	(Bio)filtration basin or swale between bituminous trail and lake
		Island 2	5-30k	Multiple (in)filtration raingardens or larger retention basin
		Island 5	2-20k	Repair existing basin skimmer and excavate 2nd cell downstream of trail
	Tier 2	Island 3, 4, 6 & 7		
	Tier 3	No Tier 3 Projects Identified		
Jones	Tier 1	Jones 12	25-100k	Retrofit existing dry pond to provide (in)filtration or water quality storage
		Jones 21	25-50k	Retrofit (in)filtration or wetland treatment system at existing wooded depression
		Jones 22	2-5k	Retrofit (in)filtration raingarden into existing turf-grass swale
	Tier 2	Jones 7, 9, 10, 11, 14, 15, 16, 17 & 18, Poplar 1		
	Tier 3	Jones 1, 2, 3, 4, 5, 6, 8, 13, 19, 20, 23 & 24		
Johanna	Tier 1	Johanna 2	50-200k	Excavation of accumulated sediment and cattails from existing wetland basin
		Little Johanna 1	30-60k	Retrofit existing dry basin to provide (in)filtration storage, native vegetation
		Little Johanna 2	10-200k	Weir repair or major basin enhancement, excavate & reduce short-circuiting
	Tier 2	Johanna 1, 4, 5, & 7, Little Johanna 3, 6, 8, & 9, Little Josephine 1		
	Tier 3	Johanna 3 & 6		

Lake	Tier	Project ID	Range of Probable Cost ($)	Description / Notes
Little Johanna	Tier 1	Little Johanna 1	30-60k	Retrofit existing dry basin to provide (in)filtration storage, native vegetation
		Little Johanna 2	10-200k	Weir repair or major basin enhancement, excavate & reduce short-circuiting
	Tier 2	Little Johanna 3, 4, 6, 8, 9, 12, 13, 14, 18 & 19, Zimmerman 5		
	Tier 3	Little Johanna 5, 7, 10, 11, 15, 16, & 17		
Josephine	Tier 1	Josephine 2	15-40k	(In)filtration swale or outfall basin along lot-lines
		Josephine 3	10-40k	Retrofit existing dry basin to provide (in)filtration storage
	Tier 2	Josephine 1 & 4, Little Josephine 1, 3 & 6		
	Tier 3	No Tier 3 Projects Identified		
Little Josephine	Tier 1	Little Josephine 1	50-200k	Sediment forebay, energy dissipation and wetland treatment ponding
		Little Josephine 4	10-25k	Convert swale to filter with native vegetation, consider with LJos 5
		Little Josephine 5	10-25k	Expand existing pond, consider combined project with LJos 4
		Little Josephine 6	20-50k	Excavate sediment forebay and wetland treatment ponding
		Little Josephine 9	2-10k	Retrofit (in)filtration raingarden into existing turf-grass swale
	Tier 2	Little Josephine 3, 7 & 12		
	Tier 3	Little Josephine 2, 8, 10 & 11		
Karth	Tier 1	Karth 1	35-50k	Ponding, (in)filtration or wetland treatment at existing depression
		Karth 5	25-150k	Island (in)filtration features or porous pavement / underground filtration
		Karth 6	<1k	Vegetative amendments
		Karth 7	1-2k	Outfall/channel stabilization
	Tier 2	Karth 2, 3 & 4		
	Tier 3	No Tier 3 Projects Identified		

Lake	Tier	Project ID	Range of Probable Cost ($)	Description / Notes
Langton	Tier 1	Langton 1	15-30k	Relocate playground, incorporate filtration or water quality ponding
		Langton 3	15-40k	Remove tree, incorporate filtration or water quality ponding
		Langton 4	15-30k	Smaller alternate to Langton 3
		Langton 6	25-40k	Pavement reduction, linear filtration
	Tier 2	Langton 5		
	Tier 3	Langton 2		
Locke	Tier 1	Locke 2	20-75k	1 or 2 cell wetland treatment ponding
		Locke 14	15-50k	Reroute stormsewer outfall east, under trail, to floodplain terrace for filtration
		Locke 19	2-5k	Linear filtration along existing lot-line swale
		Locke 24	5-20k	Retrofit existing dry pond, provide (in)filtration storage, native vegetation
	Tier 2	Locke 1, 13, 16, 17, 18, 23, 25, & 27, Long 1, Pike 1		
	Tier 3	Locke 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 20, 21, 22 & 26		
Long	Tier 1	Long 1	100-500k	Reconstruct weir, consider additional upstream impoundments & excavation
		Long 14	5-25k	Excavate shallow storage areas adjacent to existing onsite catchbasins
		Long 17	10-30k	Expand and enhance existing rock storage/filter feature
		Pike 1	50-300k	Hanson Pond - Excavate sediment, expand, vegetation and carp mgmt.
		Pike 2	50-250k	Mirror Pond - sediment sealing and/or chemical treatment (add annual costs)
	Tier 2	Long 3, 4, 5 & 10, Little Johanna 2, Pike 9 & 27		
	Tier 3	Long 2, 6, 7, 8, 9, 11, 12, 13, 15 & 16		

Lake	Tier	Project ID	Range of Probable Cost ($)	Description / Notes
Marsden	Tier 1	Marsden 2	5-15k	(In)filtration raingarden for local drainage
		Marsden 3	5-15k	Retrofit dry basin to incorporate (in)filtration
	Tier 2	Marsden 4, Martha 1, 2 & 3		
	Tier 3	Marsden 1		
Martha	Tier 1	Martha 1	5-20k	Vegetative filter and/or shallow (in)filtration raingarden
	Tier 2	Martha 2 & 3		
	Tier 3	No Tier 3 Projects Identified		
Moore	Tier 1	Moore 7	10-40k	Enhance/expand existing swale, sediment forebay with downstream filtration
		Moore 10	5-10k	Convert turf to filtration raingardens
		Moore 11	10-20k	Remove bituminous flume, create linear filtration swale
		Moore 12	1-3k	Expanded storage and native vegetation amendments
	Tier 2	Moore 1, 2, 4, 5, 8 & 9		
	Tier 3	Moore 3 & 6		
Pike	Tier 1	Pike 1	50-300k	Excavate accumulated sediment, expand, vegetation and carp management
		Pike 2	50-250k	Sediment sealing and/or chemical treatment (additional annual costs)
		Pike 9	5-15k	Divert west stormsewer & 7th St runoff to filtration or water quality basin
		Pike 11	5-20k	Retrofit (in)filtration storage into dry basin
		Pike 13	20-50k	Expand or create upstream (in)filtration cell at existing basin/wetland
		Pike 27	10-25k	Ramsey County Ditch 3 outfall energy dissipation and bank stabilization
		Jones 12	25-100k	Retrofit existing dry pond to provide (in)filtration or water quality storage
	Tier 2	Pike 6, 10, 12, 14, 16, 19, 20, 21, 23, 25 & 26		
	Tier 3	Pike 3, 4, 5, 7, 8, 15, 17, 18, 22 & 24		

Lake	Tier	Project ID	Range of Probable Cost ($)	Description / Notes
Poplar	Tier 1	Poplar 1	20-100k	Need to first determine if and when the pond discharges to Poplar Lake
		Poplar 4	5-20k	Depressional storage and vegetation amendments
	Tier 2	Poplar 2 & 3		
	Tier 3	No Tier 3 Projects Identified		
Round	Tier 1	No Tier 1 Projects Identified		
	Tier 2	Round 1, 2 & 3		
	Tier 3	No Tier 3 Projects Identified		
Rush	Tier 1	Rush 2	5-20k	Wetland treatment or filtration at stormsewer outfall, assess with 3 & 4
		Rush 3	5-20k	Wetland treatment or filtration at stormsewer outfall, assess with 2 & 4
		Rush 4	5-20k	Wetland treatment or filtration at stormsewer outfall, assess with 2 & 3
	Tier 2	Rush 1		
	Tier 3	No Tier 3 Projects Identified		
Spring	Tier 1	Spring 2	5-15k	Demonstration/Education raingarden at parking lot outfall
	Tier 2	Spring 1, 3, 4, 5 & 6		
	Tier 3	No Tier 3 Projects Identified		
Sunfish	No Projects Identified			

Lake	Tier	Project ID	Range of Probable Cost ($)	Description / Notes
Turtle	Tier 1	Turtle 3	<1k	May need minor site modifications to ensure water is routed to existing BMP
		Turtle 4	5-20k	Increase treatment capacity & creatively tuck second cell to south
	Tier 2	Turtle 1 & 2		
	Tier 3	No Tier 3 Projects Identified		
Valentine	Tier 1	Valentine 2	10-20k	Small wetland treatment system or filtration basin
		Valentine 3	5-20k	(In)filtration storage & vegetation enhancement of swale upstream of culvert
		Valentine 4	20-60k	Expand & enhance swale to create shallow filtration basin, relocate parking
		Valentine 11	5-20k	Retrofit additional storage, native vegetation amendments to reduce geese
	Tier 2	Valentine 1, 6, 8, 9, 10, 13 & 14		
	Tier 3	Valentine 5, 7 & 12		
Walsh	Tier 1	Walsh 6	5-15k	Sediment excavation, pond expansion, native vegetation amendments and skimmer
		Walsh 7	3-6k	Native vegetation buffer
	Tier 2	Walsh 1, 2, 3, 4, 5 & 8		
	Tier 3	No Tier 3 Projects Identified		
Zimmerman	Tier 1	Zimmerman 5	5-10k	Retrofit dry basin, incorporate (in)filtration storage, native vegetation amendments
		Zimmerman 8	2-5k	Retrofit dry swale, incorporate (in)filtration storage, native vegetation amendments
	Tier 2	Zimmerman 1, 3 , 4 & 6		
	Tier 3	Zimmerman 2 & 7		

6. References

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Nürnberg, G.K. 1988. Prediction of phosphorus release rates from total and reductant-soluble phosphorus in anoxic lake sediments. *Can. J. Fish. Aquat. Sci*. 45:453-462.

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Appendix – Management Actions Plans

Hart Lake Management Action Plan

Hart Lake (02-0081) is located in the City of Columbia Heights, Hennepin County, Minnesota (Figure 1). The lake has a surface area of 8 acres, a maximum depth of 5 feet[1]. Based on its low estimated maximum depth, it is considered a shallow lake according to MPCA's definition. The lake has a very small watershed of only 14 acres and is tributary to Silver Lake. A TMDL study for Silver Lake is currently being completed and will contain allowable phosphorus loading within the entire Silver Lake watershed, which includes Hart Lake. Because the drainage area to Hart Lake is predominantly residential backyards or commercial areas that have recently retrofitted water quality treatment BMPs, it is not anticipated that additional water quality improvements will be made within the Hart Lake watershed as a result of the TMDL.

The surrounding watershed area is a mix commercial and residential land use. The east shore of the lake is a very steep, slightly vegetated slope. Exposed fill rubble has been observed.

The primary use of the lake is for local lakeshore owner enjoyment. The DNR does not stock the lake with fish, and a fisheries survey is not available.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos. No bathymetric data were available for this lake. The maximum depth was estimated using depth data collected during sediment sampling.

Figure 1. Hart Lake

Water Quality Summary

Water quality data for Hart Lake were collected through the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP) from 2004-2006. A summary of the three years of monitoring data suggest that the lake is not currently meeting lake water quality standards (Table 1).

Table 1. Average Water Quality Data (2004-2006) and Standards

Parameter	Hart Lake	Shallow Lakes Standard
TP (µg/L)	168	60
Chl (µg/L)	75	20
Secchi Depth (m)	0.4	1.0

Figures 2 through 4 show the growing season total phosphorous (TP), chlorophyll-*a* and Secchi depth (clarity) data from Hart Lake. The average water quality did not vary much during the three years of data collection. The large error bars are due to small sample size in some years (n~3).

During an August 2007 site visit, the lake was chocolate brown from construction runoff from the east side of the lake. Data were not collected during 2007 when the effects of construction were seen.

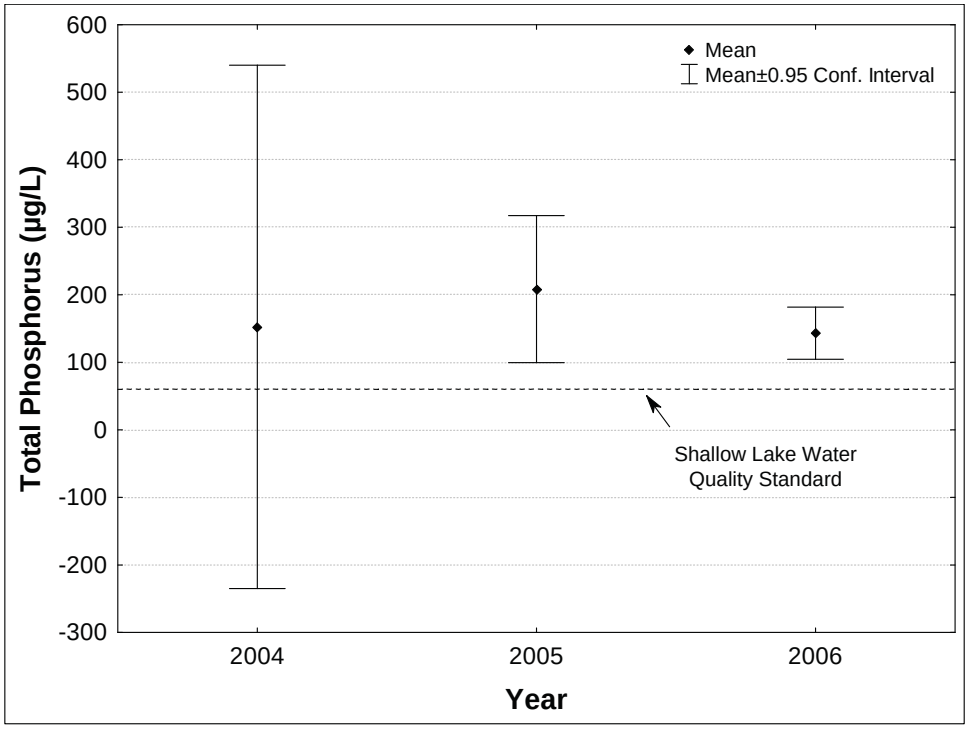


Figure 2. Hart Lake Total Phosphorus

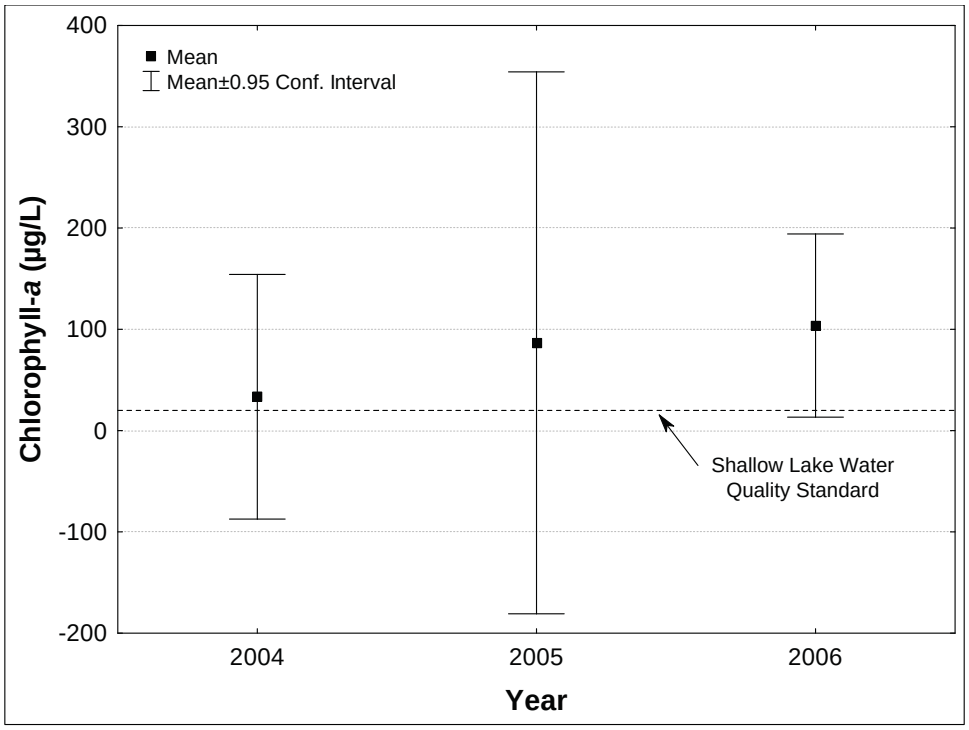


Figure 3. Hart Lake Chlorophyll-*a*

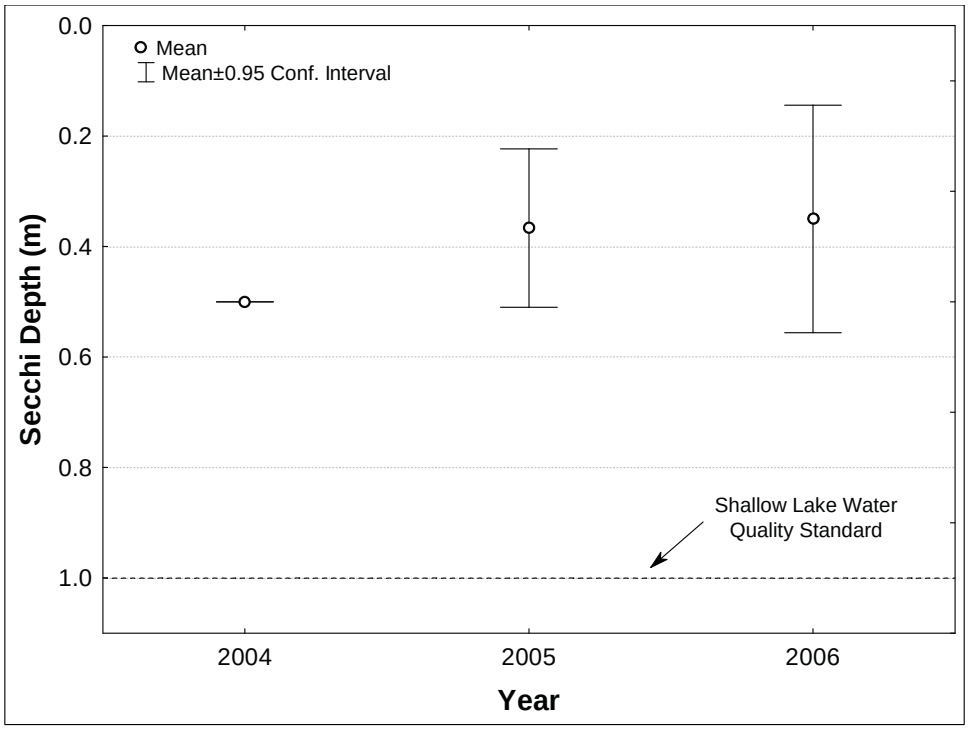


Figure 4. Hart Lake Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. The lake model was calibrated to in-lake monitoring data. Water quality modeling indicates that watershed inputs account for approximately 68% of the nutrient load, with internal loading accounting for the remaining 32% (Figure 5). To reach the in-lake goal of 60 µg/L TP, the phosphorous loading to the lake would need to be reduced by approximately 60%.

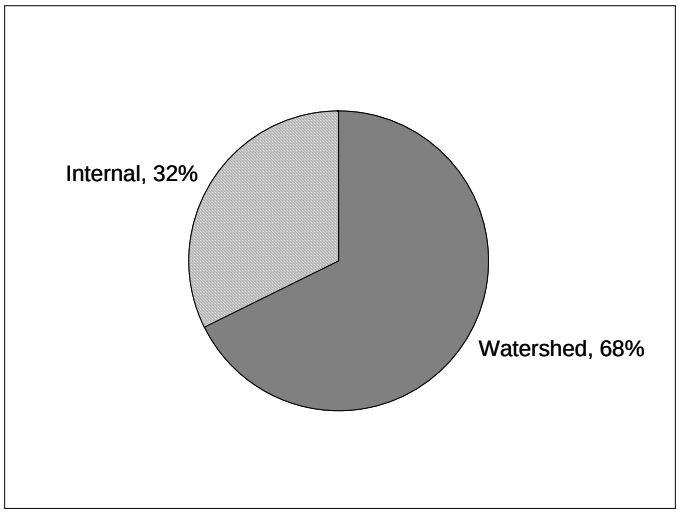


Figure 5. Hart Lake Phosphorus Load Distribution

Public Input

At the public input meeting held on June 2, 2008, no attendees spoke on issues related to Hart Lake.

Water Quality Issues

- Watershed runoff can negatively impact the water quality, as observed in 2007 by local construction east of the lake.
- Judging by the small watershed to lake ratio and the very high in-lake phosphorus concentrations, internal loading is likely a problem in Hart Lake.

Recommended Management Approach

Watershed Management Recommendations

It appears that most of the runoff entering the lake does so untreated, except for the recently redeveloped commercial area east of the lake. This area is now served by a water quality pond near the south east corner of the lake. While no BMP retrofit opportunities were identified during the preliminary field reconnaissance, there are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate and erosion control

- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control. The RCWD is currently working to remedy insufficient stormwater treatment from the construction site to the east.

Internal Lake Management Recommendations

With very little in-lake biological data for Hart Lake, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply to Hart Lake:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.
- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake. If cooperation is possible, work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Hart Lake. There are only two years of in-lake data for Hart Lake; if the implementation of management practices for the lake were to move forward, in-lake data and bathymetric data would be needed and should be considered a high priority.

- Bathymetric data collection
- TP, chlorophyll, and Secchi depth data: Collect data for one to two additional years, with at least five sampling dates per year.
- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation.

Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.

- Fish survey: Complete a fish survey to evaluate the fish species composition of the lake.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.

Island Lake Management Action Plan

Island Lake (62-0075) is located in the City of Shoreview, Ramsey County, Minnesota (Figure 1). The lake is divided by I-694 into two basins, north and south. The south basin is 43.6 acres (Figure 2), with a maximum depth of 9 feet[1]. The north basin is 18.6 acres in size, with a maximum depth of 9 feet. Both basins are 100% littoral and, based on the maximum depth, are both considered shallow lakes according to MPCA's definition. Island Lake is listed as an impaired lake on the EPA's 303(d) list of impaired water bodies. It is impaired for aquatic recreation due to high nutrients.

The watershed draining to the south basin of Island Lake is approximately 92 acres and the watershed draining to the north basin is approximately 183 acres. Both sub-watersheds are quite small compared to the size of the lake. The east side of the south basin is bordered by Island Lake County Park. This park provides swimming, boating, fishing, and passive recreational access to Island Lake. The west side of the south basin and most of the north basin are surrounded by residential area, with some open space and ponds. I-694 cuts between the two basins and spans a small bridge connection between them. The south basin is bordered on the northwest side by Island Lake Golf Center. On the northwest side of the lake, Island Lake discharges out of the north basin to the northwest. It discharges into the Valentine Lake watershed and eventually to Long Lake. Both Valentine and Long are on the EPA's list of impaired water bodies due to high nutrients.

Eurasian watermilfoil was detected in Island Lake beginning in 1991 and was treated with 2, 4-D herbicide in 1994. A Eurasian watermilfoil management plan was completed by Ramsey County in the late 1990s. An August 2004 DNR Lake Survey found that Eurasian watermilfoil and coontail are the most abundant aquatic plants present in Island Lake.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from the Rice Creek Watershed District website.

The lake is stocked by DNR with walleye, yellow perch, channel catfish, tiger muskellunge, and bluegill. A 2004 fisheries survey indicated a high density of bluegill and indicated the presence of carp in the lake. A 1995 DNR Lake Management Plan states that the long range goal for the lake is "to provide a gamefish population of legal size hybrid muskellunge that will support 225 man-hours/acre of fishing." The report lists a 1974 rotenone fish eradication as a past management as well as the use of Antimycin partial chemical treatments to decrease young-of-the-year bluegills from 1975-1977. In 1989 an aeration system was installed by the county to prevent winter fish kills.

Figure 1. Island Lake and Potential BMP Locations

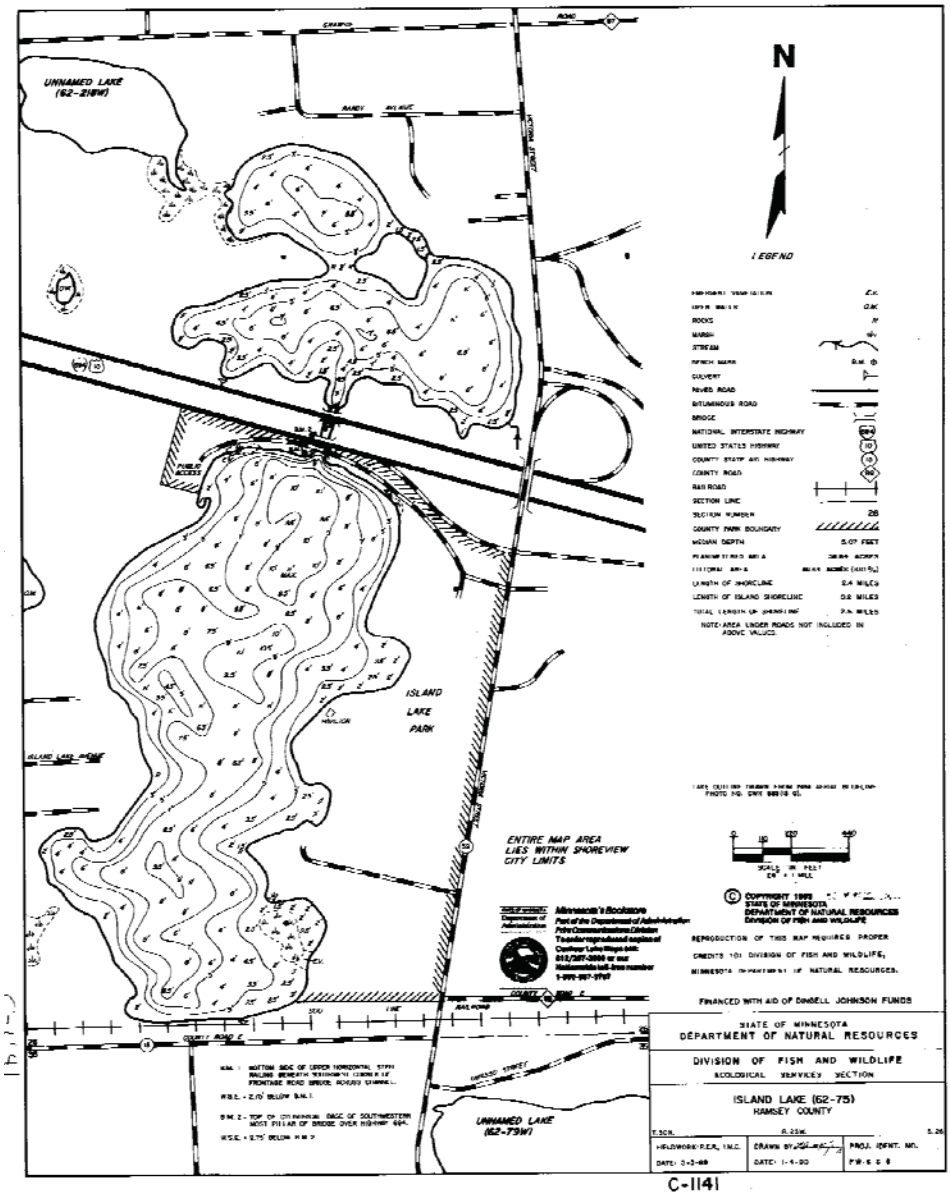


Figure 2. Island Lake Bathymetry

Water Quality Summary

Water quality data for Island Lake were collected from 1985-2007. Data were collected by Ramsey County Public Works and the Minnesota Pollution Control Agency. A summary of the most recent 10 years of monitoring data (Table 1) suggests that the total phosphorous (TP) and chlorophyll-*a* concentrations did not meet the MPCA water quality standards, while the Secchi depth (clarity) narrowly met standards.

Table 1. Average Water Quality Data (1998-2007) and Standards

Parameter	Island Lake North Basin	Island Lake South Basin	Shallow Lakes Standard
TP (µg/L)	102	86	60
Chl (µg/L)	25	34	20
Secchi Depth (m)	1.3	1.1	1.0

Figures 3 through 5 show the growing season total phosphorus (TP), chlorophyll-*a*, and Secchi depth (clarity) data over that period for the north basin of Island Lake. The same series of data is shown in Figures 6 through 8 for the south basin. Overall, the water quality of Island Lake has worsened since the 1990s.

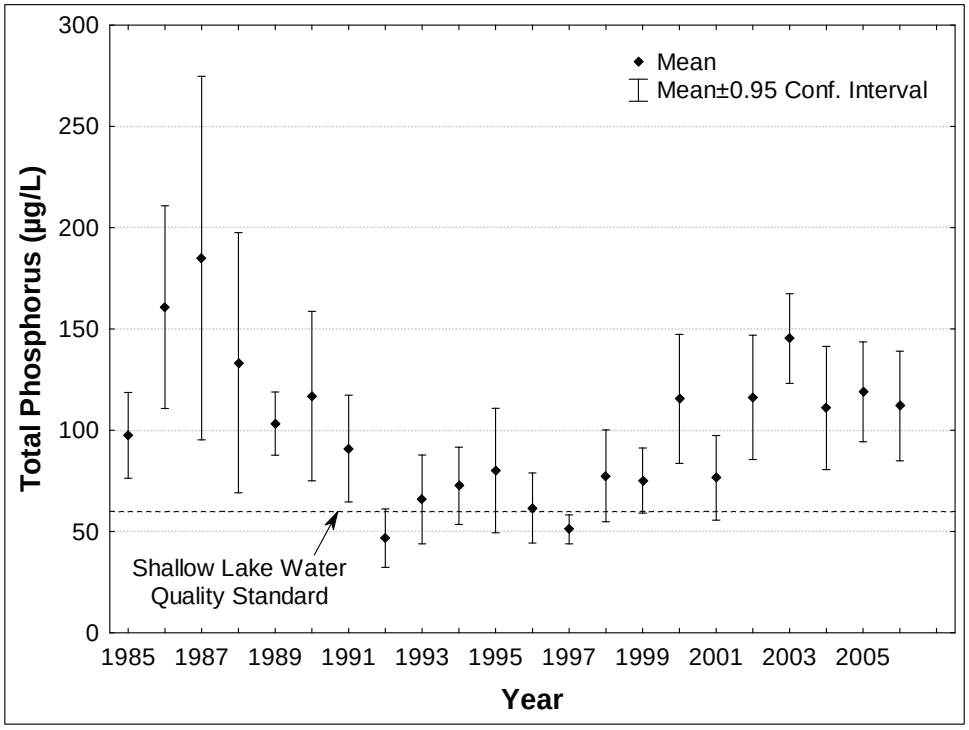


Figure 3. Island Lake North Basin Total Phosphorus

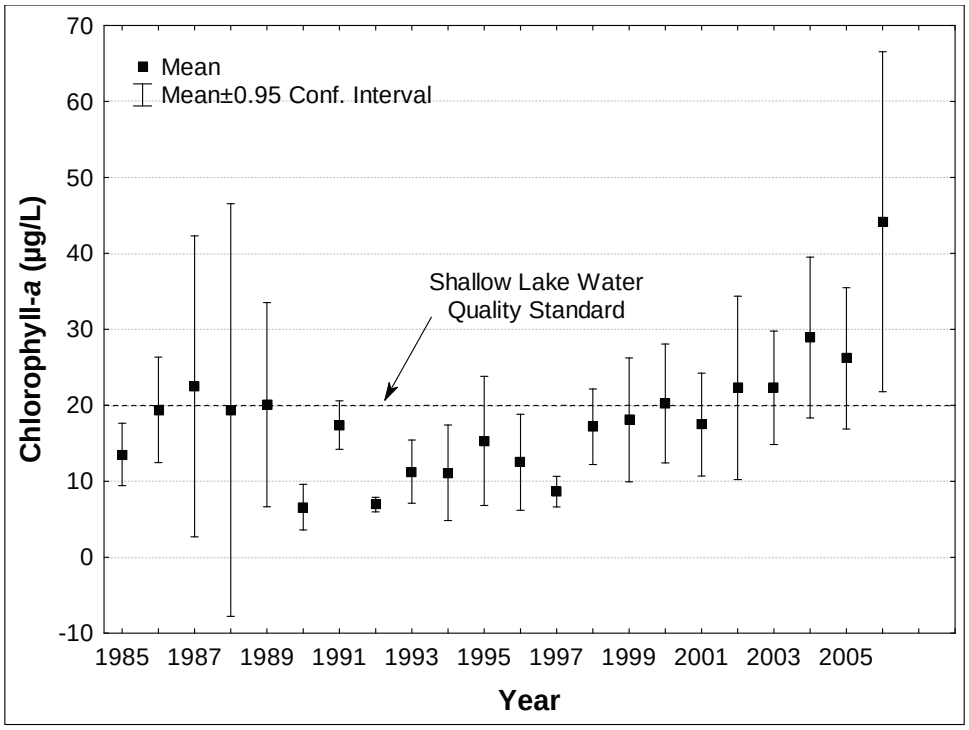


Figure 4. Island Lake North Basin Chlorophyll-*a*

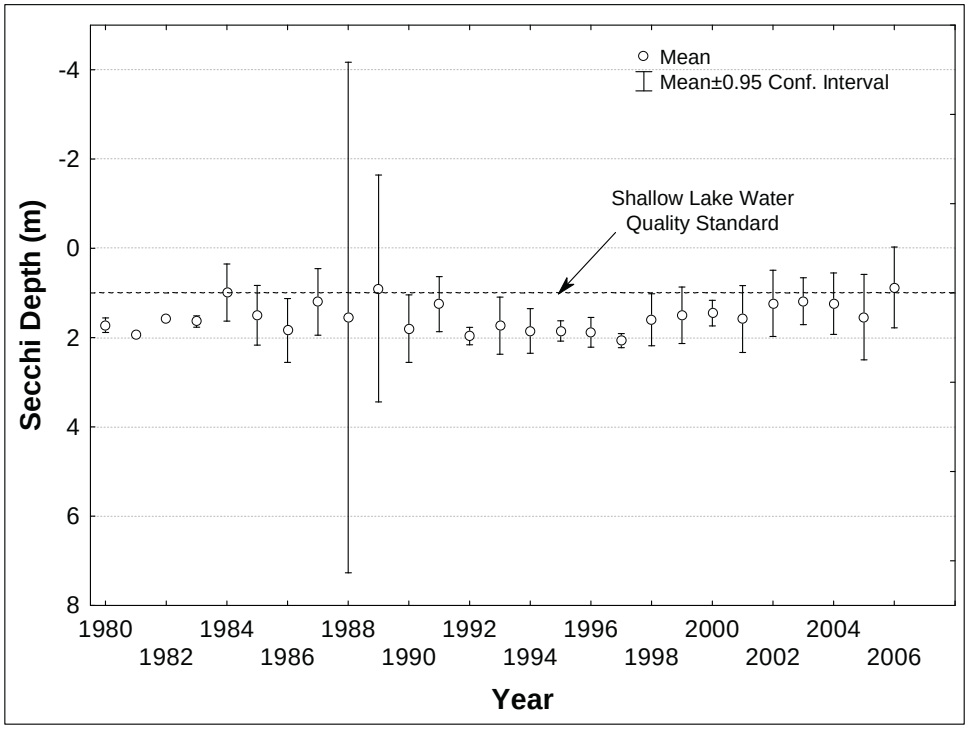


Figure 5. Island Lake North Basin Secchi Depth

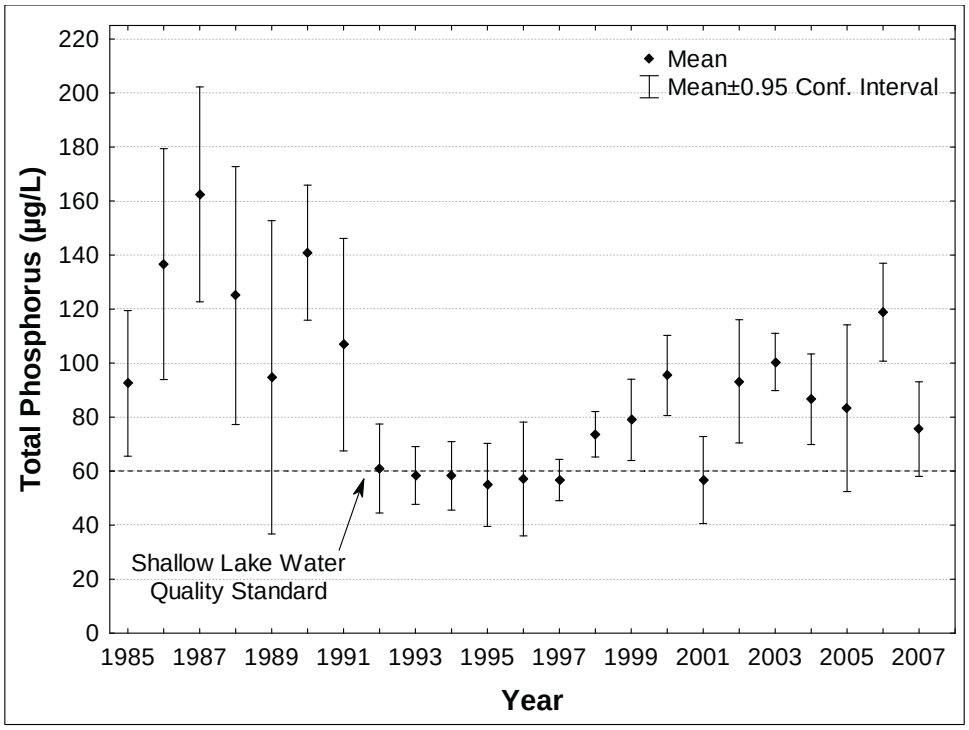


Figure 6. Island Lake South Basin Lake Total Phosphorus

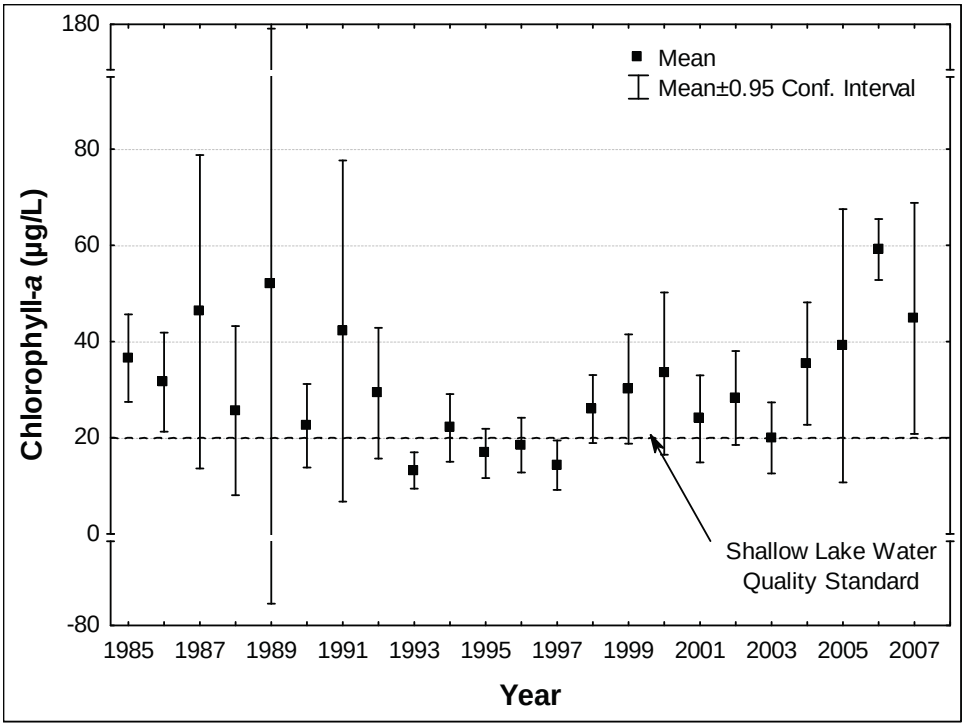


Figure 7. Island Lake South Basin Chlorophyll-*a*

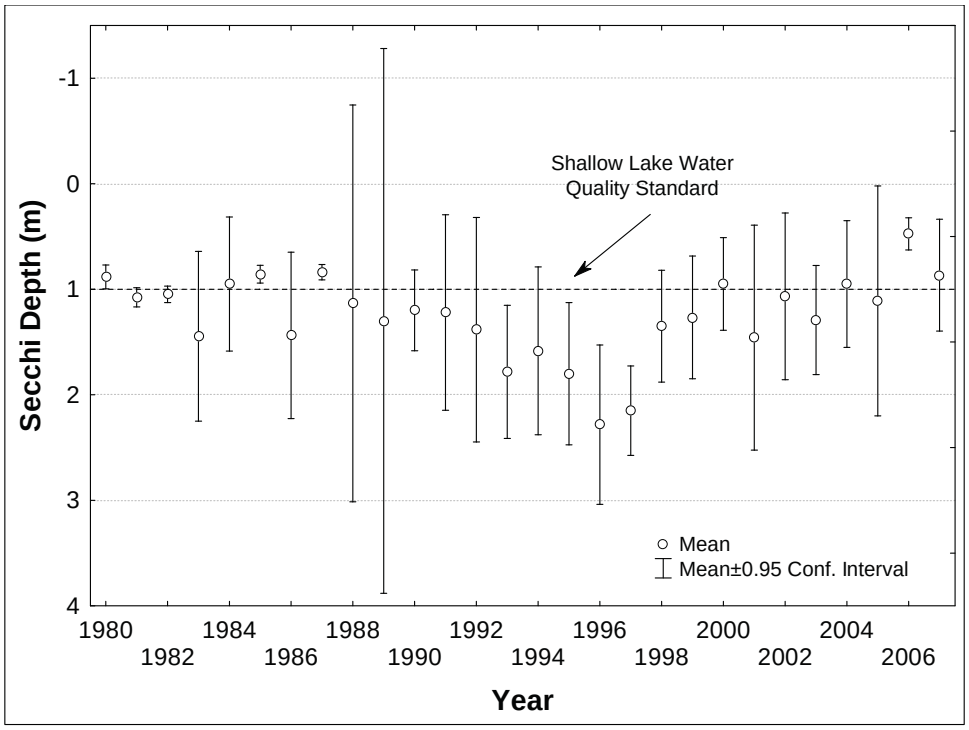


Figure 8. Island Lake South Basin Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. The lake model was calibrated to in-lake monitoring data. Water quality modeling indicates that watershed inputs account for approximately 36% of the nutrient load, with internal loading accounting for 64% (Figure 9). To reach the in-lake goal of 60 µg/L TP, phosphorus loading would need to be reduced by approximately 41%.

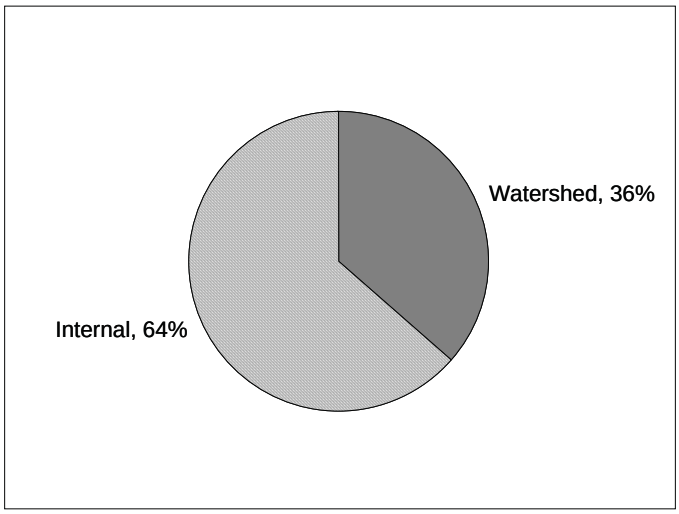


Figure 9. Island Lake Phosphorus Load Distribution

Public Input

At the public input meeting held on June 5, 2008, no attendees spoke on issues related to Island Lake.

Water Quality Issues

- Internal loading is high and likely has a big influence on the lake's water quality conditions.
- Although Island Lake has a relatively small watershed, it appears that the watershed load is still negatively impacting water quality.
- Both basins of the lake are directly adjacent to Interstate-694 and likely receive highway runoff.
- The presence of carp and high densities of bluegill likely contribute to the high rates of internal loading, through the disturbance of bottom sediments and through high grazing pressure on the zooplankton community.
- The prevalence of Eurasian watermilfoil displaces native plants and negatively impacts the habitat quality in the lake.

Recommended Management Approach

Watershed Management Recommendations

Management of land in the watershed is a critical element in addressing the nutrient impairment. Because the Island Lake watershed is nearly fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, seven BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of the four potential local BMP locations identified in the *field reconnaissance supplement.*
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- Reduce runoff coming directly from the parking lots and impervious areas at the county park.
- Coordinate with Mn/DOT during the MS4 process when highway upgrades and re-construction occurs to seek out opportunities to decrease runoff from the I-694 bridge.
- Develop BMPs between the road surface of CSAH 52 and the lake to decrease runoff.
- Coordinate with Ramsey County on opportunities to reduce runoff from Ramsey County property surrounding the lake.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

- Develop an aquatic vegetation management plan, focusing on Eurasian watermilfoil.
- The bluegill population size is well above the medial level for this type of lake. Planktivore size structure outlined in the DNR fisheries survey suggests that the population is dominated by small individuals; 97% of bluegills were less than 5 inches. This could indicate planktivore 'stunting,' where intraspecific competition limits growth. Dense populations of small planktivores are capable of limiting zooplankton populations, leaving no biological check on algae growth. Work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Island Lake. Since there is a long record of in-lake water quality data for Island Lake, additional data collection is not a high priority at this time.

- TP, chlorophyll, and Secchi depth data: Collect at least five sampling dates per year. The TMDL can be based on the existing monitoring data; additional data should be collected after management actions are implemented to track the response of the lake.
- Macrophyte surveys: Complete macrophyte surveys before and after aquatic vegetation management practices are implemented.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the existing fisheries information regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.
- Work with city to identify all stormwater input locations.

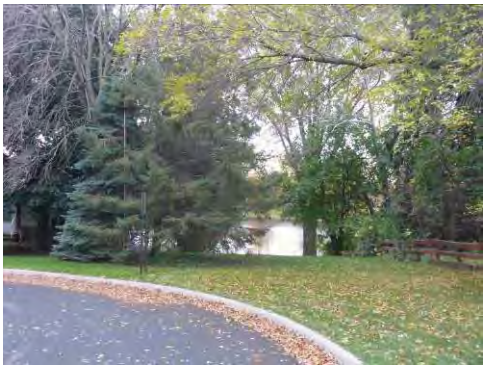
The watershed drainage to Island Lake is all direct drainage; there are no incoming tributaries that could be monitored to better define the watershed phosphorus loads to the lake. Occasional grab samples could be taken from the many stormwater outfalls to the lake to provide information on the TP concentration in the watershed's runoff.

Island Lake Field Reconnaissance Supplement

Local Management BMPs

Island #1
Location: South end of Milton Street west of Island Lake
Description: Area at stormsewer outlet
Possible Improvements: Squeeze in feature to treat piped outlet at this location

Island #2
Location: South of County Road E and east of Vivian Avenue
Description: Ditch / swale areas at corner
Possible Improvements: Rain gardens for roof outlet (seen in pic) or larger feature at corner also picking up adjacent street and parking (larger feature would need to be quite deep and may not be practical).



Island #3
Location: South side of Randy Avenue north of Island Lake
Description: Small green space areas
Possible Improvements: Incorporate small treatment areas for street runoff going directly to the lake

Island #4
Location: South side of Randy Avenue north of Island Lake
Description: Small green space areas
Possible Improvements: Incorporate small treatment areas for street runoff going directly to the lake

Site Specific Management BMPs

Island #5
Location: In park on east side of Island Lake
Description: Existing water quality pond
Possible Improvements: Excavation of second cell of pond downstream of bituminous trail; fix existing skimmer that has been heaved by ice and has been rendered ineffective.

Island #6
Location: South of County Road E and west of Vivian Avenue
Description: Green space next to parking lot
Possible Improvements: Provide treatment for parking lot in open space

Island #7
Location: In park west side of Island Lake
Description: Parking lot at boat launch draining via curb cut
Possible Improvements: Lower grade downstream of curb cut to improve drainage and consider enhancement of existing treatment area

Lake Johanna Management Action Plan

Lake Johanna (62-0078) is located in the City of Arden Hills, Ramsey County, Minnesota (Figure 1). The lake has a surface area of 214 acres, a maximum depth of 41 feet, and a mean depth of approximately 17 feet (Figure 2)[1]. Lake Johanna is listed on the EPA's 303(d) list of impaired waters due to the mercury content in fish. The MPCA completed a statewide TMDL study and implementation plan to address the state's mercury impairments.

The watershed draining to Lake Johanna is 3,413 acres. The surrounding watershed area is primarily residential with some commercial and transportation land uses. The campus of Northwestern College sits on the south shore of the lake.

An aquatic vegetation survey was performed by the DNR in late July of 2001. Coontail, bushy pondweed, and water celery were listed as common in abundance, while curly-leaf pondweed was listed as rare.

In past years the lake has been stocked with walleye, tiger muskellunge, and northern pike. According to a 2002 DNR fisheries assessment, the most abundant species of fish within Lake Johanna is bluegill. Other fish found in the lake include yellow perch, pumpkinseed sunfish, hybrid sunfish, green sunfish, northern pike and black crappie. The City of Arden Hills's 2030 Comprehensive Plan states that the fish within Lake Johanna had elevated levels of perfluorooctane sulfonate (PFOS) in 2007; however, the source is unknown.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from the Rice Creek Watershed District website.

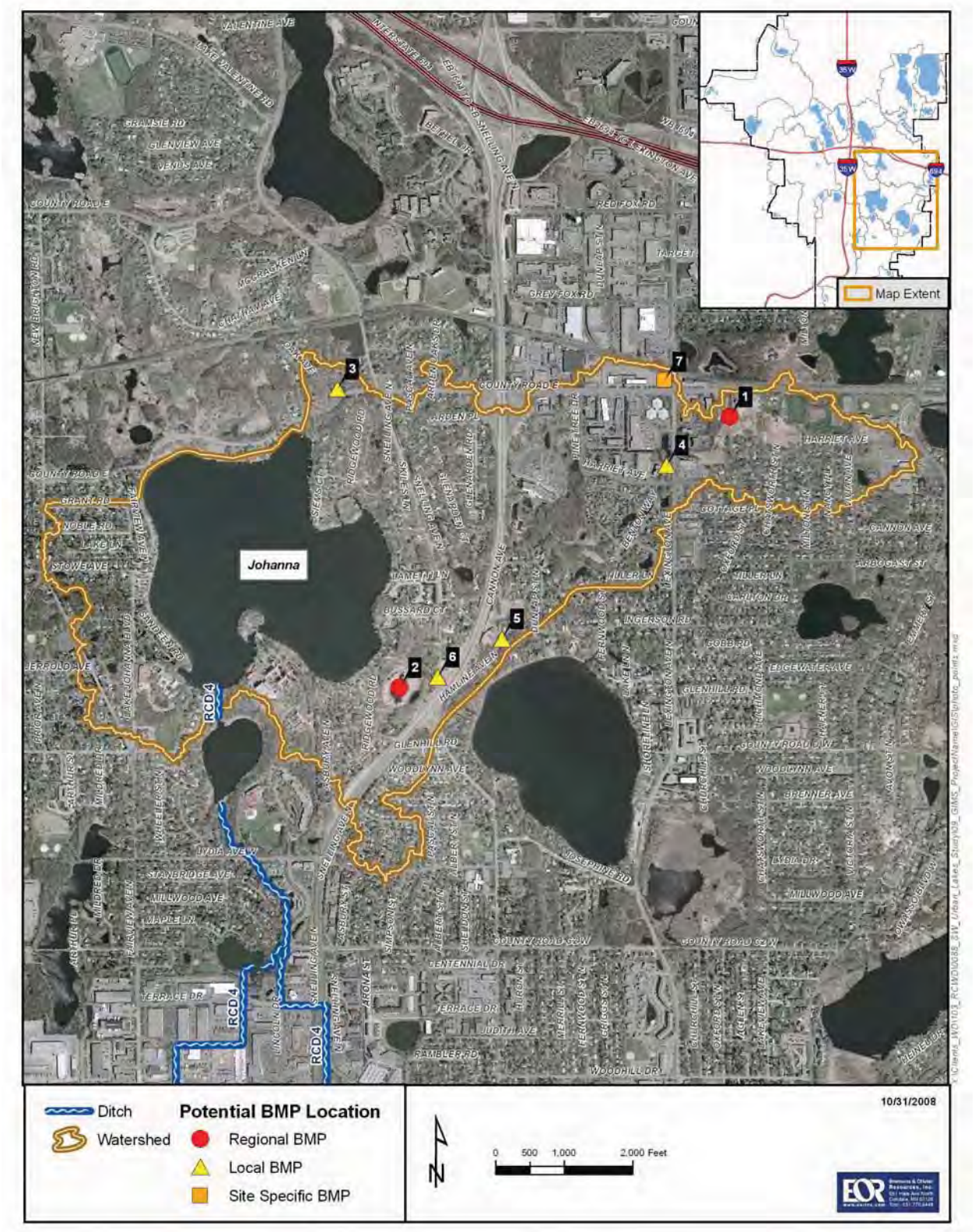


Figure 1. Lake Johanna and Potential BMP Locations

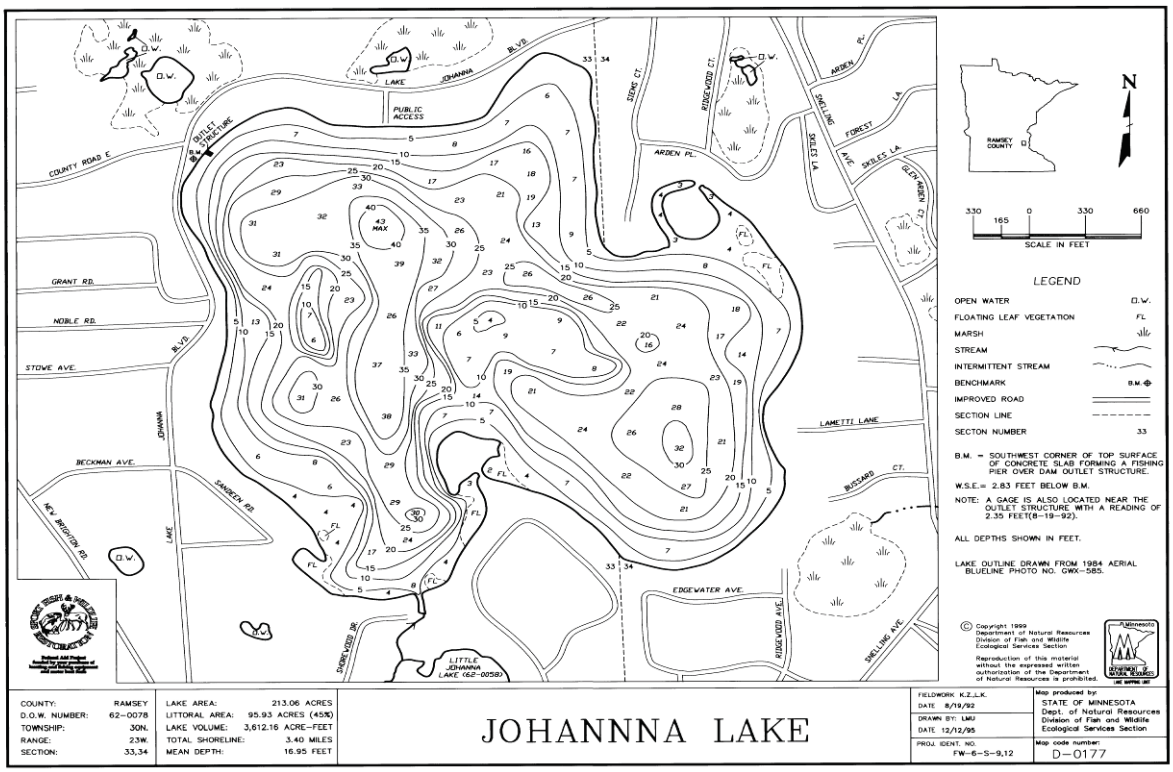


Figure 2. Lake Johanna Bathymetry

Water Quality Summary

Water quality data for Lake Johanna have been collected from 1971-2007. Data are collected by Ramsey County Public Works, Metropolitan Council Environmental Services, and the Minnesota Pollution Control Agency. A summary of the most recent 10 years of monitoring data suggest that the lake is currently meeting water quality standards (Table 1).

Table 1. Average Water Quality Data (1998-2007) and Standards

Parameter	Lake Johanna	Standard
TP (µg/L)	31	40
Chl (µg/L)	12	14
Secchi Depth (m)	2.0	1.4

Figures 3 through 5 show the growing season total phosphorus (TP), chlorophyll- *a*, and Secchi depth (clarity) for Lake Johanna.

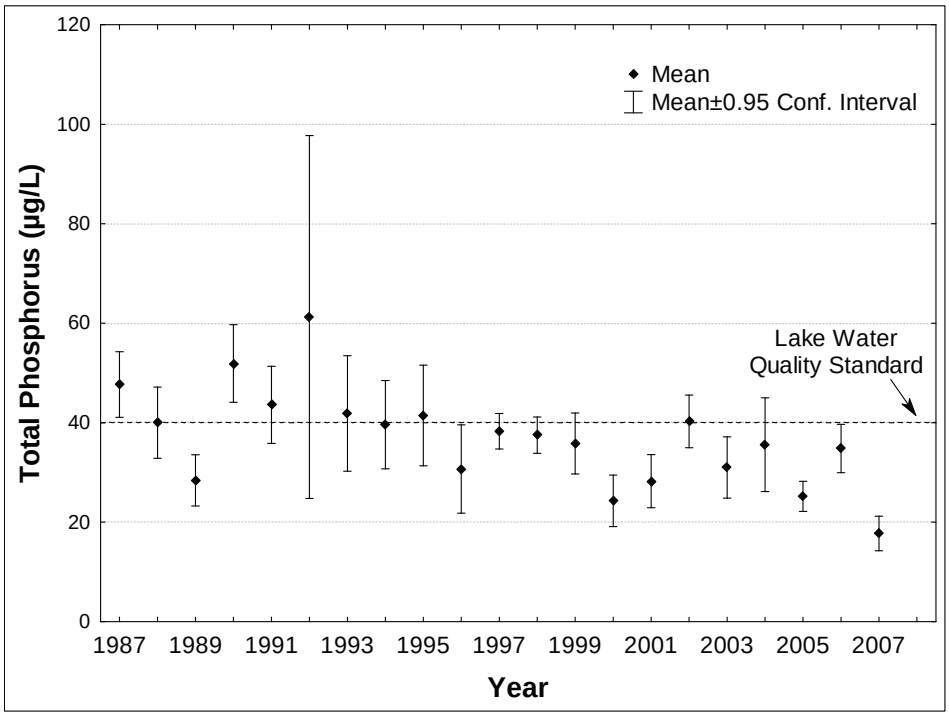


Figure 3. Lake Johanna Total Phosphorus

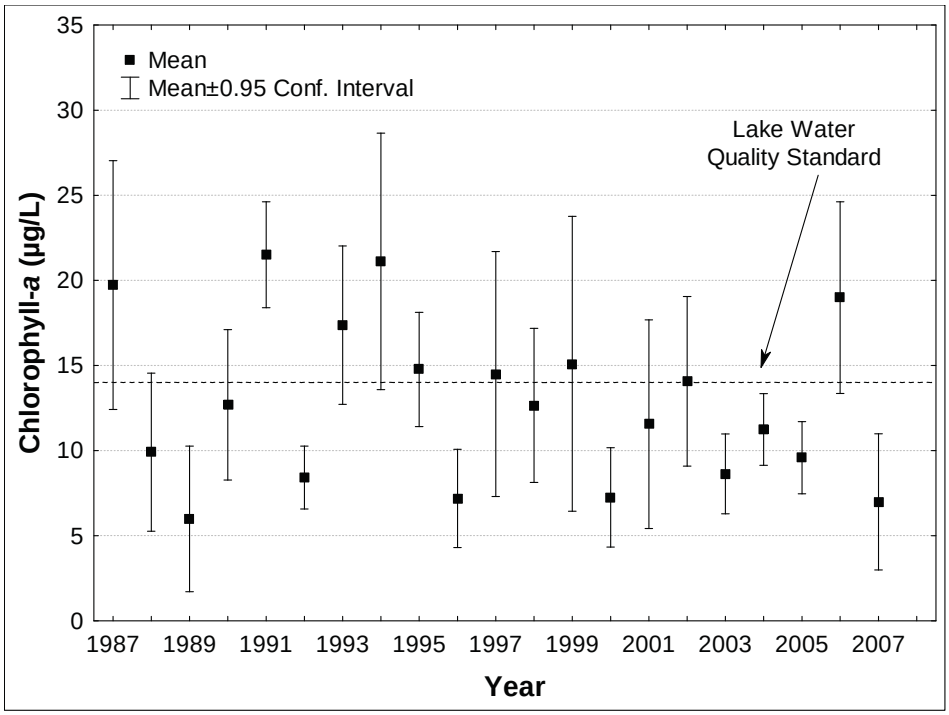


Figure 4. Lake Johanna Chlorophyll-*a*

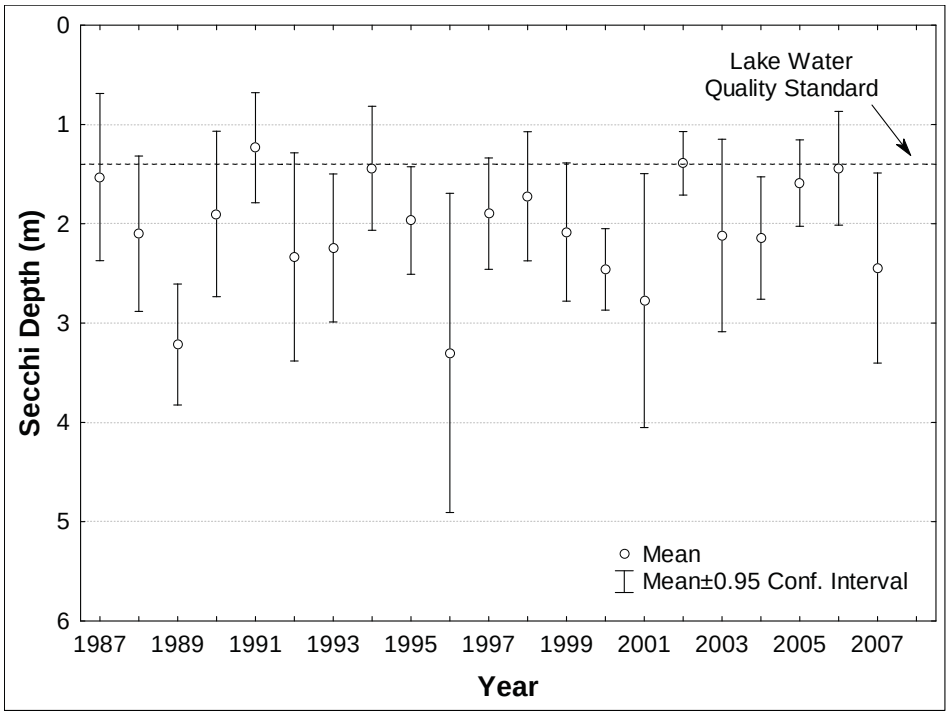


Figure 5. Lake Johanna Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. The lake model was calibrated to in-lake monitoring data. Water quality modeling indicates that

watershed inputs account for approximately 74% of the nutrient load, with internal loading accounting for the remaining 26% (Figure 6).

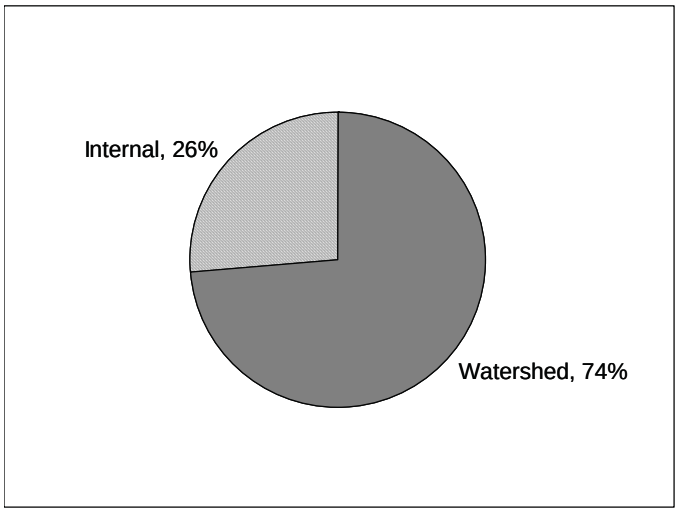


Figure 6. Lake Johanna Phosphorus Load Distribution

Public Input

At the public meeting held on June 5, 2008 issues facing Lake Johanna were addressed. Some of the comments refer to a previous Clean Water Partnership study for Long Lake that included recommendations for the Johanna and Little Johanna watershed. Many of the recommendations in that project were implemented and have proven successful to some degree, but problems continue to exist with the lake.

- Many of the comments for Lake Johanna pertained to the need to clean-up Little Lake Johanna so that it would stop discharging highly nutrient-laden water into Lake Johanna and degrading its quality. The lake has traditionally been very good quality, but this year has started off recognizably bad and all fingers pointed to Little Johanna inflows. The attendees indicated their top priority would be cleaning up the Little Johanna inflow into the south side of the lake.
- It was pointed out that runoff from essentially all of the land on the west side of the lake enters the lake untreated. This should be a focal point for retrofitting BMPs with a phosphorus reduction emphasis. Lametti's Addition, Northwestern College (east side of the lake), and Bussard Ct. were mentioned as examples of locations in need of treatment.
- There was mention that at times the outlet to the lake plugs and is in need of maintenance, but no one knew who to call. It has since been determined that the RCWD owns the structure. Field staff from the District inspected and cleaned the outlet in August 2008. District personnel will regularly inspect the structure in the future.
- Several residents are concerned that the DNR will eliminate the ability of lakeshore owners to chemically treat weeds. They believe that the agency has cut back their permitting of these applications and might eventually eliminate this as a macrophyte management tool. The residents currently spray three times a year with a chemical they could not off-hand identify. They do not currently harvest plants. The suggestion should

be made that the homeowners work with the RCWD and DNR on an overall macrophyte management plan to identify a long-term plan for nuisance weed control on the lake. This approach would allow the homeowners to engage in direct communication with DNR on which approaches will be allowed in the future and which might be curtailed.

- The smell of algae on the lake was raised by some attendees. Solving the nutrient influx into the lake would go a long way toward reducing algal blooms, but it was recognized that short-term improvements are not likely. However, due to the fact that Little Johanna is impaired for excess nutrients, the MPCA will be required to complete a TMDL study in the future.
- Street sweeping was a popular recommendation by meeting attendees. It was stated that the City of Roseville sweeps its streets only once per year and that the Rosedale shopping Center does not do a good job of keeping its parking lots clean. Attendees recommended that the city increase its sweeping frequency and that the shopping center(s), including others in the sub-watershed, also be asked to do a better job of sweeping. Spot sweeping of critical areas, such as those directly tributary to lakes, was encouraged.
- It was noted that detention ponds on the Northwestern College campus, one located west of Snelling and south of Co. Rd. C, and at EagleCrest Retirement Community, were in need of deepening to restore their ability to adequately handle runoff.
- Some attendees expressed their unhappiness with runoff leaving some of the construction underway at the Northwestern College campus. The attendees urged the RCWD to do a better job of site inspection for construction activities within the watershed.
- Residents would like some attention placed on fish management. Nuisance rough fish are currently a problem. The number of panfish (planktivores) is unusually high, although most are very small in size.

In addition to the public input provided at the meeting held on June 5, 2008, members of both the Lake Johanna Improvement Society and the Arden Hills Beach Club expressed concern about the condition of Lake Johanna's outlet structure. Visits by RCWD staff revealed that the structure had been damaged, and was allowing water to pass approximately 0.02 feet lower than designed (Figure 7). RCWD engineers produced a technical memo recommending repair of the structure. Repair is slated for 2009.

Figure 7. Photos of damaged outlet structure*, Sept 9, 2008*

Water Quality Issues

- Curly-leaf pondweed was found in the lake at a rare abundance in a late July 2001 aquatic plant survey. Since curly-leaf pondweed usually dies back after June, its presence in late July could indicate that it is abundant earlier in the growing season. Curly-leaf pondweed can contribute to internal loading.
- The poor water quality of Little Lake Johanna may negatively influence the water quality of Lake Johanna. Approximately half of the watershed load comes from the Little Lake Johanna outlet.
- High densities of bluegill and other panfish may contribute to periodic high algal concentrations through grazing pressure on the zooplankton community. Nuisance rough fish have also been observed, which can increase internal loading rates.

Recommended Management Approach

Watershed Management Recommendations

Management of land in the watershed is a critical element in addressing the nutrient impairment of Little Lake Johanna and the overall health of Johanna. Because the Lake Johanna watershed is nearly fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, seven BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Feasibility and Benefit Level Assessment of the potential regional BMP locations identified in the *field reconnaissance supplement*.
- Consideration of local partnerships for further assessment of the four potential local BMP locations identified in the *field reconnaissance supplement*.
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- As stated in The City of Arden Hills 2030 Comprehensive Plan, stormwater treatment systems are being evaluated as part of the city's pavement management program to reduce pollutants entering Lake Johanna.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)

- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
  Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

- Develop an aquatic vegetation management plan to prevent curly-leaf pondweed abundance from increasing within the lake.
- The bluegill population size is well above the medial level for lakes of this type. Planktivore size structure outlined in the DNR fisheries survey suggests that the population is dominated by small individuals; 65% of bluegills were less than 5 inches, and no black crappie larger than 8 inches were sampled. This could indicate planktivore 'stunting,' where intraspecific competition limits growth. Dense populations of small planktivores are capable of limiting zooplankton populations, leaving no biological check on algae growth. Work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Lake Johanna. Since there is a long record of in-lake water quality data for Lake Johanna, additional data collection is not a high priority at this time.

- TP, chlorophyll, and Secchi depth data: Continue to collect at least five sampling dates per year.
- Macrophyte surveys: A late spring / early summer macrophyte survey should be completed to better assess plant communities, especially in regards to curlyleaf pondweed occurrence and abundance. Macrophyte surveys should also be conducted pre-planning and post-implementation of an aquatic vegetation management plan.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the existing fisheries information regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.

Johanna Lake Field Reconnaissance Supplement

Regional Management BMPs

Johanna #1
Location: North of the intersection of Richmond Avenue and Richmond Court
Description: Wetland areas receiving upstream stormwater discharges.
Potential Improvements: Enhancements to the existing wetlands to provide more saturation and reduce ditched conditions that may exist in the complex. An assessment of the water quality leaving the wetland complex and the quality of the existing wetland vegetation should be assessed to determine the need for alterations.

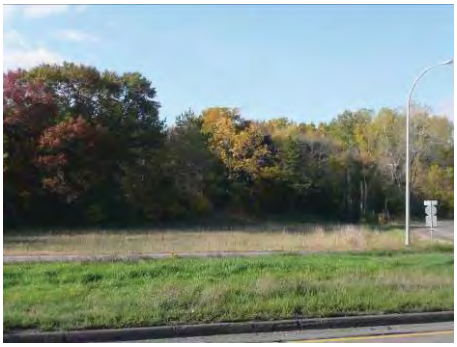
Johanna #2
Location: Northeast of the intersection of Edgewater Avenue and Ridgewood Road
Description: Large wetland area, currently receiving water from a sizable drainage area.
Potential Improvements: Potential excavation/cattail removal. Assess the current water quality treatment being provided by the basin and assess options for improvement if warranted.

Local Management BMPs

Johanna #3
Location: North of County Road E and west of Oak Avenue
Description: Low open area at the corner
Potential Improvements: Use for treatment of adjacent roadways.

Johanna #4
Location: North of Harriet Avenue and west of Lexington Avenue
Description: Mowed swale area
Potential Improvements: Use and enhance to provide treatment for adjacent business and/or roadway.

Johanna #5
Location: South of Ingerson Road and east of Hamline Avenue
Description: Open green space at the corner
Potential Improvements: Incorporate large raingarden to provide treatment for adjacent roadways.



Johanna #6
Location: West of Snelling Avenue and north of Hamline Avenue
Description: Open space at corner
Potential Improvements: Use for wetland treatment or ponding for Snelling Avenue.

Site Specific Management BMPs

Johanna #7
Location: North of County Road E and west of Lexington Avenue
Description: Green space at edge of parking lot
Potential Improvements: Incorporate raingarden areas for treatment of adjacent parking lot.

Jones Lake Management Action Plan

Jones Lake (62-0076) is located in the City of New Brighton, Ramsey County, Minnesota (Figure 1). The lake has a surface area of 37.5 acres (Figure 2) and a maximum depth of approximately 1 foot[1]. The lake has a very large watershed of about 2,775 acres and is tributary to Pike and Long Lakes.

Jones Lake meets the MPCA definition of wetland and is classified as a Class 2D (wetland) water in accordance with Minn. Rules Ch. 7050. Furthermore its designation as a Public Water Wetland ["W" 62-76] by the DNR Protected Water Inventory and the lack of an aquatic recreational resource management history (MPCA (*Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment,* 2007) substantiates the designation as a Class 2D water. The Class 2D designation means that the wetland resource is protected for the "maintenance of a healthy wetland aquatic community and for wetland based aquatic recreation." Numeric nutrient standards developed for shallow lakes (i.e. 60 µg/L TP) do not apply to Class 2D wetlands.

Jones Lake is listed as an impaired wetland on the EPA's 303(d) list of impaired waters. It is impaired for aquatic life, based on aquatic macroinvertebrate and aquatic plant bioassessments. In the 2008 listing cycle, the MPCA began listing wetlands that are tributary to other impaired water bodies; in the case of Jones Lake, both Pike Lake and Long Lake are on the 303(d) list of impaired water bodies. The intent of listing wetlands is to highlight the potential of wetland restoration within the context of restoring the downstream impaired water body, while avoiding the use of the wetland as a treatment basin, which might improve the downstream resource but would further degrade the wetland. The MPCA will be developing guidance on how an impaired wetland will be addressed through the TMDL program. In its report on the reasoning behind the recommendation to list Jones Lake as an impaired wetland, the MPCA acknowledged that the potential to restore Jones Lake will be limited due to history of watershed disturbance and management practices in the Jones Lake watershed.

The primary use of the wetland is for temporary detention of stormwater. The biological impairment is likely the result of years of urban runoff passing into and through this stormwater feature, in addition to substantial water level fluctuations. In the 1960s, the water level in Jones Lake dropped by approximately 18 inches after projects were implemented in the Jones Lake watershed to alleviate flooding. In response to the lowered water level, a weir was installed in the late 1970s to restore the lake's water level.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from the Rice Creek Watershed District website.

Jones Lake is a wetland with a dense population of cattails around the fringes and open water in the middle. It is currently used to treat stormwater runoff from an urbanized watershed and has suffered from water level fluctuations and high nutrient loading.

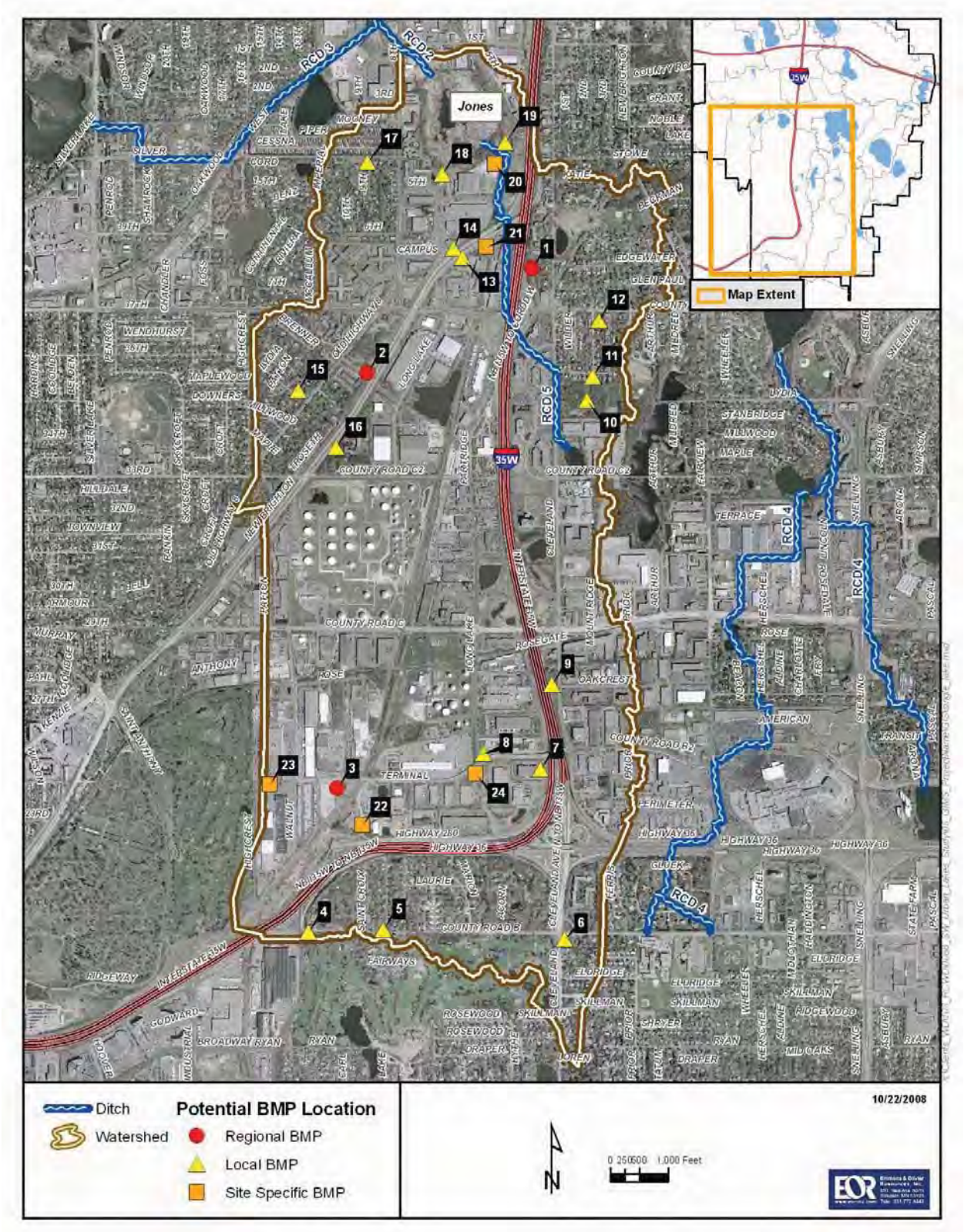


Figure 1. Jones Lake and Potential BMP Locations

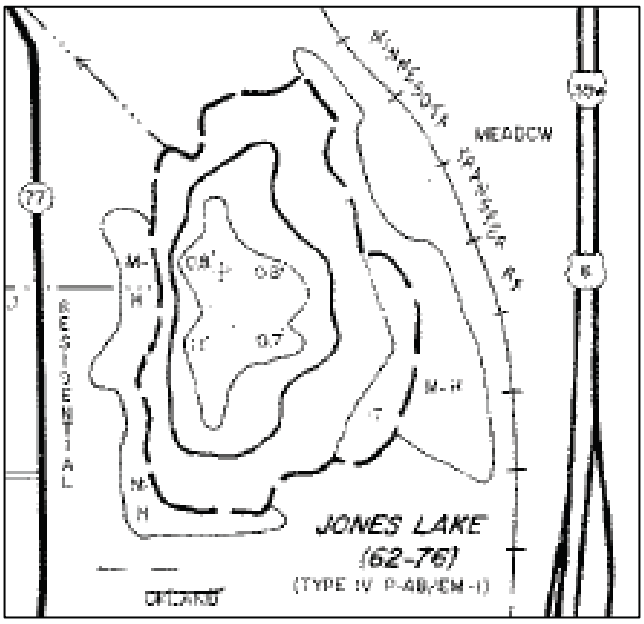


Figure 2. Jones Lake Bathymetry. Map from DNR files, unknown date.

Water Quality Summary

Water quality and biological data for Jones Lake are very limited. A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. There are no in-lake monitoring data to calibrate the lake model. Water quality modeling indicates that watershed inputs account for approximately 92% of the nutrient load, with internal loading accounting for the remaining 8% (Figure 3). Without any in-lake nutrient data for the lake for model calibration, the modeling results should be considered preliminary.

In 2001, RCWD undertook a phosphorus budget study of Jones Lake, which concluded that Jones Lake was capturing approximately 13% of the TP entering it. The study noted the dense plant growth in the lake, with even the open water areas having almost complete coverage from the dense amount of submerged macrophytes.

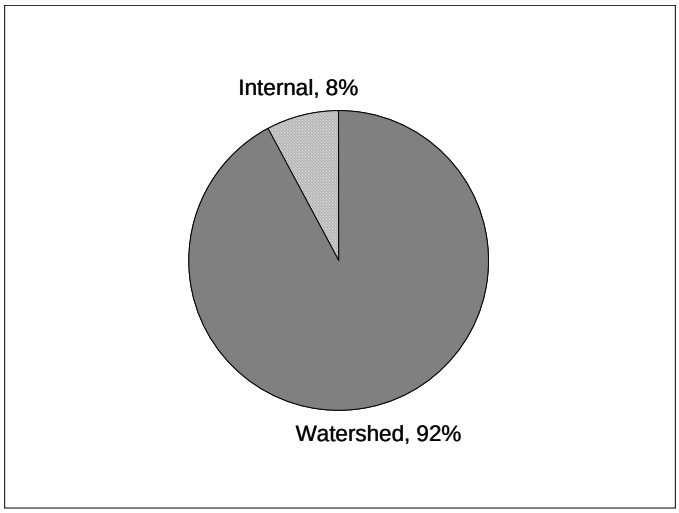


Figure 3. Jones Lake Phosphorus Load Distribution

Public Input

At the public input meeting held on June 2, 2008, no attendees spoke on issues related to Jones Lake.

Water Quality Issues

- Historically, Jones Lake has been used for stormwater management and not treated as its own water body. The resulting water level fluctuations and the stormwater runoff to the lake have degraded the ecological health of the wetland.
- In addition to decreasing phosphorus loading to the lake, the degraded plant community in Jones Lake will need to be restored. This will provide improved habitat for aquatic macroinvertebrates and will lead to an overall improved ecological health.

Recommended Management Approach

A watershed-level TMDL study should be completed for the Jones Lake, Pike Lake, and Long Lake impairments. Although the approach to developing a wetland TMDL has not yet been defined by the MPCA[2], this watershed could be used as a pilot study that would demonstrate how to incorporate a wetland biological impairment with other downstream impairments. The following recommendations would be further refined in a TMDL study.

Watershed Management Recommendations

Management of land in the watershed may not be as critical an element as in-lake management in addressing the biotic impairment of Jones Lake. However, improvements within the watershed will have effects not only for Jones Lake but also on nutrient impaired downstream receiving waters (i.e. Pike and Long Lakes). The Jones Lake watershed is fully developed, with the bulk of the watershed developed without any onsite water quality treatment. Therefore, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify

[2] US EPA has recently (Dec 2008) developed draft guidance for watershed TMDLs. The document is titled "Handbook for Developing Watershed TMDLs," and can be found at www.epa.gov/owow/tmdl.

likely regional, local, and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, 24 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Feasibility and Benefit Level Assessment of the three potential regional BMP locations identified in the *field reconnaissance supplement*.
- Consideration of local partnerships for further assessment of potential local BMP locations identified in the *field reconnaissance supplement.*
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- The sub-watershed draining to Jones Lake contains a long ditch paralleling railroad tracks on the west side of I-35W. There is a small detention pond on the ditch near the top of the watershed; this pond has a substantial sediment delta and is not likely operating at its design capacity. At a minimum, this pond should be restored to its original design. A retrofit opportunity should also be assessed to increase its storage capacity and stormwater treatment effectiveness.
- Runoff from the sub-watershed to the southeast of Jones Lake is delivered by Ramsey County Ditch 5 (RCD 5). This ditch drains the Langton Lake sub-watershed, as well as other areas adjacent to the I-35W corridor. This part of the Jones Lake watershed contains some small-scale drainage ponds that should be evaluated for performance.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization and runoff management.
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

The poor plant and macroinvertebrate communities in Jones Lake suggest that in-lake management practices will be needed to address the poor quality habitat. However, the water level fluctuations and the high nutrient loading create an environment that makes it difficult for the establishment of native plant communities, and supports cattail dominance. Any in-lake restoration project will have a greater likelihood of success after the rate and volume of stormwater runoff to Jones Lake is controlled.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Jones Lake:

- RCWD should use the recent draft EPA *Handbook for Developing Watershed TMDLs* and work with the MPCA to define data needs for a potential watershed TMDL.
- TMDLs for wetland impairments have not yet been completed by the MPCA and therefore the process is not well-defined. Work closely with MPCA on data collection efforts aimed at completing the TMDL for Jones Lake.
- Ramsey County Ditch 5 should be monitored close to the inlet to Jones Lake to provide flow and phosphorus loading estimates.

Jones Lake Field Reconnaissance Supplement

Regional Management BMPs

Jones Lake #1
Location: North of County Road D and west of Cleveland Avenue
Description: Large open area south of an apartment complex
Potential Improvements: Area could be used for a significantly sized feature depending on the drainage area that could be routed to this area.

Jones Lake #2
Location: South of County Road D and west of New Brighton Blvd
Description: Large open/wooded area with drainage running southeast under New Brighton Blvd.
Potential Improvements: Create regional treatment feature for drainage area west of this location. An assessment of grades and routing would be required.

Jones Lake #3
Location: South of Terminal Road and west of railroad tracks
Description: Large vacant lot
Potential Improvements: A large treatment area could be incorporated here to serve untreated industrial areas. Further assessment of the drainage area that could be routed to this location would be required.

Local Management BMPs

Jones Lake #4
Location: County Road B and TH 280
Description: Road closed off due to TH 280 expansion
Potential Improvements: If County Road B and TH 280 will no longer be connected, this area could be converted to a stormwater BMP

Jones Lake #5
Location: North of County Road B and west of Saint Stephen Street
Description: Open corner lot
Potential Improvements: Route road runoff to this area and provide treatment

Jones Lake #6
Location: South of County Road B and east of Cleveland Avenue
Description: Large open green space with no apparent current use
Potential Improvements: Use this area to treat adjacent roads. The site sits higher than roads so additional excavation would be required if this site were to be used.

Jones Lake #7
Location: West side of Rosegate and south of County Road B2
Description: Large grass swales along Rosegate with catch basins at the bottom
Potential Improvements: Convert into treatment areas to provide storage/infiltration

Jones Lake #8
Location: East of Long Lake Road and north of County Road B2
Description: Green space at the corner
Potential Improvements: Incorporate infiltration/water quality treatment BMP to treat roads or the adjacent business

Jones Lake #9
Location: West of the intersection of Oakcrest Avenue and Cleveland Avenue
Description: Triangular open space between 35W and Cleveland Avenue
Potential Improvements: Potentially incorporate large treatment area. Would need to assess what areas could be routed to this area.

Jones Lake #10
Location: East of Cleveland Avenue and South of Brenner Avenue
Description: Low wetland area
Potential Improvements: Enhance wetland to provide additional water quality treatment. Would need assessment to evaluate need, the quality of the wetland, and what could be routed to it.

Jones Lake #11
Location: South of the intersection of Brenner Avenue and Mount Ridge Road
Description: Green space that could be used to treat adjacent roads
Potential Improvements: Infiltration or ponding feature.

Jones Lake #12
Location: South of County Road D and east of Mount Ridge Road
Description: Large dry pond
Potential Improvements: Retrofit to provide infiltration or water quality storage.

Jones Lake #13
Location: North of County Road D and west of New Brighton Blvd
Description: Large open area
Potential Improvements: Use area to treat New Brighton road and/or adjacent businesses.

Jones Lake #14
Location: West side of New Brighton Blvd and north of County Road D
Description: Large grass swale areas
Potential Improvements: Could easily be enhanced to provide additional treatment and infiltration.

Jones Lake #15
Location: North of the intersection of Manson Street and Stanbridge Street
Description: Green space next to trail
Potential Improvements: Incorporate raingarden

Jones Lake #16
Location: North of County Road C2 and east of New Brighton Blvd
Description: Large grass swale area
Potential Improvements: Could be enhanced to provide additional treatment.

Jones Lake #17
Location: South of Foss Road and west of 9th Avenue
Description: Low green space
Potential Improvements: Retrofit to provide treatment for adjacent roads.

Jones Lake #18
Location: North of 5th Street and east of Old Highway 8
Description: Open space behind water tower
Potential Improvements: Use area to treat adjacent untreated industrial areas. Would need to assess adjacent drainage area to evaluate what could be routed here.

Jones Lake #19
Location: East side of Jones Lake
Description: Large open area, perhaps used as raspberry patch.
Potential Improvements: Use to treat industrial areas to the north. Would need further assessment of the drainage area and would have to get water under railroad tracks. A smaller feature north of this location and closer to the drainage connection under the railroad tracks might be more practical.

Site Specific Management BMPs

Jones Lake #20
Location: North of Lakeview Point Drive just south of Jones Lake
Description: Large amounts of impervious area routed directly to Jones Lake
Potential Improvements: Remove some impervious area and install treatment features or incorporate underground treatment devices.

Jones Lake #21
Location: North of County Road D and west of New Brighton Blvd
Description: Large amounts of impervious areas from warehouse site routed through wooded area directly into culvert with no treatment.
Potential Improvements: Plenty of room to incorporate wetland treatment or an infiltration feature depending on site soils.

Jones Lake #22
Location: West of St. Croix Street and North of Frontage (north of I-35W)
Description: Grass swale to pipe outlet
Potential Improvements: Easy retrofit into raingarden area for adjacent business.

Jones Lake #23
Location: West of Walnut Street and south of Terminal Road
Description: Large parking lot routed directly to piped outlet. Area in front of pipe has been collecting sediment with vegetation growing.
Potential Improvements: Remove this corner of flood-prone parking and incorporate a ponding or infiltration feature.

Jones Lake #24

Location: West of Long Lake Road and south of Terminal Road

Description: Parking area draining straight to a catch basin.

Potential Improvements: Retrofit to provide treatment in the available green space.

Lake Josephine Management Action Plan

Lake Josephine (62-0057) is located in the cities of Arden Hills and Roseville, Ramsey County, Minnesota (Figure 1). The lake has a surface area of 116 acres (Figure 2), a maximum depth of 44 feet, and a mean depth of approximately 20 feet[1]. The watershed that drains to Lake Josephine is 774 acres. The surrounding watershed area is primarily residential with some commercial and transportation land uses. The lake is bordered on the southeast side by Lake Josephine Park. Little Lake Josephine and its watershed are contained within the Lake Josephine watershed.

Lake Josephine is on the EPA's 303(d) list of impaired waters due to the mercury content in fish. The MPCA completed a statewide TMDL study and implementation plan to address the state's mercury impairments.

An aquatic vegetation survey was performed by the DNR in late July of 2001. Coontail was found to be abundant and clasping-leaf pondweed was common. The lake has a history of aquatic vegetation control, including the treatment of approximately 10 acres of aquatic vegetation in 1996.

In the last 4 years, the DNR has stocked Lake Josephine with walleye and largemouth bass.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from the Rice Creek Watershed District website.

Figure 1. Lake Josephine and Potential BMP Locations

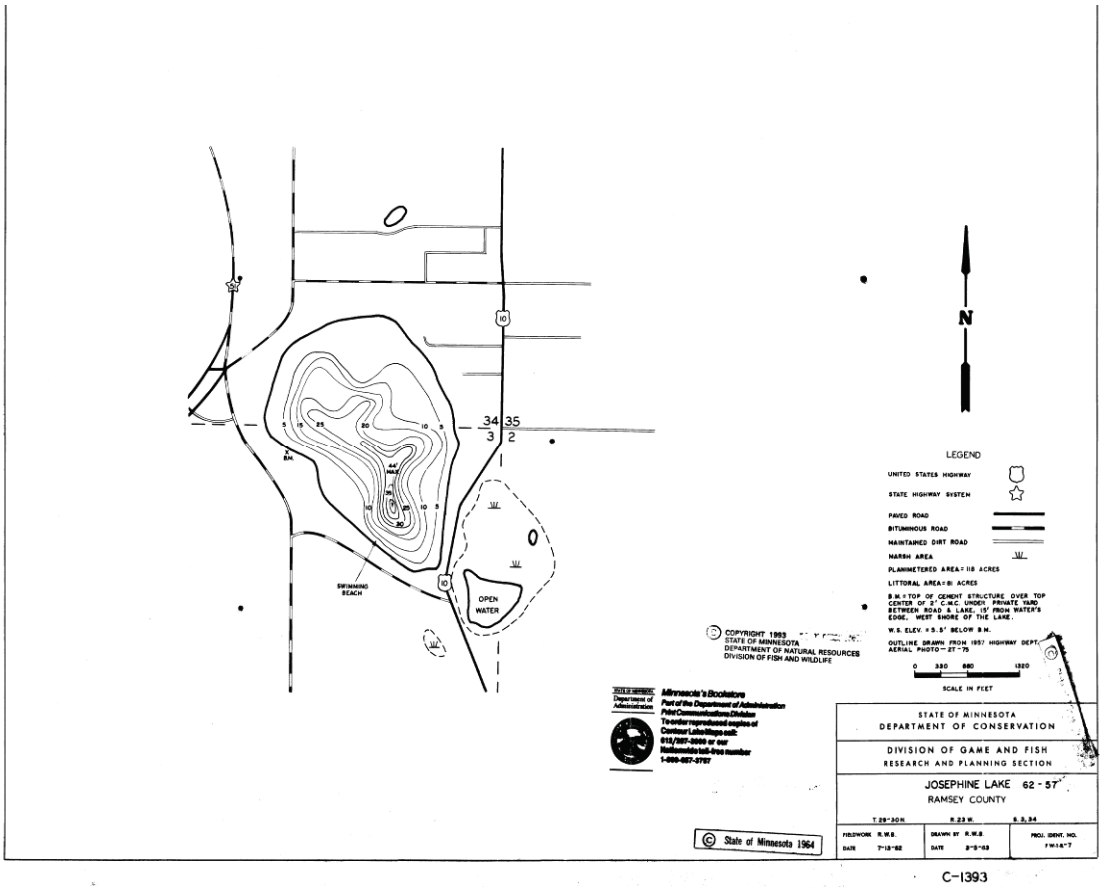


Figure 2. Josephine (and Little Josephine) Lake Bathymetry

Water Quality Summary

Lake Josephine has an abundance of water quality data that have been collected over recent years. Data are collected by Ramsey County Public Works, Metropolitan Council Environmental Services, and the Pollution Control Agency. A summary of the most recent 10 years of monitoring data suggests that the lake is currently meeting water quality standards (Table 1), although the average water quality conditions are close to the standards.

Table 1. Average Water Quality Data (1998-2007) and Standards

Parameter	Lake Josephine	Standard
TP (µg/L)	36	40
Chl (µg/L)	11	14
Secchi Depth (m)	2.0	1.4

Figures 3 through 5 show the total phosphorus (TP), chlorophyll-*a*, and Secchi depth (clarity) data for Lake Josephine. The figures show that in some years the standards are exceeded. Water quality improved through the 1980s and 1990s and appears to have stabilized. However, the last two years of chlorophyll-*a* and Secchi depth data show that water quality worsened during that time period.

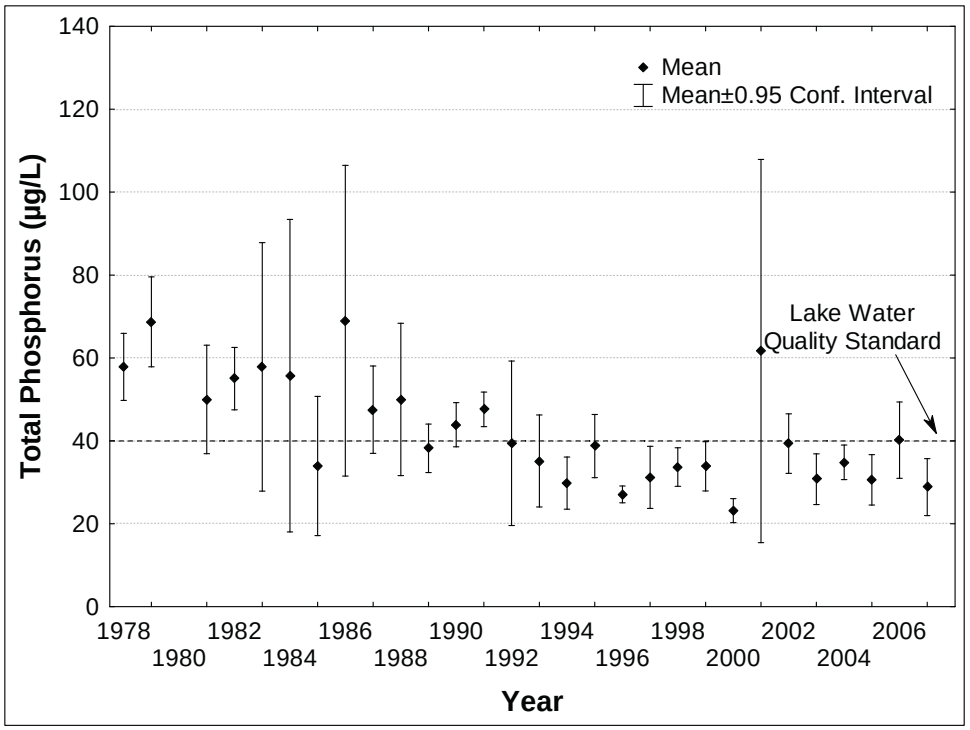


Figure 3. Lake Josephine Total Phosphorus

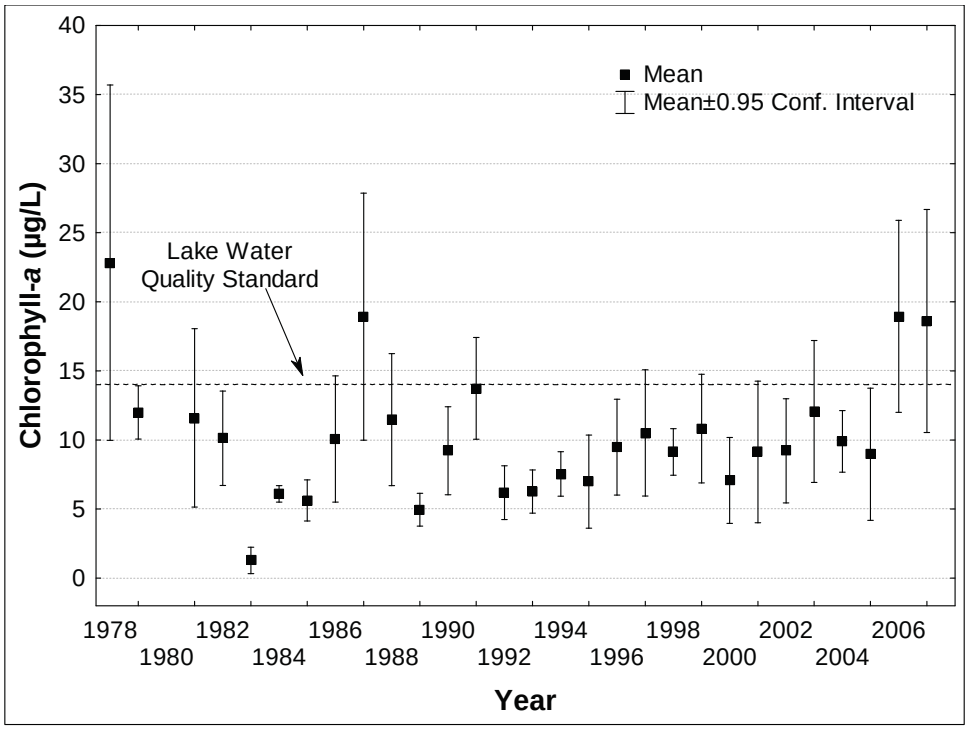


Figure 4. Lake Josephine Chlorophyll-*a*

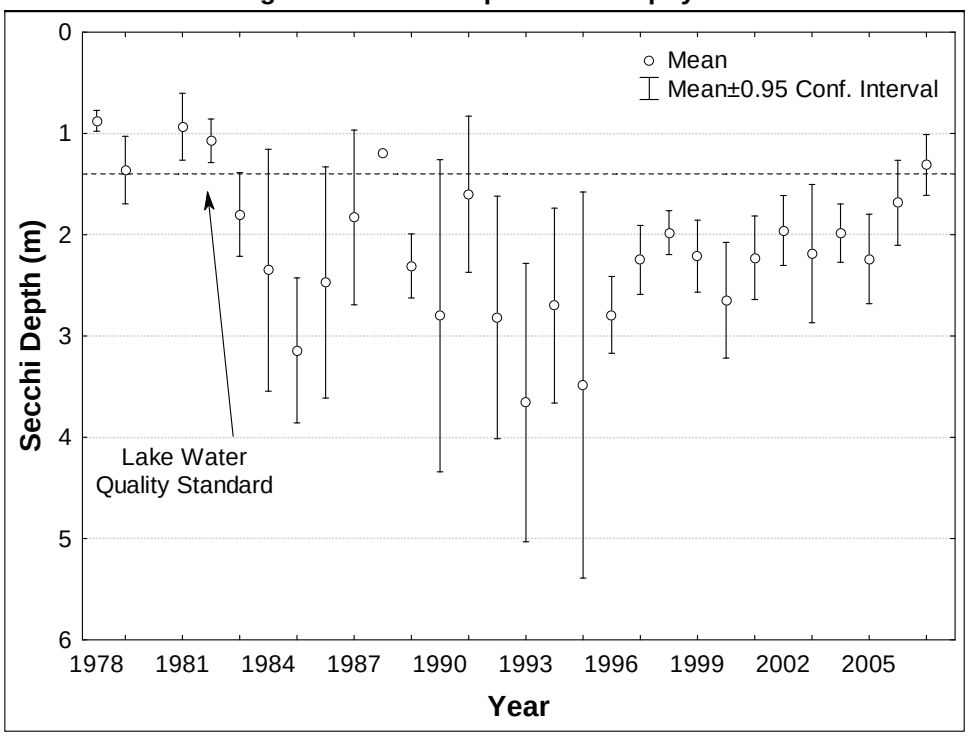


Figure 5. Lake Josephine Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. The lake model was calibrated to in-lake monitoring data. Water quality modeling indicates that

watershed inputs account for approximately 35% of the nutrient load, with internal loading accounting for 65% (Figure 6).

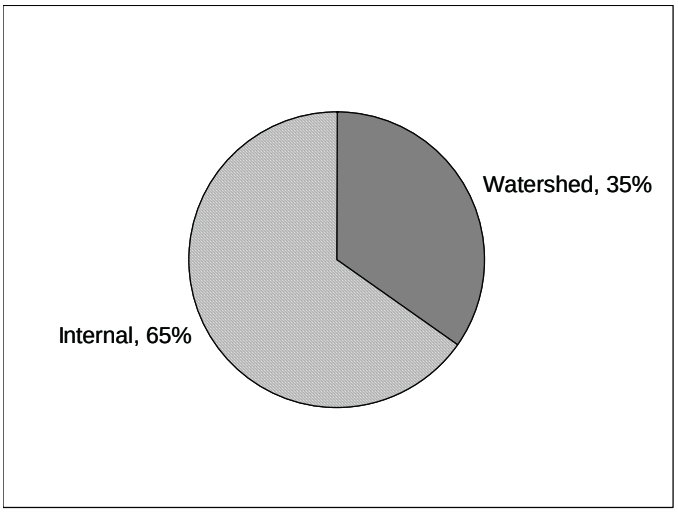


Figure 6. Lake Josephine Phosphorus Load Distribution

Public Input

At the public input meeting held on June 5, 2008, issues facing Lake Josephine were addressed. Preparation for this meeting and some comments offered refer to a previous Clean Water Partnership study for Long Lake that included recommendations for the Lake Josephine watershed. Many of the recommendations in that project were implemented and have proven successful to some degree, but problems continue to exist with the lake.

- Attendees at the public meeting recognized the good quality of Lake Josephine and acknowledged their desire to keep it clean. Lake residents did note the presence of nuisance algae this year. Also noted were problems with carp and dense curly-leaf pondweed. A DNR 2001 survey from late July did not identify the presence of curly-leaf pondweed. However, curly-leaf pondweed dies back after June and therefore could have been missed in the late July survey.
- Runoff management programs in the watershed focusing on nutrient control were indicated as a desirable approach to pursue.
- The attendees also indicated the need for more education on runoff control for residents of the watershed.

Water Quality Issues

- Algae reaches nuisance levels in mid-summer.
- Curly-leaf pondweed is present in the lake and likely contributes to internal loading.
- Bluegill are present in high densities in the lake, potentially leading to overgrazing of zooplankton.

Recommended Management Approach

Watershed Management Recommendations

Because the Lake Josephine watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, 4 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of the two potential local BMP locations identified in the *field reconnaissance supplement.*
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

Although the water quality of Lake Josephine is relatively good, it is close to water quality standards and should be managed to prevent any degradation in water quality.

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- The abundance of coontail and other macrophytes have in the past created conflicts with the recreational use of the lake, in that they inhibit boating. Efforts to remove vegetation could be potential stressors to the stability of the lake's water quality; aquatic macrophytes tend to hold back the growth of planktonic algae and stabilize lake sediments from re-suspension. If removal of aquatic vegetation besides curly-leaf

pondweed is desired by residents, care should be taken to only remove nuisance species, and to encourage the growth of non-invasive native species. All vegetation management actions should be coordinated and permitted with the DNR.

- Although there is a substantial population of northern pike and other piscivorous fish in the lake, there are also *very* high densities of planktivores, including bluegill and sunfish. In addition to the high numbers, planktivores are mostly small in size – 97% of bluegill were less than 5 inches. This could indicate planktivore 'stunting,' where intraspecific competition limits growth. High densities of small planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. Work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Lake Josephine. Since there is a long record of in-lake water quality data for Lake Josephine, additional data collection is not a high priority at this time.

- TP, chlorophyll, and Secchi depth data: Continue to collect at least five sampling dates per year.
- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the existing fisheries information regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.

Josephine Lake Field Reconnaissance Supplement

Local Management BMPs

Josephine #1
Location: South of Josephine Road and east of Hamline Avenue
Description: Large openspace at church
Potential Improvements: Use area for treatment of church or adjacent roads.

Josephine #2
Location: East of the intersection of Hamline Avenue and Clarmar Lane
Description: Stormsewer outfall through large estate lot(s). Roseville apparently installed a control structure at this location.
Potential Improvements: Assess effectiveness of structure and consider if additional opportunities exist to provide treatment prior to discharge to the lake.

Site Specific Management BMPs

Josephine #3
Location: South of Cannon Avenue and east of Lexington Avenue
Description: Large dry pond on church lot
Potential Improvements: Retrofit to provide infiltration / water quality treatment.

Josephine #4
Location: Lake Josephine Park
Description: Green space adjacent to parking lot and boat launch.
Potential Improvements: Incorporate raingarden area in green space. (Note: impervious areas are routed to a ponding area to the north.)

Karth Lake Management Action Plan

Karth Lake (62-0072) is located in the City of Arden Hills, Ramsey County, Minnesota (Figure 1). The surface area of the lake is approximately 20 acres (Figure 2) and the lake has a maximum depth of 14 ft.[1] Based on its low maximum depth, it is considered a shallow lake according to MPCA's definition.

The watershed draining to Karth is approximately 118 acres and includes mixed commercial and residential areas, while the immediate lakeshore is primarily residential with a city park (Karth Lake Park) on the south and southwest sides. The primary use of the lake is by the residents or the public visiting the park. No motors are allowed on the lake. Public access for non-motorized boating is available from the park. Flooding has occurred in the past at Karth Lake so an outlet pump was installed in 2004 on the south side of the lake. This is the only current outlet from the lake and it flows to Valentine Lake.

Limited environmental and fish monitoring data are available, with a single DNR Lake Survey Summary available from 1980. This survey notes a problem with winter fish-kills, but no information is available on the fish community in the lake. DNR does not currently stock the lake with fish.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from DNR files.

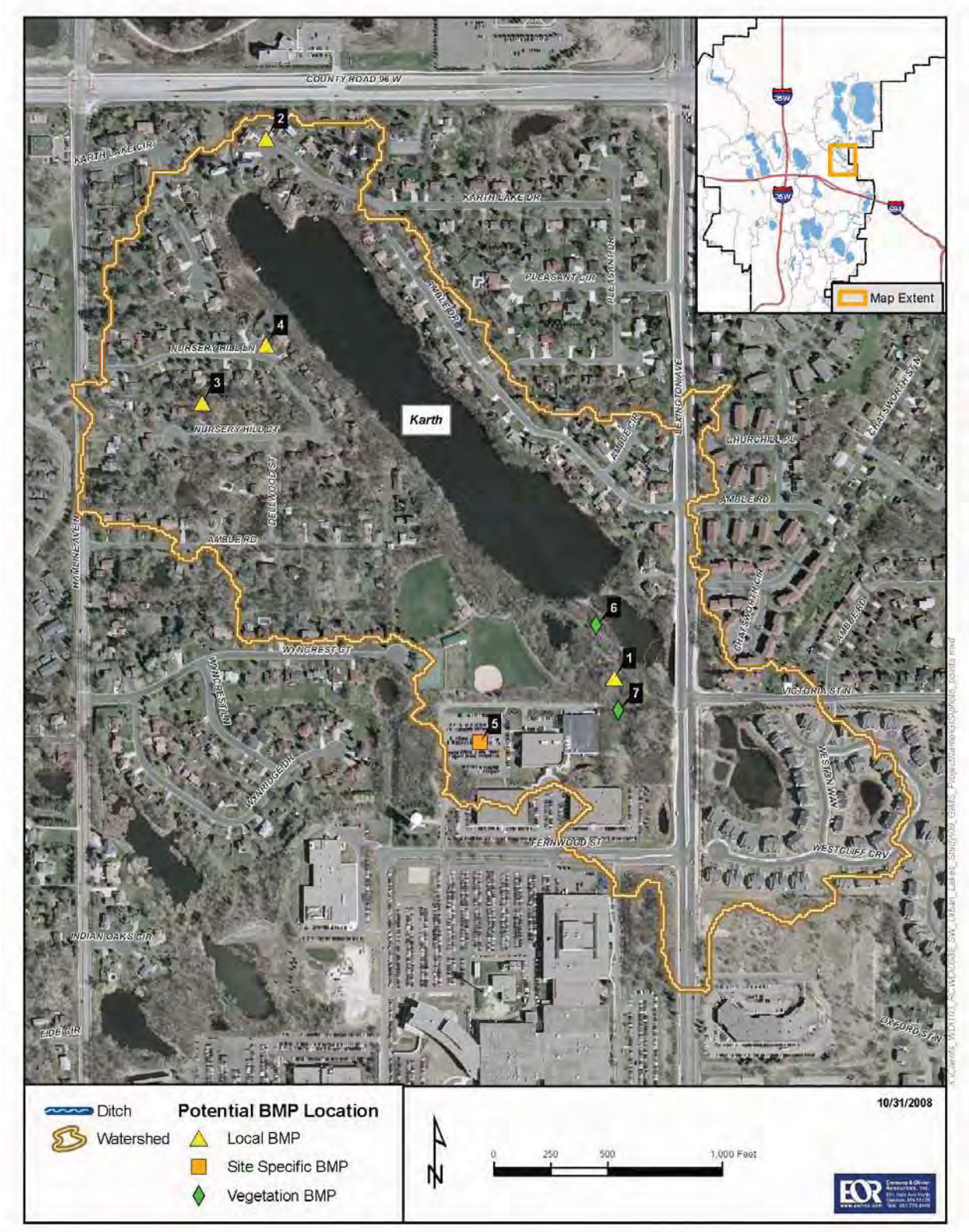


Figure 1. Karth Lake and Potential BMP Locations

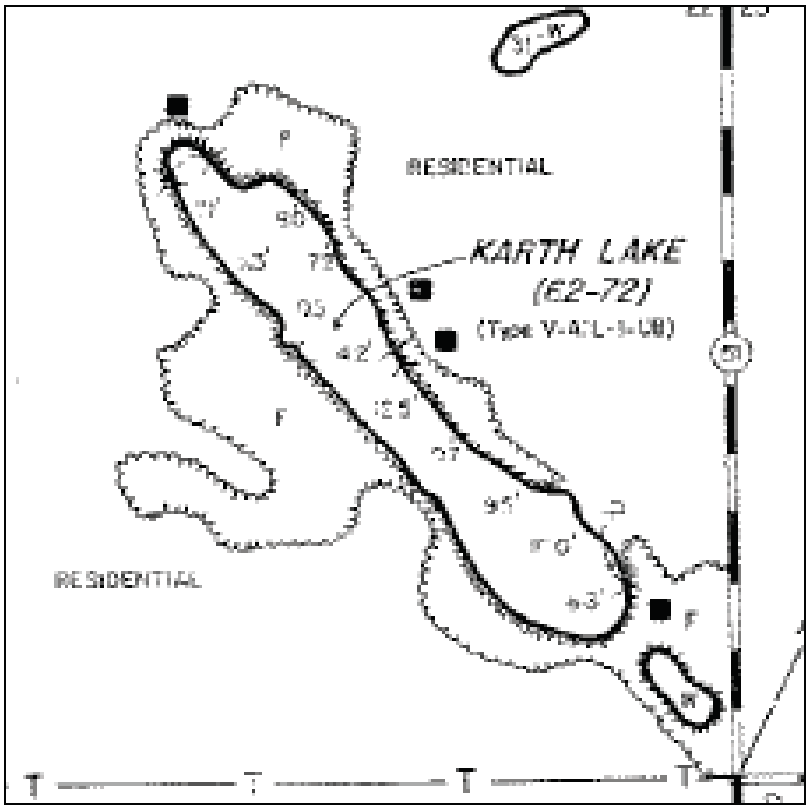


Figure 2. Karth Lake Bathymetry. Map from DNR files, unknown date.

Water Quality Summary

Limited historic data exist on the quality of Karth Lake. The Metropolitan Council's Citizen Assisted Monitoring Program (CAMP) has had the lake as part of its program since 2006. A summary of the CAMP data taken over the last two years (Table 1) shows that Karth Lake is meeting the water quality standards for shallow lakes.

Table 1. Average Water Quality Data (2006-2007) and Standards

Parameter	Karth Lake	Shallow Lakes Standard
TP (µg/L)	54	60
Chl (µg/L)	18	20
Secchi Depth (m)	1.0	1.0

Figures 3 through 5 show the total phosphorus (TP), chlorophyll-*a*, and Secchi depth (clarity) data from Karth Lake.

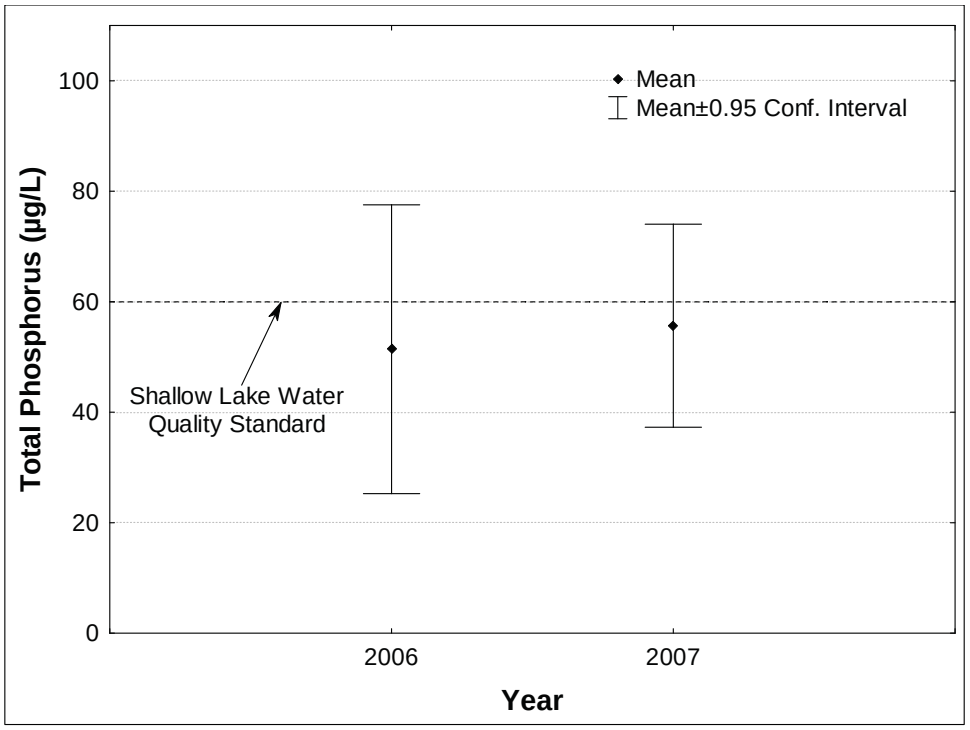


Figure 3. Karth Lake Total Phosphorus

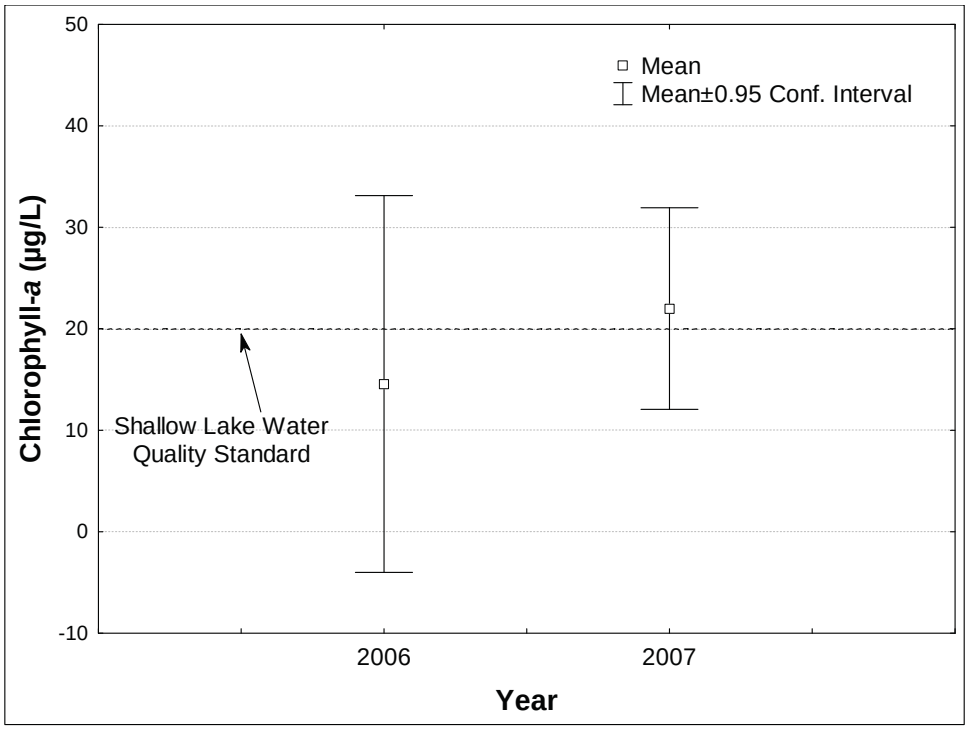


Figure 4. Karth Lake Chlorophyll-*a*

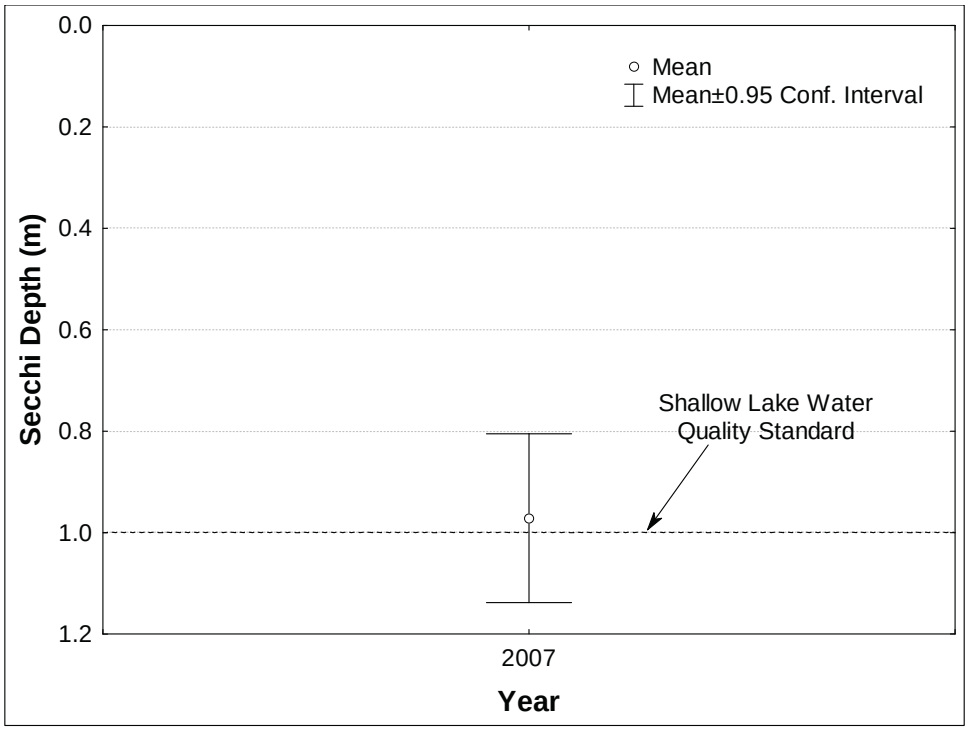


Figure 5. Karth Lake Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. The lake model was calibrated to in-lake monitoring data. Water quality modeling indicates that the watershed inputs account for approximately 85% of the nutrient load, with internal loading accounting for the remaining 15% (Figure 6).

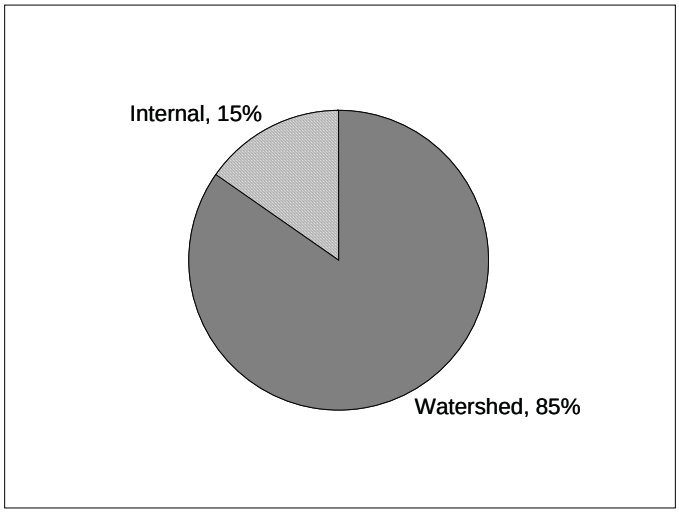


Figure 6. Karth Lake Phosphorus Load Distribution

Public Input

At the public input meeting held on May 29, 2008, lake residents offered local insight on Karth Lake. Residents are very interested in keeping the lake at its current quality or even in reducing the TP level further. A homeowners group, the Karth Lake Improvement District, has attempted to establish technical assistance from RCWD in framing issues and defining problems and solutions.

- Attendees noted that they have seen an orange discharge entering the lake occasionally from the Cummings stormsewer outlet on the southeast side of the lake. The nature of this discharge is unknown. The RCWD was urged to collect a sample if this colored discharge is seen again by residents. It was mentioned that it could be simply an iron coloring from groundwater seepage into the pipe.
- The residents felt that additional BMPs should be identified and retrofit opportunities sought. Several general approaches were recognized within the immediate watershed for retrofits whenever redevelopment or road projects are undertaken.
- The residents were also interested in undertaking a fish stocking program to attain a better ecological balance. They would like to either invite DNR to stock the lake or do some stocking themselves if an affordable supplier could be found and permission granted from DNR. The residents were interested in conducting a fish survey to see what fish are present and then determining a proper mix that would restore ecological balance among the planktivores (plankton eaters) and piscivores (fish eaters).
- The presence of curly-leaf pondweed (a nuisance macrophyte) was noted by attendees at the meeting. RCWD staff confirmed the presence of curly-leaf, but also noted that some native macrophytes (like coontail) were also present in the lake. A plant management program could target curly-leaf pondweed eradication and fostering of natives. Residents would like to pursue curly-leaf pondweed control either through chemical addition or control of sediment pH. The residents are interested in how such a program could be initiated, perhaps in cooperation with the RCWD. Various methods of chemical control were discussed at the meeting.
- Residents are currently controlling buckthorn along the shore of the lake to improve overall habitat and bank stability.

Water Quality Issues

- Curly-leaf pondweed, a nuisance macrophyte, is present in the lake. Curly-leaf may contribute to internal loading of phosphorus.
- Soil erosion has been observed at the site of the outlet pump on the south side of the lake.
- There is an access/parking street between the commercial/industrial area and the lake that slopes steeply to the east and discharges water at a high velocity into a channel draining to the lake.

Recommended Management Approach

Watershed Management Recommendations

Because the Karth Lake watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-

specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, four BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of the 4 potential local BMP locations identified in the *field reconnaissance supplement*.
- Notice/letter to FairIssac (business area south of the lake) educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program. All of this area (BMP #5) discharges directly to the lake untreated. There would be opportunity for easy (surface) retrofits in this area during pavement maintenance activities.
- Erosion control measures could be put in place to address soil erosion at the site of the outlet pump (BMP #6) on the south side of the lake.
- Erosion at the bottom of the slope that discharges water at a high velocity into a channel (BMP #7) draining to the lake should be stabilized.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs

Internal Lake Management Recommendations

With very little in-lake biological data for Karth Lake, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply to Karth Lake:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.
- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus

into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake. If cooperation is possible, work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

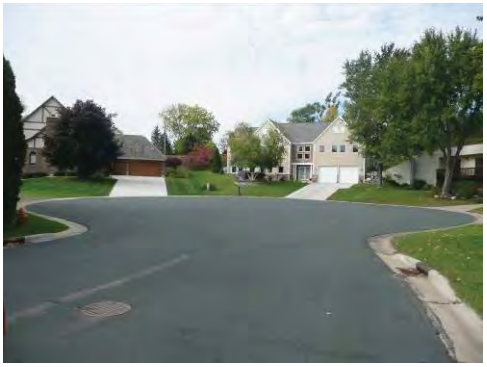
The following in-lake data collection will help tailor the management recommendations for Karth Lake. Since there are only two years of in-lake data on Karth Lake and the lake is close to the water quality standards, additional in-lake data collection on the lake should be considered high priority.

- Updated bathymetric data collection
- TP, chlorophyll, and Secchi depth data: Collect data for one to two additional years, with at least five sampling dates per year. Continued support of data collection through the CAMP program will provide sufficient information.
- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Fish survey: Complete a fish survey to evaluate the fish species composition of the lake.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.

Karth Lake Field Reconnaissance Supplement

Local Management BMPs

Karth #1
Location: South end of Karth Lake
Description: Low wooded area that could be used to treat the large manufacturing business south of lake. There is room to incorporate a good sized feature, which would be needed for that large amount of impervious draining to this location.
Potential Improvements: Incorporate ponding, infiltration, or wetland treatment depending on soils and water table.



Karth #2
Location: Cul-de-sac at the end of Karth Lake Drive
Description: Catch basins drain directly to lake
Potential Improvements: Incorporate island with treatment in cul-de-sac to treat adjacent impervious.

Karth #3
Location: North of Nursery Hill Court and west of Dellwood Street
Description: Low wooded wetland area
Potential Improvements: Incorporate treatment for adjacent roads (would need to asses current quality and function of the wetland)

Karth #4
Location: Cul-de-sac on Nursery Hill Lane
Description: A lot of unnecessary impervious, typical of several neighborhood streets around Karth Lake.
Potential Improvements: Incorporate islands with treatment in cul-de-sacs and reduce street widths. Reclaimed green space could also be used for raingardens.

Site Specific Management BMPs

Karth #5
Location: Parking lot serving manufacturing business south of Karth Lake
Description: The flume for storm water runoff from the large parking area currently discharges offsite untreated.
Potential Improvements: Incorporate stormwater treatment retrofits onsite during pavement maintenance.

Vegetation Management BMPs

Karth #6
Location: South end of Karth Lake
Description: Outlet pump and associated erosion.
Potential Improvements: Incorporate erosion control measures to prevent sediments from entering the lake.

No Photo

Karth #7
Location: East end of private drive on FairIssac site
Description: Erosion at the bottom of the slope that discharges water at a high velocity into a channel.
Potential Improvements: Stabilize outfall to prevent further erosion.

Langton Lake Management Action Plan

Langton Lake (62-0049) is located in the City of Roseville, Ramsey County, Minnesota (Figure 1). The 30-acre lake has three connected basins defined by trail crossings. There is a wetland to the north of the lake that is dominated by wetland macrophytes; this wetland is connected to the other lake basins but is isolated under low flow conditions. The north and south basins of the lake are separated by the southern-most trail crossing. Langton Lake has a maximum depth of 5 feet, and is 100% littoral[1]. The watershed area draining to Langton is approximately 208 acres with a mixed commercial-residential landuse, while the immediate lakeshore is primarily a city park.

Langton Lake meets the MPCA definition of a wetland and used to be classified as a Class 2D (wetland) water. In 2001, it was reclassified as a public water (not a wetland) as the request of a local legislator. Due to its shallow depth, it is considered a shallow lake according to MPCA's definition and, as a public water, is held to the state nutrient standards.

An aquatic plant survey was completed by the DNR in late June of 2000. The plant community consisted of both submerged vegetation (flatstem pondweed, Canada waterweed, sago pondweed, and narrowleaf pondweed) and emergent vegetation (cattail, arrowhead, bulrush, and spikerush). White waterlily is abundant in the northern wetland and common in the middle basin (referred to as Langton North in this report). The DNR field notes from the survey indicate that the City of Roseville has cooperated with local residents to control waterlily; this effort was initiated in 1996 to control white waterlily in the northern wetland, and the effort was expanded in 2000 to portions of the middle basin.

The DNR manages the fishery on Langton Lake as part of their Fishing in the Neighborhood (FIN) program. The FIN program provides fishing opportunities to local residents by stocking panfish and providing access; a fishing pier is located on the west shore of the south basin. Langton is a shallow lake subject to winterkill, so stocking efforts are active and continuous to replace fish that are caught or killed. The most recent DNR fisheries survey was conducted in 2000. In addition to high numbers of bluegill and sunfish, black bullheads were also sampled.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from the Rice Creek Watershed District website.

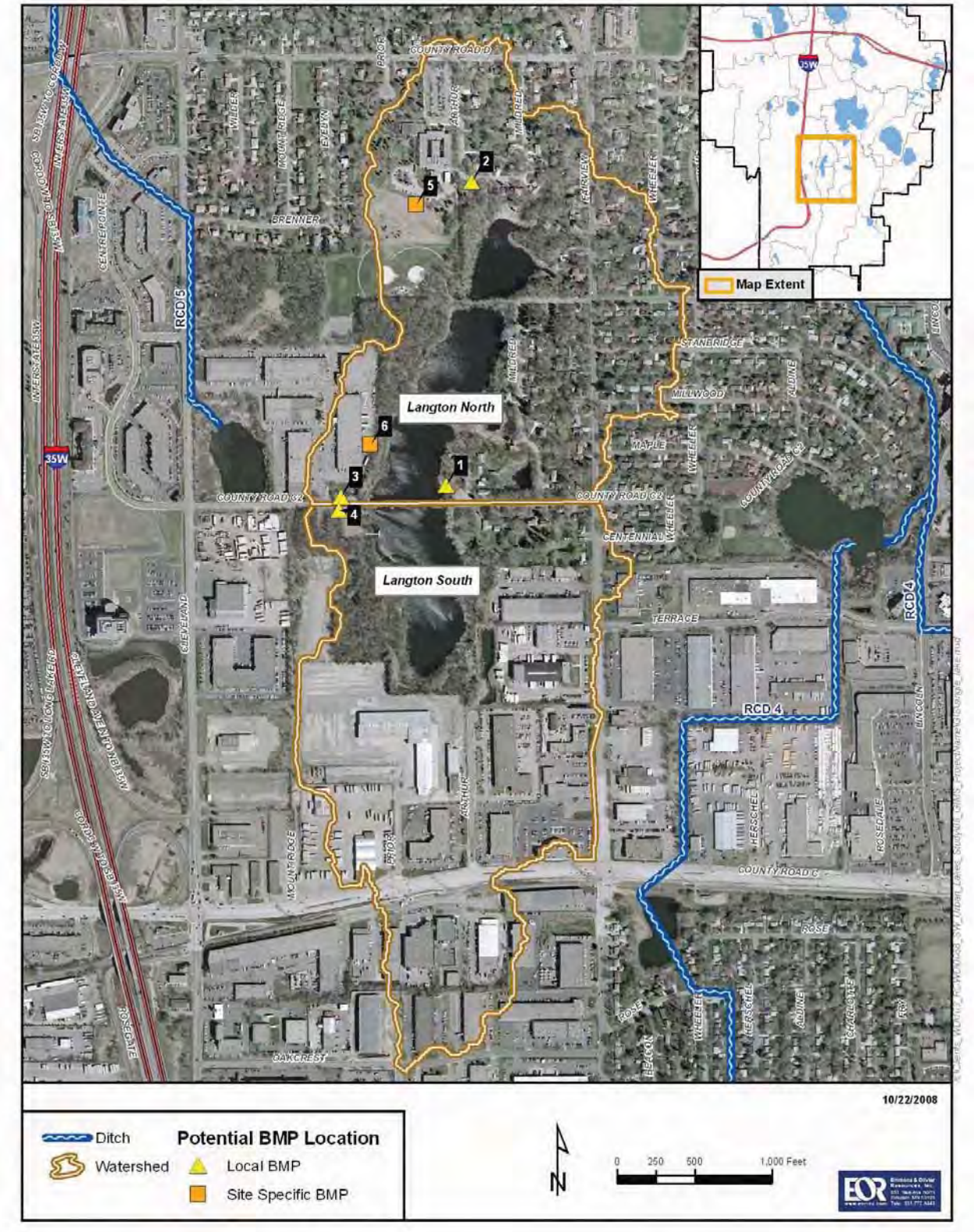


Figure 1. Langton Lake and Potential BMP Locations

Water Quality Summary

Water quality data for Langton Lake has been collected by the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP) since 2005. A summary of the monitoring data suggests that the lake is currently meeting lake water quality standards (Table 1). The phosphorus concentration is just meeting the standard, while the chlorophyll and Secchi depth are slightly better than the standards.

Table 1. Average Water Quality Data (2005-2007) and Standards

Parameter	Langton Lake North Basin	Langton Lake South Basin	Shallow Lakes Standard
TP (µg/L)	60	60	60
Chl (µg/L)	17	14	20
Secchi Depth (m)	1.1	1.2	1.0

Figures 2-7 show the TP, chlorophyll-*a*, and clarity (Secchi depth) data from both basins of Langton Lake.

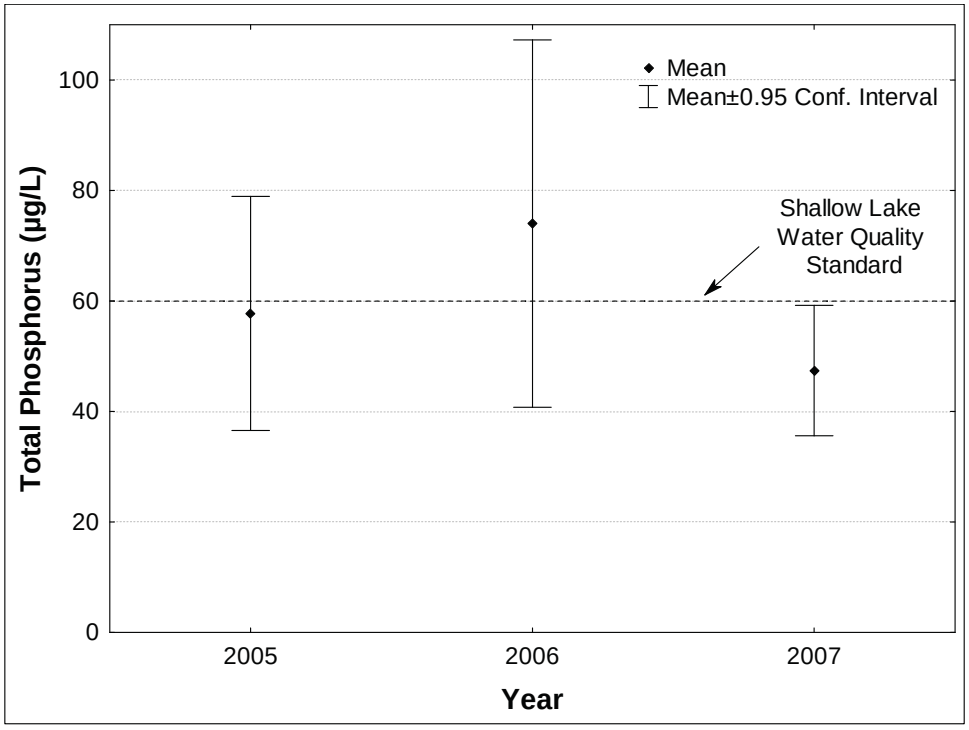


Figure 2. Langton Lake North Basin TP

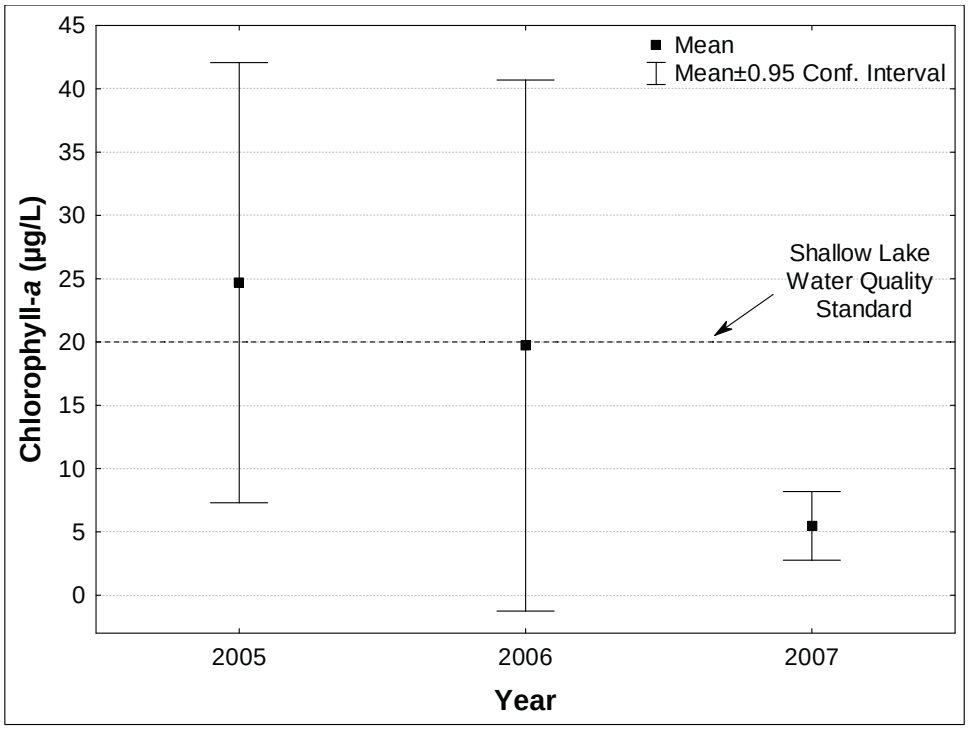


Figure 3. Langton Lake North Basin Chlorophyll-*a*.

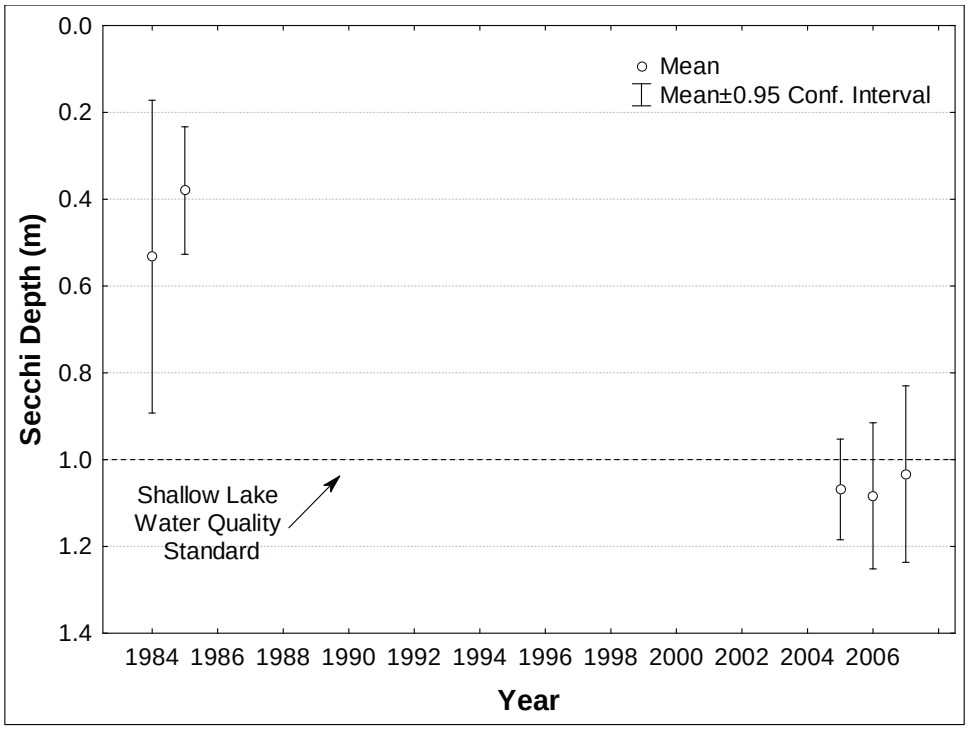


Figure 4. Langton Lake North Basin Secchi Depth

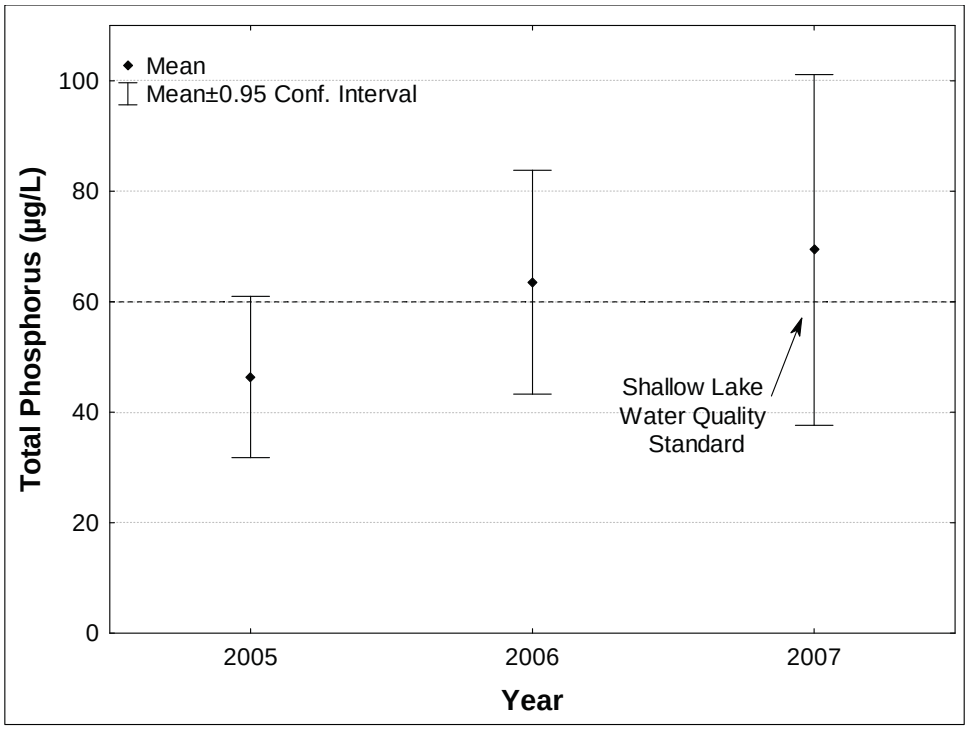


Figure 5. Langton Lake South Basin TP.

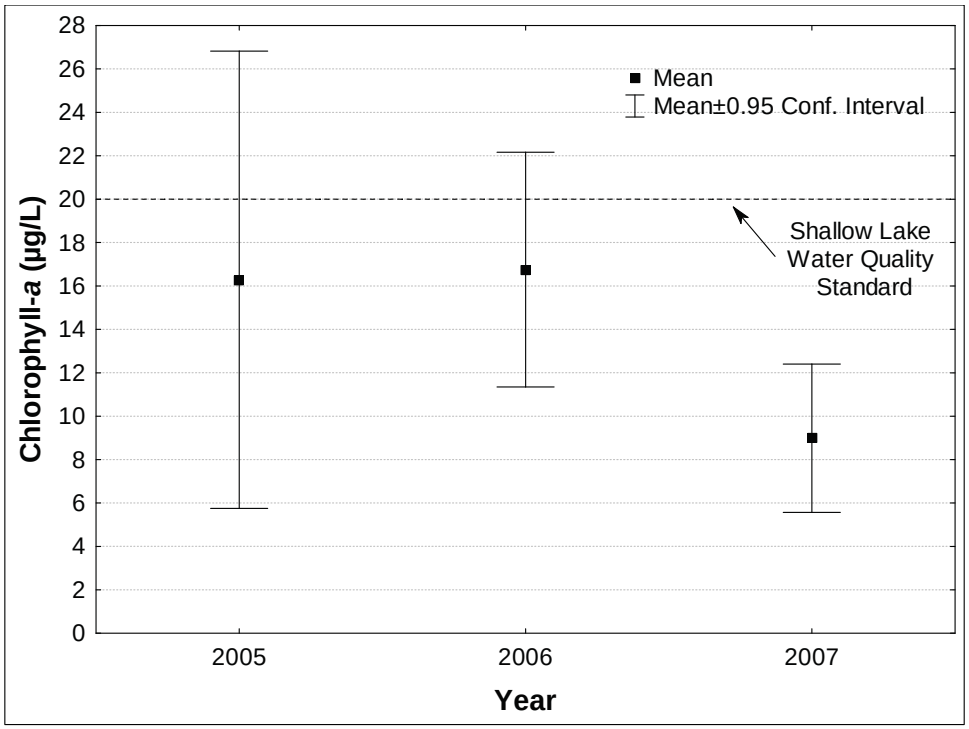


Figure 6. Langton Lake South Basin Chlorophyll-*a*.

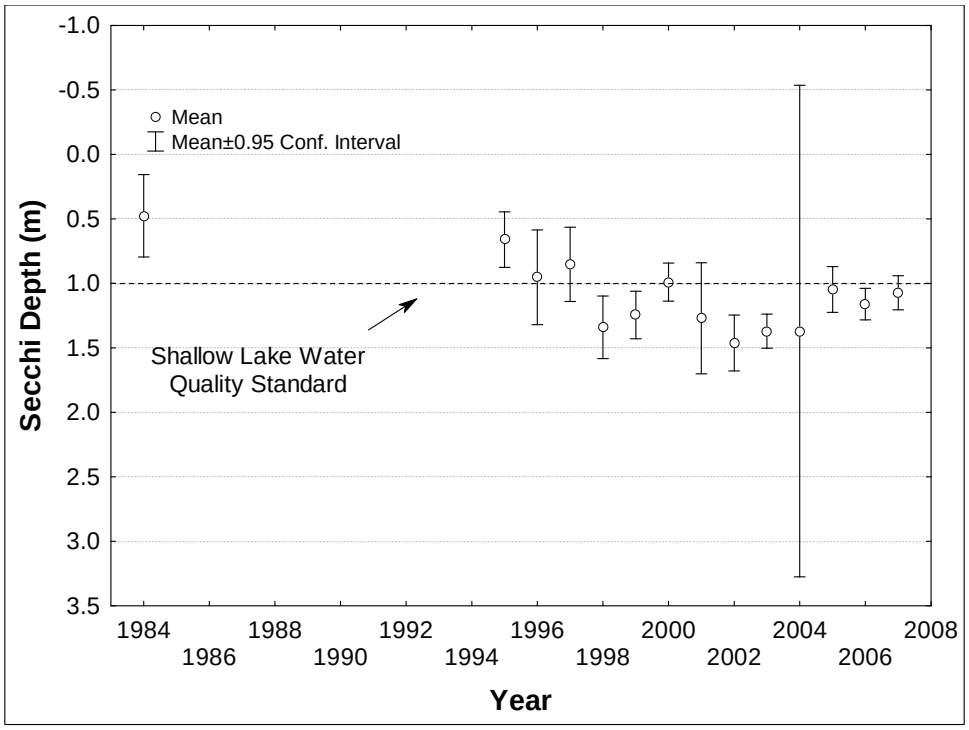


Figure 7. Langton Lake South Basin Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. The lake model was calibrated to in-lake monitoring data. Water quality modeling indicates that the watershed inputs account for approximately 94% of the nutrient load, with internal loading accounting for the remaining 6% (Figure 8). (The northern wetland was not included in lake modeling.)

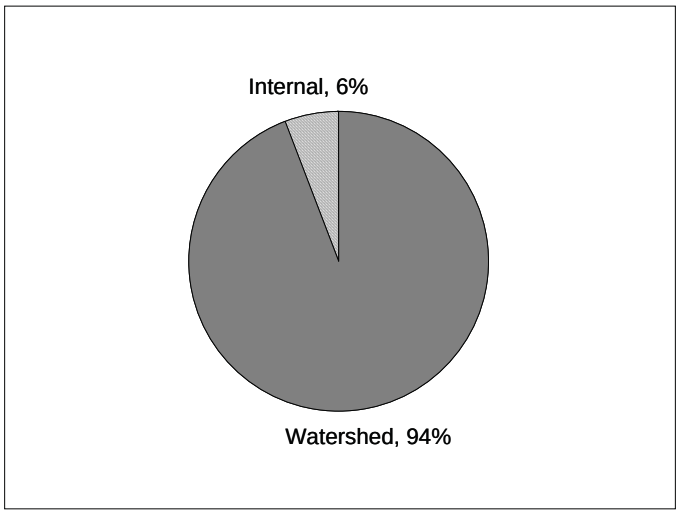


Figure 8. Langton Lake Phosphorus Load Distribution

Public Input

At the public input meeting held on June 2, 2008, a lake resident offered her insight on Langton Lake.

- This resident discussed the lake's water quality problems and suggested that untreated runoff from the surrounding area directly discharging into the lake was the obvious source of the problem. She suggested identifying major stormsewer inlets and getting some treatment upstream of those points. Specifically, she identified as one possible retrofit BMP site the parking lot on the west side of the lake that runs directly off into the lake. Installation of a treatment swale or rain garden would be an easy and inexpensive retrofit for this situation. The citizen urged that any new BMPs be adequately maintained because she has noticed that they often are ignored after installation.
- The resident also noted that there is an area in the south basin where there is no evident plant life. She also noted there is at least one barrel and some assorted debris (fence, old dock) visible in the south basin. Because she did not know the nature of the barrel or whether it was structurally intact, it is recommended that the MPCA or the county be contacted to assess it prior to removal. The barrel was reported to an MPCA Duty Officer on January 6, 2009 – reference #100698.
- The attendee also noted that her feeling is that concerned citizens want to do as much as they can to protect their lakes of interest, but often do not know what they can or should do. Some guidance from the RCWD, the city, and MPCA on lake protection activities for citizens would be appreciated. She also noted a past problem with agency responsiveness, wherein the buck was often passed to some other agency when action is requested. She specifically mentioned this in terms of the city, RCWD, the county, and MPCA. Although specific details were not offered, frustration resulted when she tried to find out which agency should be addressing the problems with Langton Lake.
- The resident also noted that she has observed the degradation of the wildlife corridor extending from Langton Lake to the east to Little Johanna Lake. She attributes the decline to development and the lack of concern for maintenance of the corridor.
- Shoreline erosion, especially near the access point on the south basin, is an issue.
- Rapid expansion of white waterlily, particularly in the north basin, has been noted as a problem by both the DNR and local residents.
- Residents suggested that the clarity (Secchi) data could be misleading. Dense aquatic vegetation often blocks viewing of the disk, suggesting that the average Secchi depth may be better than what the data indicate.

Water Quality Issues

- There appears to be a high phosphorus load originating in the watershed and several areas that are untreated that drain directly to the lake.
- The lake is meeting water quality standards, but a slight degradation in water quality could cause the lake to not meet standards. Additionally, a slight degradation in water quality could cause the lake to shift from the clear-water, macrophyte dominated phase to the turbid, algal-dominated phase common in shallow lakes.
- The waterlily removal effort is a potential stressor to the stability of the lake's water quality, in that aquatic macrophytes tend to stabilize the lake in the clear-water phase. White waterlily also provides excellent fish habitat.

- High densities of planktivores (bluegill and sunfish) can also stress the stability of the lake's water quality through overgrazing zooplankton, which normally keep the algal density under control. Although the lake is subject to winterkill, the continual stocking of the lake with panfish and the lack of piscivores in the lake ensure that the panfish densities remain high throughout the growing season.
- Although they don't appear to be a nuisance in Langton Lake, black bullhead are present in the lake. Black bullhead are benthivorous fish that can disturb bottom sediments, releasing sediment phosphorus into the water column.

Recommended Management Approach

Lake improvements could be achieved if additional watershed and internal lake management practices are pursued.

Watershed Management Recommendations

Management of land in the watershed is a critical element in addressing the water quality of Langton Lake. Because the Langton Lake watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, 6 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of potential local BMP locations identified in the *field reconnaissance supplement.*
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- Continue to coordinate closely with the City of Roseville and developers of the Twin Lakes Area to ensure that District Rules are achieved or exceeded as this area develops.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management.
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs.
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control.

Internal Lake Management Recommendations

Although the lake is currently in the clear-water, macrophyte dominated phase, several stressors currently exist in the lake that could tip the balance and lead to a shift to the turbid, algal-dominated phase. Internal lake management should address these stressors and prevent the accumulation of additional stressors.

- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. Floating macrophytes can help keep a shallow lake in the clear-water phase by shading out algae and keeping the nutrients within aquatic macrophyte biomass instead of algal biomass. Although dense populations of white waterlily (a floating macrophyte) can inhibit boating, lake management should balance the recreational uses of the lake against the lake's water quality. Removal of aquatic macrophytes can destabilize the lake and make it more likely to shift to the turbid algal-dominated state commonly observed in shallow lakes.
- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. The fisheries stocking plan should take into account the potential impact of high densities of panfish. The black bullhead population should be tracked to determine if it reaches nuisance levels. Work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Langton Lake.

- Bathymetric data collection
- TP, chlorophyll, and Secchi depth data: Collect data for one to two additional years, with at least five sampling dates per year. Continued support of the CAMP program should ensure sufficient water quality data are collected.
- Macrophyte surveys: To update the survey from 2000, complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the existing fish data regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.

Langton Lake Field Reconnaissance Supplement

Local Management BMPs

Langton #1
Location: West of Arthur Place and north of County Road C2
Description: Playground area on the east side of Langton Lake Park.
Potential Improvements: Coordinate with Roseville Parks & Rec to incorporate water quality BMP at the location of the playground equipment. Capture adjacent parking and street runoff. Move playground equipment to the east on higher ground.

Langton #2
Location: Brenner Avenue just north of Langton Lake
Description: Open area currently being used as small basketball court.
Potential Improvements: Coordinate with Roseville Parks & Rec., consider this area for treatment of street runoff prior to discharge to lake. An assessment would need to be made with respect to how much drainage area could be routed to this location.

Langton #3
Location: Industrial area west of Langton Lake and north of County Road C2
Description: Open space with trees just north of County Road C2.
Potential Improvements: Coordinate with Roseville Parks & Rec and private landowner. Consider tree remove tree and excavation of large filtration or ponding. This location could potentially pick up a large amount of impervious area from the adjacent roads and industrial sites.

Langton #4
Location: South of County Road C2 and west of Langton Lake
Description: Open space with trees just south of County Road C2. (Note: area to the left of fire hydrant is lower and more suitable than the area in the center of the photo.)
Potential Improvements: Coordinate with Roseville Parks & Rec Dept. Consider tree remove tree and excavation of large filtration or ponding. This location could potentially pick up a large amount of impervious area from the adjacent roads and industrial sites.

Site Specific Management BMPs

Langton #5
Location: Eagle Crest at the corner of Brenner Avenue and Arthur Street
Description: Open area with swale currently receiving parking runoff
Potential Improvements: Swale could be enhanced to provide more treatment / depressional storage prior to discharge to the lake.

Langton #6
Location: Industrial area west of Langton Lake north of County Road C2
Description: Large amounts of impervious (parking and roof top) ponding in parking area before discharging to Langton Lake.
Potential Improvements: Create a ponding/treatment area for this runoff at discharge location. This would require removal of trees and/or pavement area.

Little Lake Johanna Management Action Plan

Little Lake Johanna (62-0058) is located in the cities of Arden Hills and Roseville, Ramsey County, Minnesota (Figure 1). The lake has a surface area of 17 acres, a maximum depth of 28 feet (Figure 2)[1].

The watershed area draining to Little Lake Johanna is 1,751 acres; the majority of the watershed runoff reaches the lake through Ramsey County Ditch 4. The watershed's land use is primarily residential with some commercial and transportation uses.

Little Lake Johanna is listed as impaired on the EPA's 303(d) list for aquatic recreation due to high nutrient concentrations.

According to a 1984 DNR fisheries assessment, the carp, black bullhead, and black crappie are abundant. The lake also supports populations of northern pike and brown bullhead. A more current fisheries assessment is not available. Currently the lake is not stocked by the DNR.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from the DNR Lake Finder website.

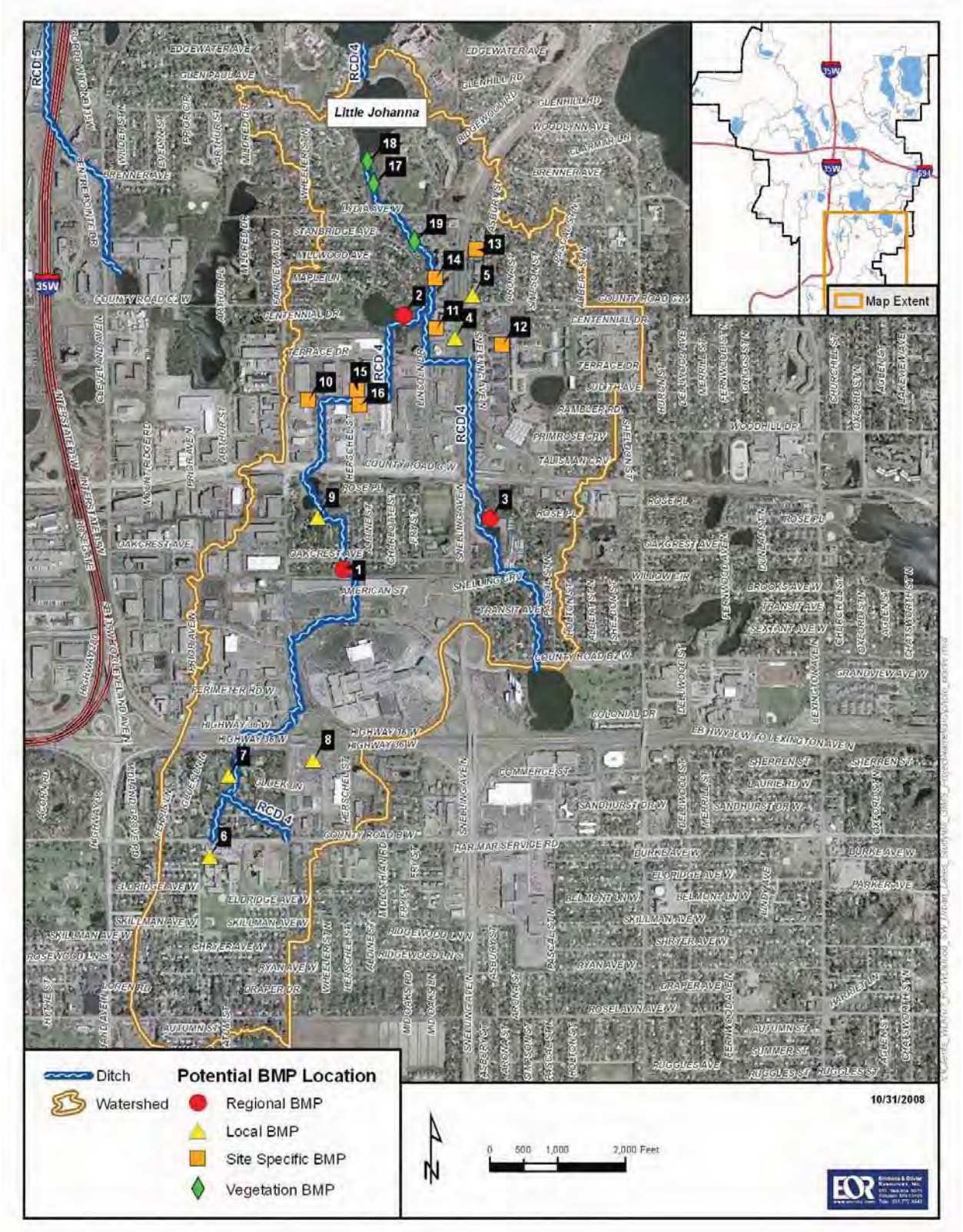


Figure 1. Little Lake Johanna and Potential BMP Locations

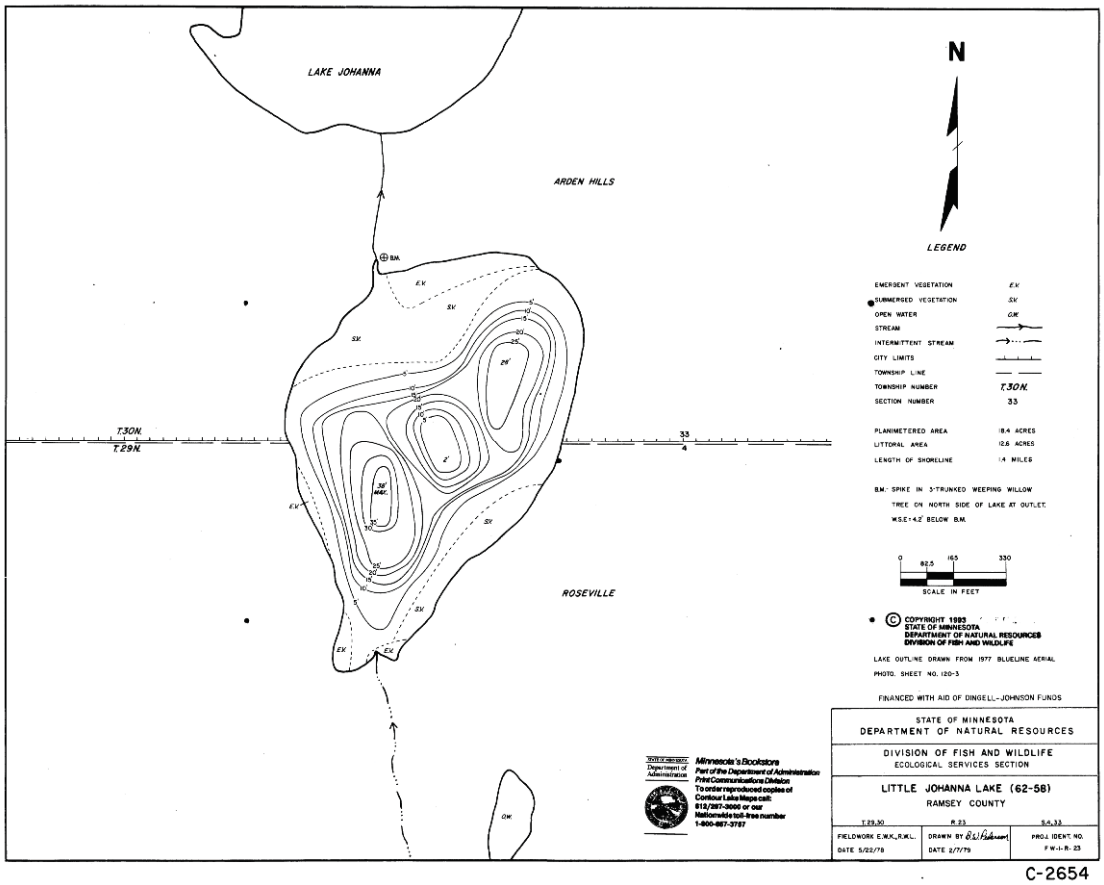


Figure 2. Little Lake Johanna Bathymetry

Water Quality Summary

Water quality data were collected for Lake Johanna from 2001 through 2006. Data were collected by volunteers through the Citizen Assisted Monitoring Program (CAMP). A summary of the six years of monitoring data (Table 1) suggests that the lake is not meeting the state water quality standards for total phosphorus (TP) or chlorophyll-*a*, but is meeting the standard for Secchi depth (clarity).

Table 1. Average Water Quality Data (2001-2006) and Standards

Parameter	Little Lake Johanna	Standard
TP (µg/L)	80	40
Chl (µg/L)	25	14
Secchi Depth (m)	1.5	1.4

Figures 3 through 5 show the growing season total phosphorus (TP), chlorophyll-*a*, and Secchi depth (clarity) for Little Lake Johanna.

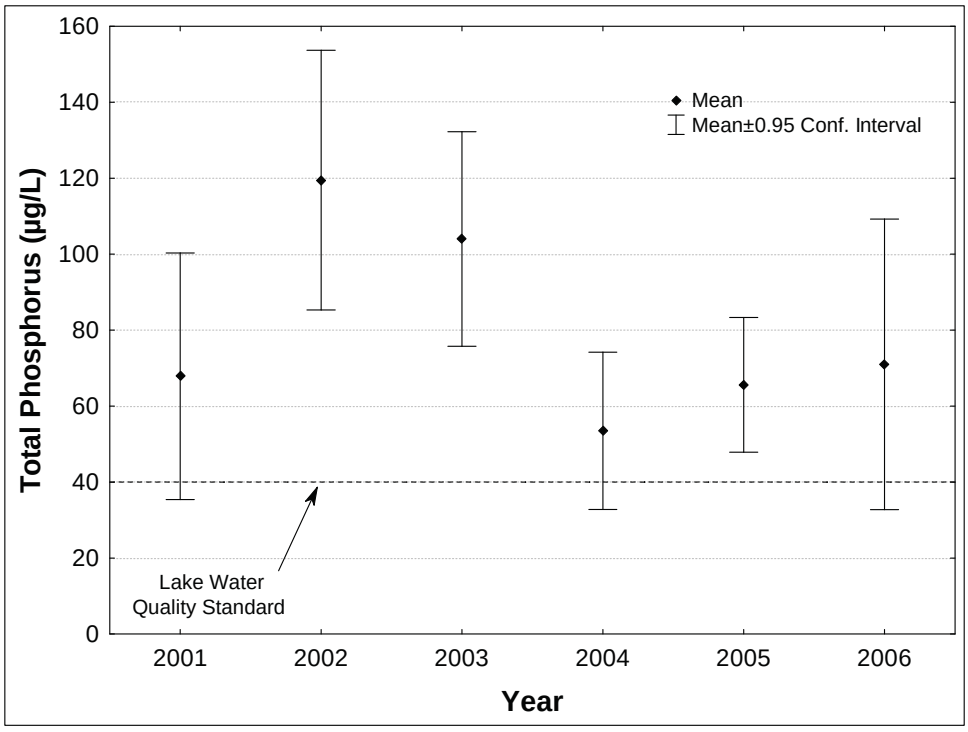


Figure 3. Little Lake Johanna Total Phosphorus

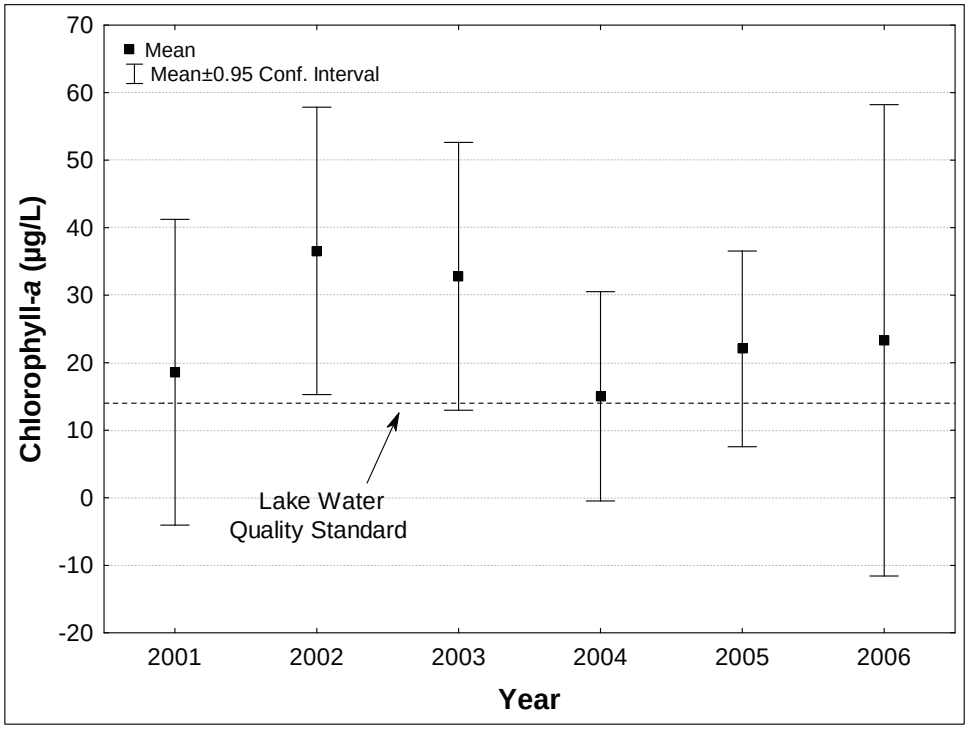


Figure 4. Little Lake Johanna Chlorophyll-*a*

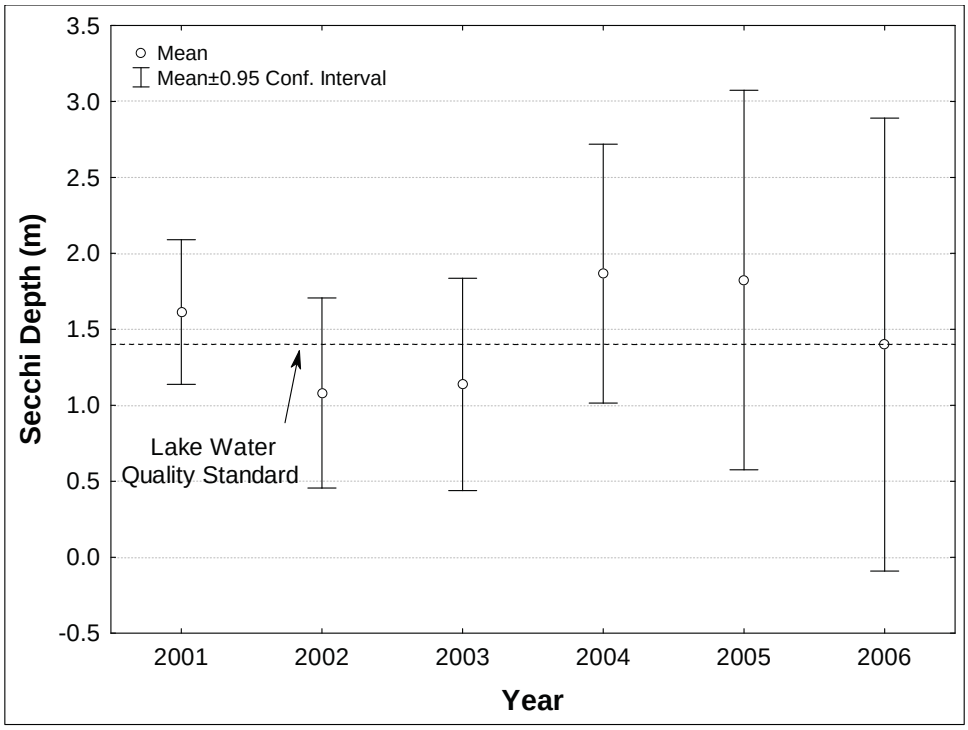


Figure 5. Little Lake Johanna Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. The lake model was calibrated to in-lake monitoring data. Water quality modeling indicates that watershed inputs account for approximately 79% of the nutrient load, with internal loading accounting for the remaining 21% (Figure 6). To reach the in-lake goal of 40 µg/L TP, the phosphorous load needs to be reduced by 62%. Water quality and flow were measured in Ramsey County Ditch 4 during the summer of 2008. The RCWD plans to use this data to better estimate watershed loading.

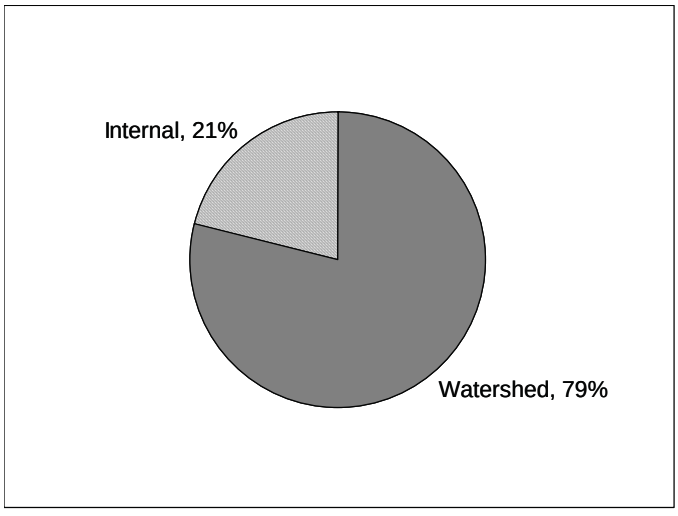


Figure 6. Little Lake Johanna Phosphorus Load Distribution

Public Input

At the public input meeting on June 5, 2008 issues facing Little Lake Johanna were addressed. Some comments offered refer to a previous Clean Water Partnership study for Long Lake that included recommendations for the Johanna and Little Johanna watershed. Many of the recommendations in that project were implemented and have proven successful to some degree, but problems continue to exist with the lake.

- Residents around the lake referenced the successful repair of the lake outlet by Ramsey County in early 2008. This repair appears to have addressed a low water problem that affected the lake for the last three years. Some residents supported the idea of dredging within the lake to remove material accumulated from the many years of watershed discharge. They also spoke of the fact that a 30+ foot hole still exists in the lake even though several areas of sediment accumulation also exist. The inflow from Ramsey County Ditch 4 (RCD 4) is the major input for problems encountered on the lake. Complaints about the erosive nature of this ditch and the lack of runoff treatment for the area draining to it are the basis for many of the recommendations for improvement.
- Curly-leaf pondweed is present in the lake at relatively high densities, and the lake was chemically treated for it in 2008.
- The smell of algae on the lake was raised by some attendees. Solving the nutrient influx into the lake would go a long way toward reducing algal blooms, but it was recognized that short-term improvements are not likely. However, the attention that Little Johanna is receiving now and will receive as an impaired water makes the future look a lot better.
- Street sweeping was a popular recommendation by meeting attendees. It was stated that the City of Roseville sweeps its streets only once per year and that the Rosedale shopping center does not do a good job of keeping its parking lots clean. Attendees recommended that the city increase its sweeping frequency and that the shopping center(s), including others in the sub-watershed, also be asked to do a better job of sweeping. Spot sweeping of critical areas, such as those directly draining to lakes, was encouraged.
- It was noted that detention ponds on the Northwestern College campus, one located west of Snelling Avenue and south of County Road C, and one at EagleCrest Retirement Homes, were in need of deepening to restore their ability to adequately handle runoff.
- Some attendees expressed their unhappiness with runoff leaving some of the construction underway at the Northwestern College campus. The attendees urged the RCWD to do a better job of site inspection for construction activities within the watershed.
- Residents suggested that the clarity (Secchi) data could be misleading. Although water clarity appears to meet state standards, dense algae colonies are often observed during the middle of summer. Colonies tend to be pushed to one shore or another (depending on wind), and clarity readings are usually taken in the middle of the lake, thus underestimating algal productivity (Figure 7).
- Finally, residents would like some attention placed on fish management. Nuisance rough fish are currently a problem.

Figure 7. Dense algae mats in the Little Lake Johanna outlet on June 29, 2008.

Water Quality Issues

- Ramsey County Ditch 4 likely carries a high phosphorus and sediment load to Little Lake Johanna. Portions of the ditch are eroding, and portions of the watershed draining to it remain untreated. Shopping centers and construction sites in the watershed may also be substantial sources of phosphorus and sediment.
- Detention ponds within the watershed are in need of maintenance.
- Carp densities were high in the 1984 fisheries survey. They are likely still a problem in the lake, contributing to internal loading rates.
- Curly-leaf pondweed is present in the lake and likely contributes to internal loading.

Recommended Management Approach

Watershed Management Recommendations

Management of land in the watershed is a critical element in addressing the nutrient impairment. Because the Little Lake Johanna watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, 19 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Feasibility and Benefit Level Assessment of the three potential regional BMP locations identified in the *field reconnaissance supplement*.

- Consideration of local partnerships for further assessment of the six potential local BMP locations identified in the *field reconnaissance supplement.*
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- The entire reach of Ramsey County Ditch 4 (RCD 4) from Co. Rd. C to Terrace Drive should be cleaned of debris scattered throughout. Within this reach, numerous adjacent commercial/transportation sites discharge runoff without any controls. Several areas of channel erosion also exist because of this unmanaged runoff. The use of rate reduction BMPs and BMPs to treat oil and grease and other toxic runoff components from these hot-spot locations is recommended. Oil and grease separators, and BMPs with sorbent pads, are needed to address the polluted runoff noted at these sites. Although these recommendations specifically address the more toxic content of urban stormwater runoff, they are also fairly effective at phosphorus removal and should benefit both Little Johanna and Johanna Lakes.
- The amount of untreated impervious runoff from the quadrant generally encompassed by Terrace Drive, Snelling Avenue, County Road C and Fairview is significant. While this area is routed to the Oasis Pond, additional field reconnaissance and cost-share opportunities should be identified as it is unlikely that Oasis Pond can adequately remove all of the pollutants being generated by this area. In addition, it is not anticipated that the Oasis Pond outlet could be retrofitted to provide substantially more water quality storage than exists today considering the lack of freeboard from streets, stormsewer and low floors north of the pond.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

The lake survey from 1984 showed an abundance of carp and high densities of panfish such as bluegill and black crappie. If this is still the case, the fisheries composition likely leads to high rates of internal loading, which should be addressed.

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be continued. Curly-leaf

pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.

- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Little Lake Johanna. Six years of in-lake water quality data exist for the lake and therefore additional in-lake data collection is not a priority at this time. Data collection at the lake's inlet (Ramsey County Ditch 4) is a high priority so that watershed loads can be estimated and loading goals developed for the future TMDL study.

- TP, chlorophyll, and Secchi depth data: Collect at least five sampling dates per year. The TMDL can be based on the existing monitoring data; additional data should be collected after management actions are implemented to track the response of the lake.
- Macrophyte surveys: Complete one macrophyte survey during early June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Fish survey: Complete a fish survey to evaluate the fish species composition of the lake.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.
- Ramsey County Ditch 4 should continue to be monitored close to the inlet to Little Lake Johanna to provide flow and phosphorus loading estimates. These data will be needed in order to estimate the watershed phosphorus load to the lake for the TMDL study. In addition, the data could serve to evaluate watershed BMP effectiveness.

Little Johanna Lake Field Reconnaissance Supplement

Regional Management BMPs

Little Johanna #1
Location: South of Oakcrest Avenue and west of Herschel Street
Description: Ramsey County Ditch 4 concrete flume, appears to be designed as a surge basin. Located on City drainage parcel
Potential Improvements: Retrofit to provide additional infiltration/filtration for small storm events. Convert to native vegetation and get low flows out of the concrete flume.

Little Johanna #2
Location: North of Terrace Drive and west of Lincoln Drive
Description: Oasis Pond (Outlet maintained by Roseville)
Potential Improvements: Reroute inlet to reduce short circuiting; maintenance of sheetpile weir outlet. The sheet piling has some holes in it that were plugged but have rusted out, allowing water to pass at a lower-than-intended elevation.

Little Johanna #3
Location: East of Snelling Avenue and south of County Road C
Description: Treatment pond inline with Ramsey County Ditch 4
Potential Improvements: It appears that there may be potential area available for expansion. It would make sense to first monitor the outlet of this pond to determine the need for additional treatment.

Local Management BMPs

Little Johanna #4
Location: West of Snelling Avenue and south of County Road C2
Description: Green space
Potential Improvements: Use for infiltration/ biofiltration features to treat adjacent drives/parking.

Little Johanna #5
Location: East of Snelling Avenue and north of County Road C2
Description: Green space
Potential Improvements: Use for treatment of Snelling Avenue. Note: There are several green space areas that appear to have the potential to be better used for treatment.

Little Johanna #6
Location: North of the intersection of Sharondale Avenue and Prior Avenue
Description: Swale area
Potential Improvements: Convert to raingarden.

Little Johanna #7
Location: South of Gluek Lane N
Description: Low areas adjacent and behind homes in this neighborhood. Stormwater from Gluek Lane appears to be routed directly to stormsewer and does not use these low areas.
Potential Improvements: Consider retrofits to provide treatment for Gluek Lane.

Little Johanna #8
Location: Intersection of Highway 36 and Fairview Avenue
Description: Green space in ramp loops
Potential Improvements: All three loops at this location could potentially be better used for treatment of adjacent roadways.

Little Johanna #9
Location: North of Rose Place and west of Wheeler Street
Description: City owner lot – open green space. Ramsey County Ditch 4 flows through a pipe below the green space.
Potential Improvements: Depending on depth and location of the pipe, a surface feature could be incorporated to treat local street runoff from Rose Place and Beacon Street.

Site Specific Management BMPs

Little Johanna #10
Location: East of Fairview Avenue and south of Terrace Drive
Description: Open space adjacent to parking areas
Potential Improvements: Use for area infiltration or biofiltration feature to treat adjacent parking.

Little Johanna #11
Location: East of Lincoln Drive and south of County Road C2
Description: Green space
Potential Improvements: Use for infiltration/ biofiltration features to treat adjacent drives/parking.

Little Johanna #12
Location: East of Snelling Avenue and south of County Road C2
Description: Green space adjacent to church parking lot
Potential Improvements: Incorporate infiltration or biofiltration feature for treatment of church parking lot.

Little Johanna #13
Location: East of Snelling Drive and south of Lydia Avenue
Description: Green space adjacent to parking.
Potential Improvements: Incorporate raingarden areas to treat adjacent parking.

Little Johanna #14
Location: South of Lydia Avenue and west of Lincoln Drive on the Presbyterian Homes property.
Description: A small detention pond on the SW side of the Presbyterian Homes looks as though it drains a portion of the parking lot for the home and possibly the street.
Potential Improvements: Retrofit existing pond, but only a small amount of local storage would likely result.

Little Johanna #15
Location: SALA truck/loading facility just south of Terrace Drive
Description: Runoff from the entire lot drains to some lot inlets and a surface pipe at the RCD 4 ditch bank.
Potential Improvements: Incorporation of a proprietary treatment device that both settles solids and adsorbs hydrocarbons.

Little Johanna #16
Location: Monarch Bus Company parking lot south of RCD 4.
Description: Parking lot runoff flows to northwest corner of site. Outfall in picture has been reconstructed to prevent bank erosion; however, parking lot is still not afforded any treatment before discharge to RCD 4.
Potential Improvements: Incorporation of a proprietary treatment device that both settles solids and adsorbs hydrocarbons.

Vegetation Management / Stabilization BMPs

Little Johanna #17
Location: Stormsewer outfall to RCD 4.
Description: Hanging stormsewer pipe on the west side of the channel midway between Lydia and the lake.
Potential Improvements: Outfall stabilization with reinforcement (ex. rip-rap, concrete, blocks) between the outlet and the channel; also the pipe itself should be supported so that it does not collapse. Roseville noted it will address this stability issue.

Little Johanna #18
Location: RCD 4 Outfall to Little Lake Johanna
Description: As the channel transitions from ditch to lake inflow, there is a break in the concrete and a drop of approximately one foot.
Potential Improvements: Stabilize with additional rock and/or concrete repair to stop undercutting and movement upstream.

Little Johanna #19
Location: Upstream of the Lydia Avenue crossing of RCD 4
Description: Homeowners west of the channel have removed a lot of the trees and planted grass down to the level of the rock emplacement; there is some erosion where the grass (sod) stops and the channel starts.
Potential Improvements: Education and buffer establishment in this stretch would address this erosion potential before a big event causes some wash-out.

Little Lake Josephine Management Action Plan

Little Lake Josephine (62-0201) is located in Roseville, Ramsey County, Minnesota (Figure 1). The lake has a surface area of 44 acres (Figure 2), a maximum depth of 25 feet, and is 90% littoral[1].

Little Lake Josephine meets the MPCA definition of wetland and is classified as a Class 2D (wetland) water in accordance with Minn. Rules Ch. 7050. Furthermore its designation as a Public Water Wetland ["W" 62-201] by the DNR Protected Water Inventory and the lack of an aquatic recreational resource management history (MPCA (*Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment*, 2007) substantiates the designation as a Class 2D water. The Class 2D designation means that the wetland resource is protected for the "maintenance of a healthy wetland aquatic community and for wetland based aquatic recreation." Numeric nutrient standards developed for shallow lakes (i.e. 60 µg/L TP) do not apply to Class 2D wetlands.

The watershed area draining to Little Lake Josephine is 450 acres. The watershed is primarily residential with some commercial and transportation uses. The lake is surrounding by much of Lake Josephine Park. Little Lake Josephine and its watershed are contained within the Lake Josephine watershed.

According to a 1984 DNR fisheries survey, the lake has an abundance of bluegill, bullhead, carp, and green sunfish. A more recent fisheries survey is not available. The DNR does not stock this lake.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth and percent littoral were taken from the DNR Lake Finder website.

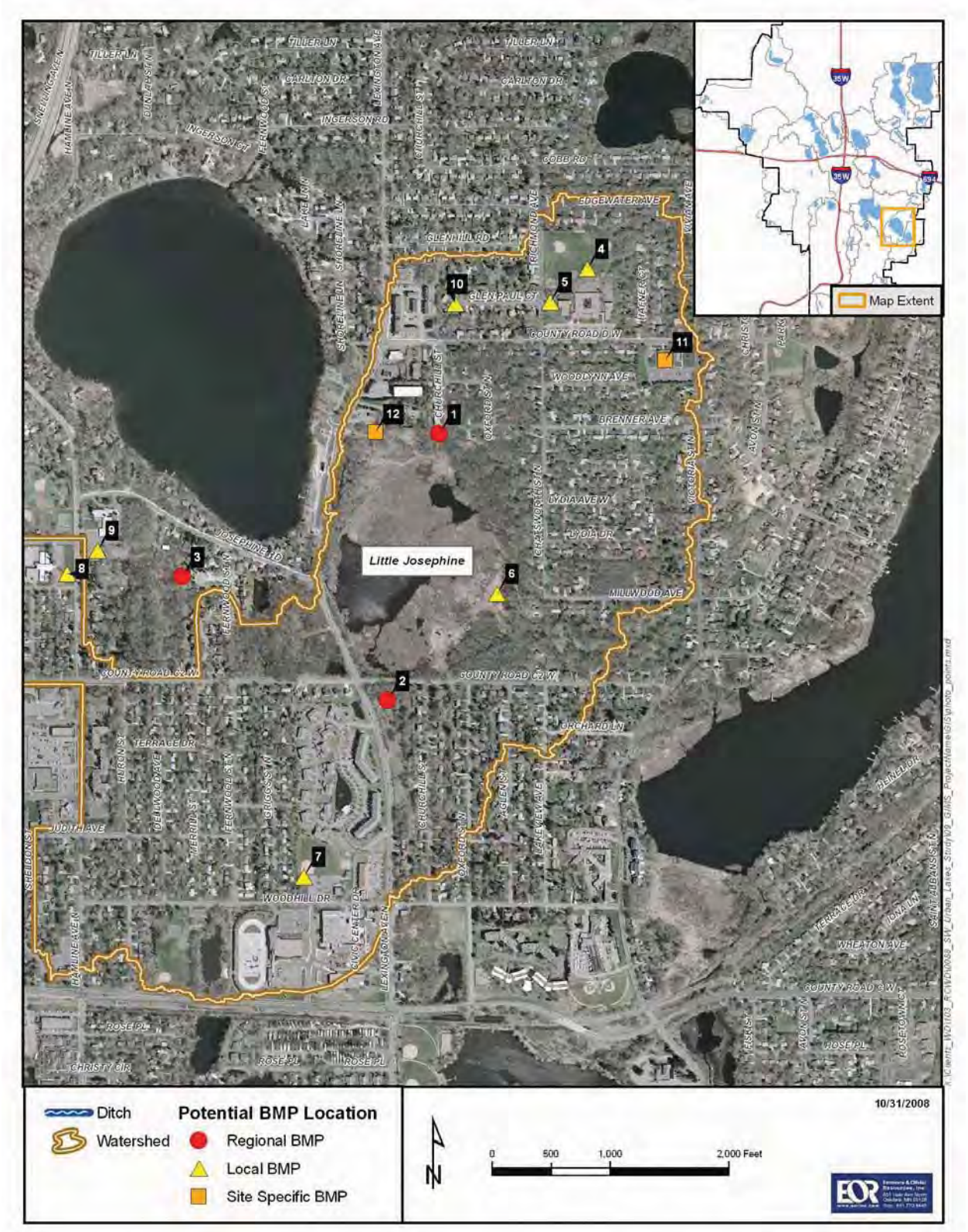


Figure 1. Little Lake Josephine and Potential BMP Locations

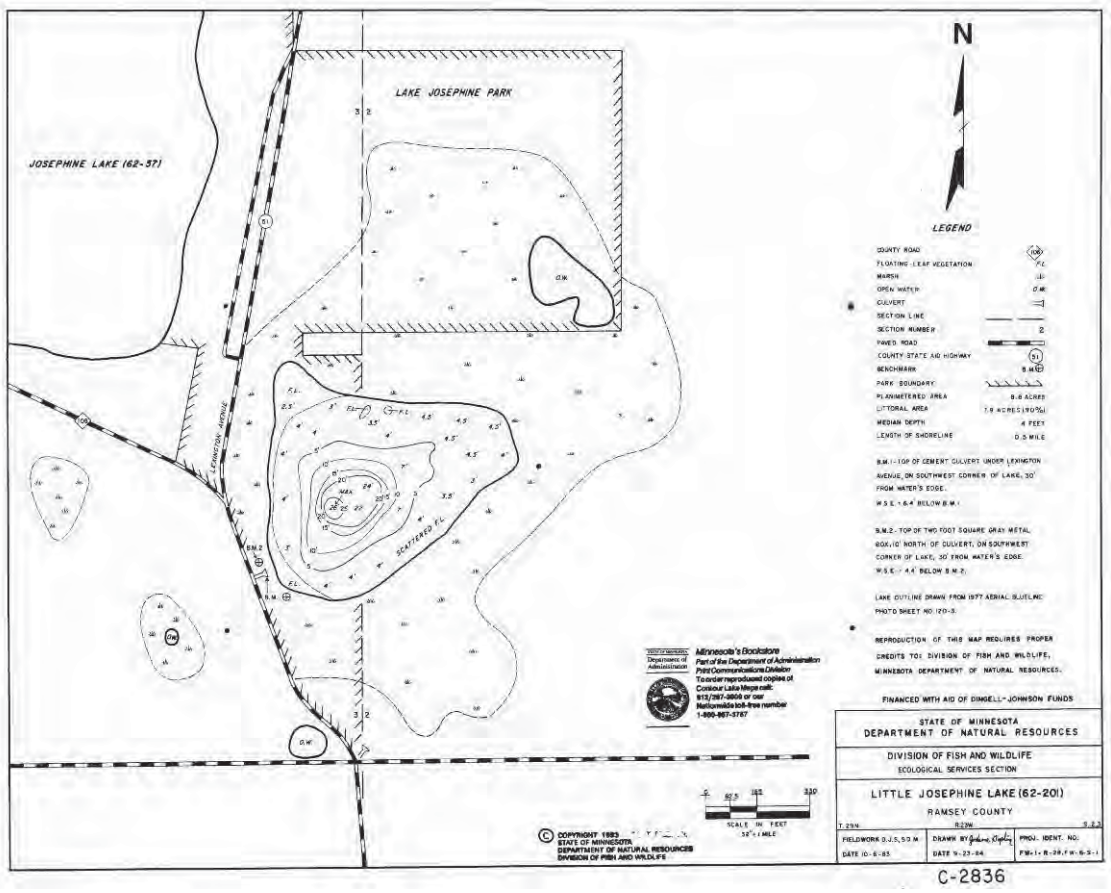


Figure 2. Little Lake Josephine Bathymetry

Water Quality Summary

There are no water quality data for Little Lake Josephine, and biological data are very limited. A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. There are no in-lake monitoring data to calibrate the lake model. Water quality modeling indicates that watershed inputs account for approximately 34% of the nutrient load, with internal loading accounting for the remaining 66% (Figure 3). Without any in-lake nutrient data for the lake for model calibration, the modeling results should be considered preliminary.

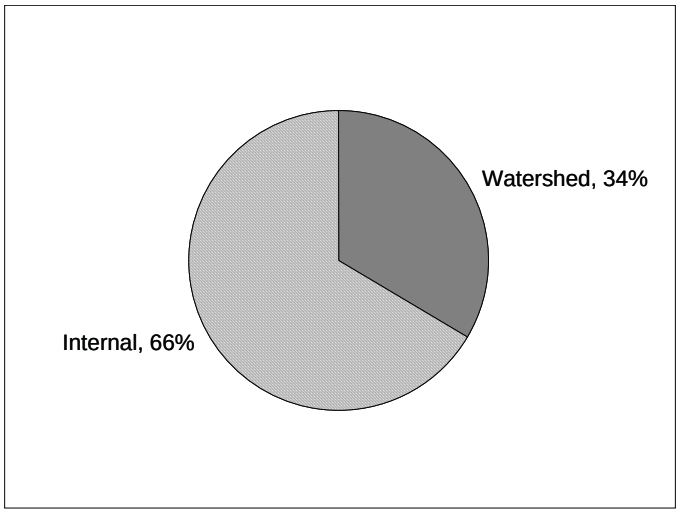


Figure 3. Little Lake Josephine Phosphorus Load Distribution

Public Input

At the public input meeting on June 5, 2008 issues facing Little Lake Josephine were addressed. Preparation for this meeting and some comments offered refer to a previous Clean Water Partnership study for Long Lake that included recommendations for the Little Lake Josephine watershed. Many of the recommendations in that project were implemented and have proven successful to some degree, but problems continue to exist with the lake.

- The attendees also indicated the need for more education on runoff control for residents of the watershed.

Water Quality Issues

- The fish community in 1984 was composed mainly of bluegill, bullhead, carp, and green sunfish. If the fish community composition is similar today, this prevalence of rough fish and planktivorous fish could lead to high rates of internal loading due to disturbance of the lake bottom sediments.
- Without further data or public input, additional water quality issues were not able to be defined.

Recommended Management Approach

Watershed Management Recommendations

Because the Little Josephine Lake watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, 11 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Feasibility and Benefit Level Assessment of the two potential regional BMP locations identified in the *field reconnaissance supplement*.
- Consideration of local partnerships for further assessment of the seven potential local BMP locations identified in the *field reconnaissance supplement*.
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- A trunk stormsewer from the west discharges to Little Josephine north of County Road C2. This trunk stormsewer could be further investigated for possible daylighting to a regional treatment pond within Cottontail Park and/or the open space east of the park.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

With very little in-lake biological data for Little Lake Josephine, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.
- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake. If cooperation is

possible, work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Little Lake Josephine. There are no in-lake water quality data for the lake; if the implementation of management practices for the lake were to move forward, in-lake data would be needed and should be considered a high priority.

- TP and chlorophyll data: Grab water quality samples should be collected if there is cause to believe that the water body is enriched with nutrients (as evidenced by mid-summer algae blooms) AND the waterbody is contributing flow to adjacent lakes.
- Macrophyte and/or aquatic invertebrate data should be collected in cooperation with the MPCA to determine if the water body is meeting the "healthy aquatic community standards."

Little Josephine Lake Field Reconnaissance Supplement

Regional Management BMPs

Little Josephine #1
Location: South of the intersection of Brenner Avenue and Churchill Street
Description: Large piped outlet that flows through woods and then into Little Josephine Lake.
Potential Improvements: Install wetland treatment ponding between outfall and Little Josephine Lake.

Little Josephine #2
Location: South of County Road C2 and east of Lexington Avenue
Description: Low wooded area
Potential Improvements: Use for treatment of the neighborhood to the west and County Road C2.

Little Josephine #3
Location: Cottontail Park
Description: The trunk stormsewer line that runs through the park and across subwatershed divides per City of Roseville storm sewer mapping.
Potential Improvements: Daylight and provide treatment within Cottontail park or open space east of the park. The depth of this trunk line has not been investigated and will have significant effects on the feasibility and cost of this potential project.

Local Management BMPs

Little Josephine #4
Location: North of County Road D and east of Richmond Avenue
Description: Swale running through school property. Swale receives runoff from adjacent neighborhood.
Potential Improvements: Convert swale into a series of raingardens.

Little Josephine #5
Location: North of County Road D and east of Richmond Avenue
Description: Pond at the end of the swale (#4) appears to be undersized.
Potential Improvements: Expand pond (however it would seem to make sense to explore Little Josephine #4 first).

Little Josephine #6
Location: West of the intersection of Chatsworth Street North and Millwood Avenue
Description: Stormsewer outflow swaled to lake
Potential Improvements: Incorporate wetland treatment feature at outlet

Little Josephine #7
Location: North of Woodhill Drive and east of Griggs Street
Description: Open green space adjacent to Veterans Park parking lot and VFW
Potential Improvements: Use area for volume control/infiltration BMP. (This area is routed to a treatment pond.)

Little Josephine #8
Location: North of Millwood Avenue and west of Hamline Avenue
Description: Vacant Lot (redeveloping)
Potential Improvements: Use part of lot to provide treatment for adjacent roads / neighbor hood areas.

Little Josephine #9
Location: East of Hamline Avenue and south of Lydia Avenue
Description: Catch basin at the bottom of green space area
Potential Improvements: Retrofit to provide infiltration and better treatment.

Little Josephine #10
Location: Intersection of Glen Paul Court and Churchill Street
Description: Large cul-de-sec
Potential Improvements: Incorporate center island and provide infiltration/treatment for adjacent impervious.

Site Specific Management BMPs

Little Josephine #11
Location: North of Woodlynn Avenue and east of Milton Street
Description: Open green space adjacent to parking lot
Potential Improvements: Use area for treatment of parking lot.

Little Josephine #12
Location: East of Lexington Avenue and just north of Jones Lake
Description: Parking areas sheet flowing to Little Josephine
Potential Improvements: Incorporate water quality treatment prior to discharge to Little Josephine.

Locke Lake Management Action Plan

Locke Lake (02-0077) is located in the City of Fridley, Hennepin County, Minnesota (Figure 1). Locke Lake is a flow-through lake located on Rice Creek and is at the end of the creek just before its confluence with the Mississippi River. The lake has a surface area of approximately 26.5 acres and a maximum depth of 6 feet[1]. Based on its low estimated maximum depth, it is considered a shallow lake according to MPCA's definition.

The watershed draining to Locke Lake is 115,583 acres and includes the entire Rice Creek drainage area and all of the various rural to urban land uses within it. The watershed to lake area ratio is approximately 4361:1. There are many improvements and studies underway in the watershed, all of which should lead in the long-term to improvement of Locke Lake. The east basin of Locke Lake essentially acts as a sediment basin for the lake.

Locke Lake is predominantly an aesthetic and habitat lake that residents use for recreational boating.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos. No bathymetric data were available for this lake. The maximum depth was estimated using depth data collected during sediment sampling.

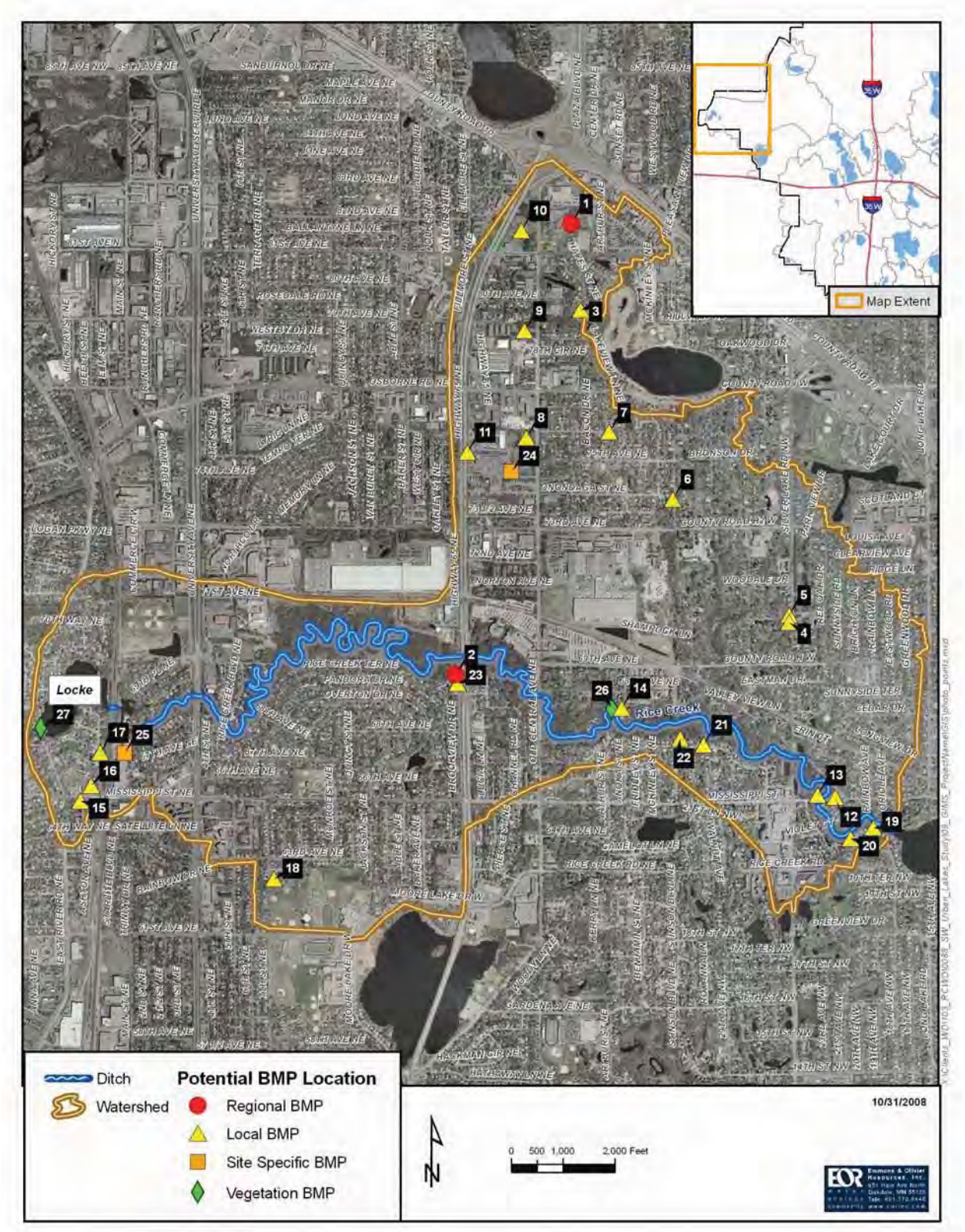


Figure 1. Locke Lake and Potential BMP Locations

Water Quality Summary

Water quality data were collected by RCWD in 2008. Preliminary phosphorus data were available at the time of the report, and are shown in Table 1. In 2008, Locke Lake was not meeting the MPCA phosphorus standard for shallow lakes.

Table 1. Average Water Quality Data (2008) and Standards

Parameter	Locke Lake	Shallow Lakes Standard
TP (µg/L)	84	60

Figure 2 shows the total phosphorus (TP) data for Locke Lake.

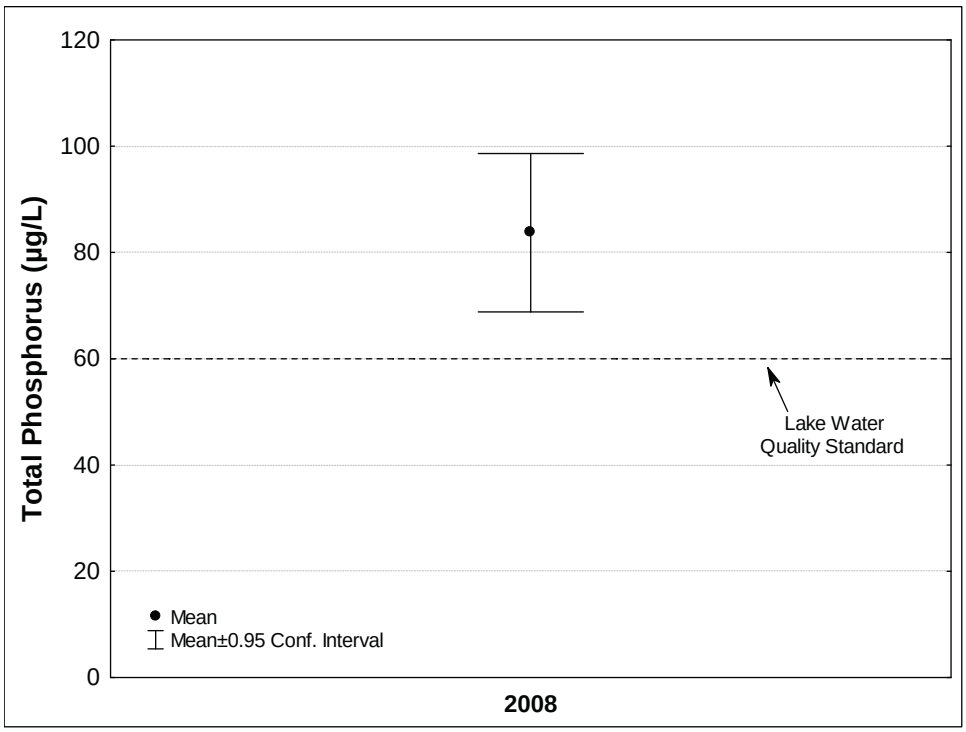


Figure 2. Locke Lake Total Phosphorus

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. Modeling indicates that watershed inputs account for nearly the entire nutrient load, with internal loading accounting for a negligible amount (Figure 3). Phosphorus data collected in 2008 were not used in the P8 model, and modeling results should be considered preliminary.

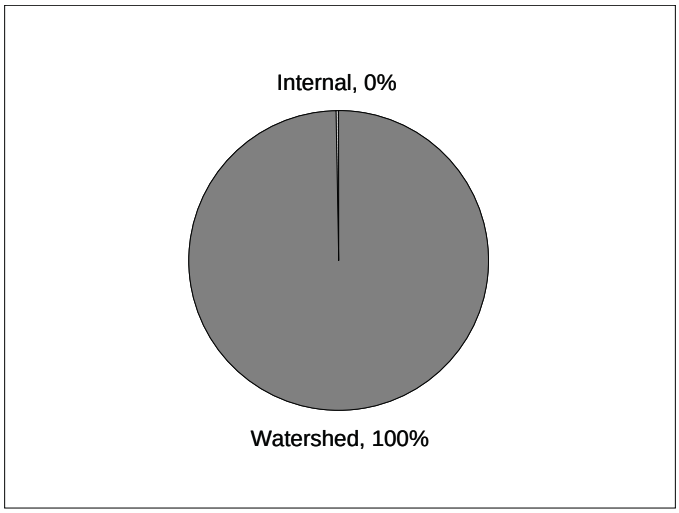


Figure 3. Locke Lake Phosphorus Load Distribution

Public Input

A public input meeting was held on June 3, 2008, no attendee spoke on issues concerning Locke Lake. A second public input meeting was held on January 19, 2008, during which a resident described difficulty reestablishing macrophytes and continuing shoreline erosion due to water elevation bounce on the lake.

Water Quality Issues

- The phosphorus concentration in Locke Lake is high due to its location as a flow-through lake along Rice Creek.
- Although secondary to watershed loading, the lack of aquatic shoreline vegetation coupled with water level fluctuations contributes to shoreline erosion and additional phosphorus inputs to the lake.

Recommended Management Approach

Watershed Management Recommendations

Because the Locke Lake watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. Note that most retrofit opportunities identified in the supplement would not only address Locke Lake, but lower Rice Creek as well. In summary, 27 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Feasibility and Benefit Level Assessment of the two potential regional BMP locations identified in the *field reconnaissance supplement*.
- Consideration of local partnerships for further assessment of the 21 potential local BMP locations identified in the *field reconnaissance supplement*.

- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- Routine monitoring of sediment accumulation and maintenance excavation of the in-lake sedimentation basin in eastern portion of the lake.
- Lower Rice Creek bank stability assessment and installation of bank stabilization amendments for areas with severe bank erosion.
- Continued project related improvements and the studies currently underway in the watershed. Various structural projects, such as critical weir replacements, maintenance projects, such as routine clean-out of the Long Lake sediment basin, and studies with implementation plans, such as the numerous TMDL studies, should all result in incremental improvements within the watershed.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Continued shoreline restoration / buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Continued public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

With very little in-lake biological data for Locke Lake, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply to Locke Lake:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.
- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an

overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake. If cooperation is possible, work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Locke Lake. If the implementation of management practices for the lake were to move forward, bathymetric data would be needed and should be considered a high priority.

- Bathymetric data collection
- TP, chlorophyll, and Secchi depth data: Collect data for several years, with at least five sampling dates per year.
- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Fish survey: Complete a fish survey to evaluate the fish species composition of the lake.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.

Locke Lake Field Reconnaissance Supplement

Regional Management BMPs

Locke 1
Location: East of Old Central Avenue and north of 81st Avenue
Description: Large existing wetland receiving drainage from adjacent industrial area.
Potential Improvements: Assess current treatment capacity and assess options for enhancements to improve water quality treatment.

Locke 2
Location: North of the intersection of Brookview Drive Rice Creek Terrace
Description: Stormsewer outfall from adjacent roadways from the south, runs through woods/swale into Rice Creek
Potential Improvements: Create wetland treatment/ ponding area to provide treatment for stormsewer flows.

Local Management BMPs

Locke 3
Location: West of Hayes Street and north of 80th Avenue
Description: Green space on corner
Potential Improvements: Incorporation of a large raingarden for treatment of adjacent roadways.

Locke 4
Location: West of Silver Lake Road and south of Woodcrest Drive
Description: Open space/small trees on corner
Potential Improvements: Incorporation of a large raingarden to treat street runoff.

Locke 5
Location: West of Silver Lake Road and north of Woodcrest Drive
Description: Open space/small trees on corner
Potential Improvements: Incorporation of a large raingarden to treat street runoff.

Locke 6
Location: West of Stinson Boulevard and south of Onondaga Street
Description: Open low area at the corner.
Potential Improvements: Incorporation of infiltration basin or ponding area for treatment of adjacent roadways.

Locke 7
Location: East of the intersection of Arthur Street and 76th Avenue
Description: Large vacant lot.
Potential Improvements: Utilize area for treatment of adjacent roadways.

Locke 8
Location: West of Old Central Avenue and south of 76th Avenue
Description: Large vacant lot adjacent to industrial areas.
Potential Improvements: Utilize for a large treatment basin for Old Central Avenue and or adjacent industrial sites.

Locke 9
Location: West of Old Central Avenue and north of Lakeview Lane
Description: Large vacant lot adjacent to industrial and residential areas.
Potential Improvements: Utilize for a large treatment basin for Old Central Avenue and or adjacent impervious areas.

Locke 10
Location: East of Old Central Avenue and north of 81st Avenue
Description: Large open and wooded areas (current use unknown)
Potential Improvements: Utilize for treatment of adjacent highway and/or adjacent industrial park.

Locke 11
Location: North of Fireside Drive and east of Highway 65
Description: Example of large swales along Highway 65 providing treatment.
Potential Improvements: Maintain and or enhance rural section drainage.

Locke 12
Location: North of the intersection of Mississippi Street and Mississippi Circle
Description: Green space between Mississippi Street and existing trail.
Potential Improvements: Incorporate raingarden area for treatment of a portion of Mississippi Street.

Locke 13
Location: North of Mississippi Street and east of Violet Lane
Description: Wooded area west of the creek.
Potential Improvements: Route stormsewer to this area and construct a wetland treatment area.

Locke 14
Location: South of the intersection of Anoka Street and Timber Ridge South
Description: Stormsewer discharge from Timber Ridge Condos and Rice Creek Condos routed directly into Rice Creek.
Potential Improvements: Reroute outlet into existing wetland area and eliminate direct connection to creek. The quality of the existing wetland and potential impacts from stormsewer discharges would need to be assessed before rerouting/reconfiguring the system.

Locke 15
Location: South of Mississippi Street and west of Ashton Avenue
Description: Open green space at the corner.
Potential Improvements: Utilize for treatment of adjacent roadways with a large raingarden.

Locke 16
Location: South of 66 ½ Way and west of Ashton Avenue
Description: Open space adjacent to an existing church.
Potential Improvements: Utilize area for treatment of the church parking lot or the adjacent roadways.

Locke 17
Location: East of Ashton Avenue and north of 66th Way
Description: Open space within Edgewater Gardens Park
Potential Improvements: Incorporate raingardens along right-of-way to treat Ashton Avenue.

Locke 18
Location: East of 7th Street and south of 63rd Avenue
Description: Large open space located within Commons Park
Potential Improvements: Incorporate treatment features for adjacent parking lot and/or 7th Avenue.

Locke 19
Location: North of the cul-de-sac at the end of Thorndale Avenue
Description: Stormsewer outlet discharging through swale along lot line into Rice Creek
Potential Improvements: Create a linear treatment feature along the lot line prior to discharge to Rice Creek.

Locke 20
Location: North of Mound Avenue and west of Thorndale Avenue
Description: Stormsewer pipe running along lot line and discharging into Rice Creek
Potential Improvements: Daylight stormsewer discharge and create at raingarden providing treatment prior to discharge to Rice Creek.

Locke 21
Location: North of Rice Creek Terrace and east of Pleasant View Drive
Description: Unnecessary impervious area
Potential Improvements: Extend driveways to road and use remaining area for creation of raingardens to treat adjacent roadway.

Locke 22
Location: North of the intersection of Stinson Boulevard and 66 ½ Avenue
Description: Stormsewer outfall discharging in woods flowing into Rice Creek
Potential Improvements: Create wetland treatment/ponding areas at stormsewer outfall.

Locke 23
Location: North of the intersection of Brookview Drive Rice Creek Terrace
Description: Local street discharge into PVC pipe connecting into stormsewer.
Potential Improvements: Convert area into a raingarden.

Site Specific Management BMPs

Locke 24
Location: North of Fireside Drive and west of Old Central Avenue
Description: Existing treatment facility adjacent to Fridley Chevrolet parking lot. Appears that the feature may provide rate control but limited water quality benefit.
Potential Improvements: Feature could be enhanced to provide additional infiltration and water quality treatment.

Locke 25
Location: West of Main Street and south of Rice Creek Terrace
Description: Low open space adjacent to industrial building
Potential Improvements: Enhance/retrofit low area and utilize for treatment of adjacent building.

Stabilization / Other BMPs

Locke 26
Location: Locke Lake Outlet
Description: Dam controlling water levels in Locke Lake. The dam is an obstruction to natural fish migration upstream.
Potential Improvements: Consider reestablishment of fish passage from the Mississippi into Locke Lake and Rice Creek. Establish a smallmouth fishery in the lower stretch of Rice Creek. The pros and cons of allowing Mississippi River fish (game and rough) to migrate upstream would need to be considered before proceeding with any studies/assessments.

Locke 27

Location: Rice Creek South of Timber Ridge South

Description: Ground water seepage beneath an undercut bank. Just one example of a failing bank along Rice Creek.

Potential Improvements: Incorporate bank stabilization for areas along Rice Creek with severe bank erosion. Continue to reduce rates and flows from upstream sources that are the cause accelerated bank erosion.

Long Lake Management Action Plan

Long Lake (62-0067) is located in the City of New Brighton, Ramsey County, Minnesota (Figure 1). The lake consists of a north and a south basin. The north basin has a surface area of approximately 73 acres, a maximum depth of 24 feet. (Figure 2)[1]. The south basin has a surface area of 119 acres, a maximum depth of 24 feet.

The watershed area draining to Long Lake is 105,082 acres (164 square miles) and includes the entire Rice Creek watershed draining into the lake from the northeast, plus the contributing area from the south, including the Lake Johanna, Valentine Lake, and Jones Lake sub-watersheds. The watershed to lake area ratio is approximately 547:1.

Long Lake is surrounded on the west, north, and south sides by residential, transportation, and some open space. I-694 is in close proximity to the southern side of the lake. The east side of the lake is contained within the Long Lake Regional Park and a municipal park managed by the City of New Brighton. Recreational facilities on the east side include a swimming beach, boat launch, and fishing pier. The use of the east side as a major recreational resource in the region is a primary reason for seeking to improve Long Lake.

Long Lake is listed as an impaired lake on the EPA's 303(d) list of impaired waters. It is impaired for aquatic recreation due to high nutrients. There are other impaired waters tributary to the south basin of Long Lake, including Pike Lake (nutrients), Valentine Lake (nutrients), Jones Lake (wetland impaired for aquatic life), Little Lake Johanna (nutrients), Silver Lake

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from DNR files.

(nutrients), and Island Lake (nutrients). The remaining impaired waters in RCWD are tributary to the north basin of Long Lake.

Long Lake was the subject of a major Clean Lakes Partnership study in the 1980-90s that resulted in the implementation of numerous projects. The completion and follow-up report indicated some progress being made toward clean-up, but also acknowledged that many of the watershed improvements did not result in measureable success.

Curly-leaf pondweed reaches a moderate growth level in Long Lake. A macrophyte survey completed in early August of 2008 by the Ramsey Conservation District and Ramsey County Public Works showed light densities of curly-leaf pondweed in many of the littoral areas of the lake. Since curly-leaf pondweed usually dies back after June, it was assumed that peak densities are higher in June than what was observed in the August survey. A lack of vegetation was observed in some of the shallow areas of both basins.

Extensive fisheries data exist for Long Lake in surveys dating back to 1953. The most recent information from 2003 indicates that a mix of fish exist in the lake as a result of migration up from the Mississippi River when the Locke Lake dam was being repaired. The lake supports populations of rough fish (carp, bullhead, sucker, and buffalo) and bluegill. Survey data indicate that the carp population size is above the normal range (i.e. higher than the third quartile) expected for lakes of this type. The bluegill population, although higher than the medial level for lakes of this type, exhibits good growth rates and a well balanced size structure. The DNR stocks the lake with walleye and northern pike.

Low concentrations of trichloroethylene (TCE) and cis-1,2-dichloroethylene (DCE), a breakdown product of TCE, have been found in Long Lake and local ground water. The occurrence of these chemicals is likely due to industries in the watershed that in the past handled solvents, degreasers, and petroleum products. The in-lake concentrations are lower than the TCE water quality standards and the DCE water quality guidance value, both based on protecting aquatic organisms and human health for fish consumption and incidental intake of water during swimming. The Minnesota Department of Health completed the Long Lake Health Consultation and concluded that levels of TCE, DCE, and vinyl chloride were well below levels of health concern. The concentrations have been decreasing over time, but it appears that there is a continuing source of the contaminants. The source is currently unknown. Recent MPCA monitoring of shallow aquifers did not show any elevated concentrations of TCE or DCE in shallow groundwater that would explain the detections found in Long Lake.

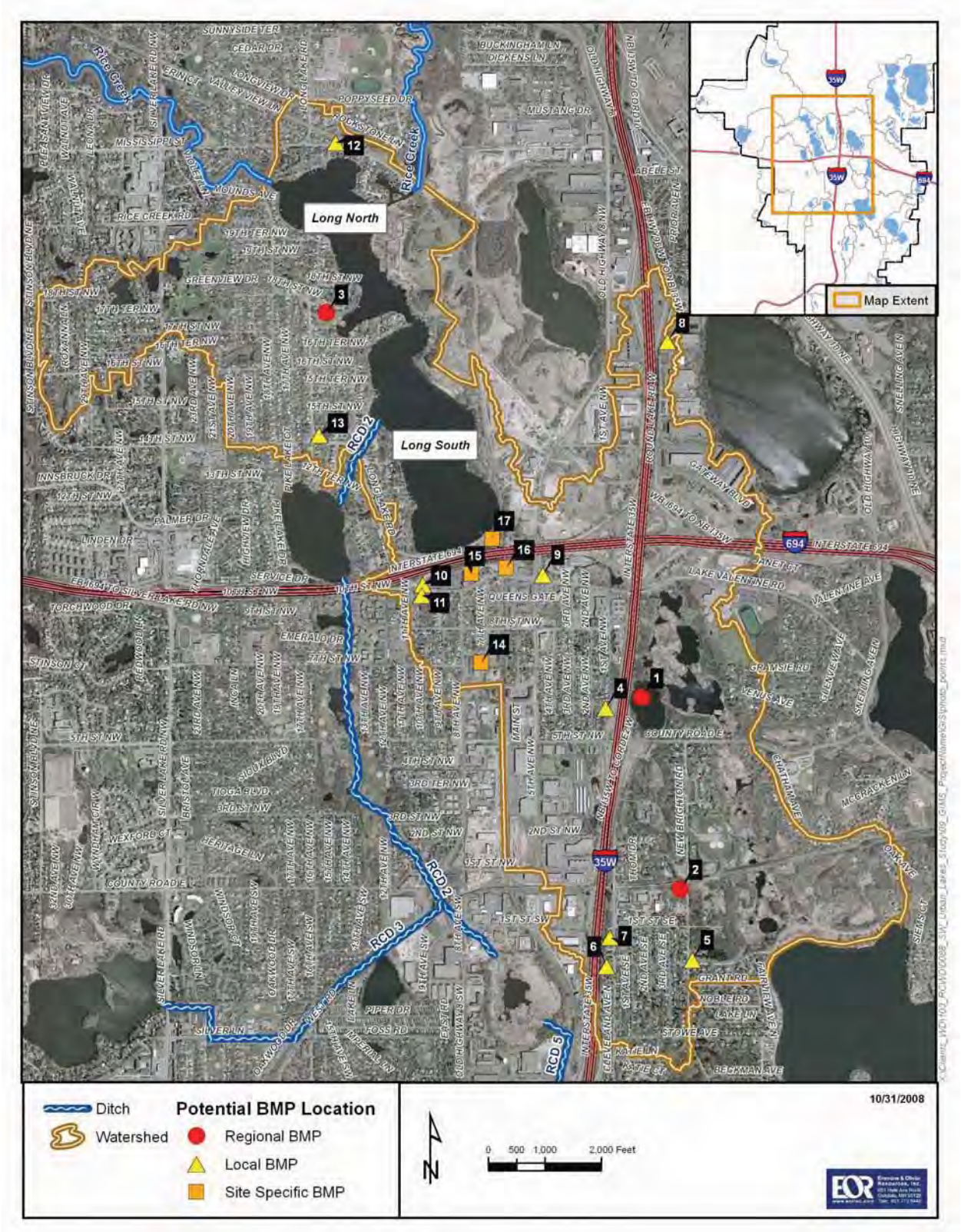


Figure 1. Long Lake and Potential BMP Locations

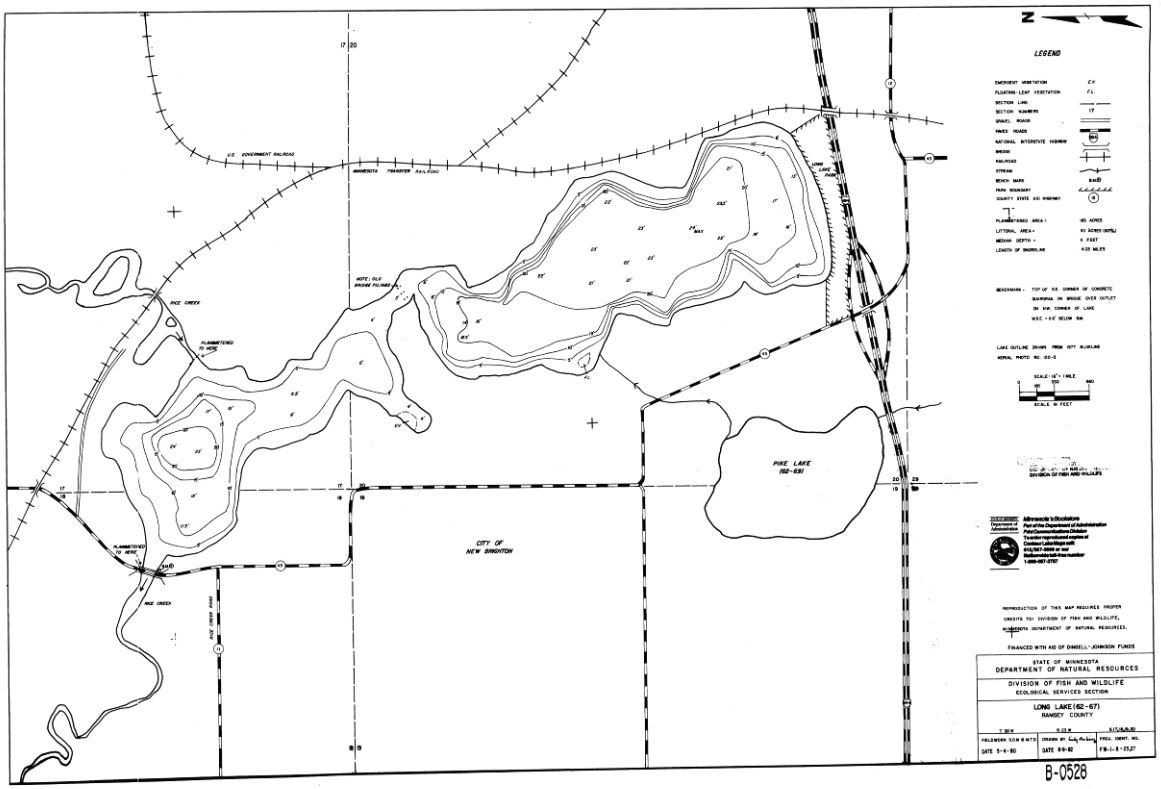


Figure 2. Long Lake Bathymetry

Water Quality Summary

Water quality data for Long Lake in recent history has been collected since the 1980s. Data were collected by Ramsey County Public Works. A summary of the most recent ten years of water quality information for the north and south basins of the lake suggest that the state water quality standards are not being met except for the Secchi depth (clarity) of the south basin. The north basin drains the entire upper Rice Creek watershed and reflects a high phosphorus load coming into the basin from the northeast. The south basin drains a large sub-watershed, but is buffered by flow through from many lakes in the sub-watershed and by Pike Lake immediately upstream of the inflow into the south basin.

Table 1. Average Water Quality Data (1998-2007) and Standards

Parameter	Long Lake, North Basin	Long Lake, South Basin	Standard
TP (µg/L)	145	54	40
Chl (µg/L)	57	25	14
Secchi Depth (m)	0.6	1.4	1.4

Figures 3 through 5 show the growing season total phosphorus (TP), chlorophyll-*a*, and Secchi depth (clarity) data for the north basin of Long Lake. The same series of data is shown in Figures 6 through 8 for the south basin.

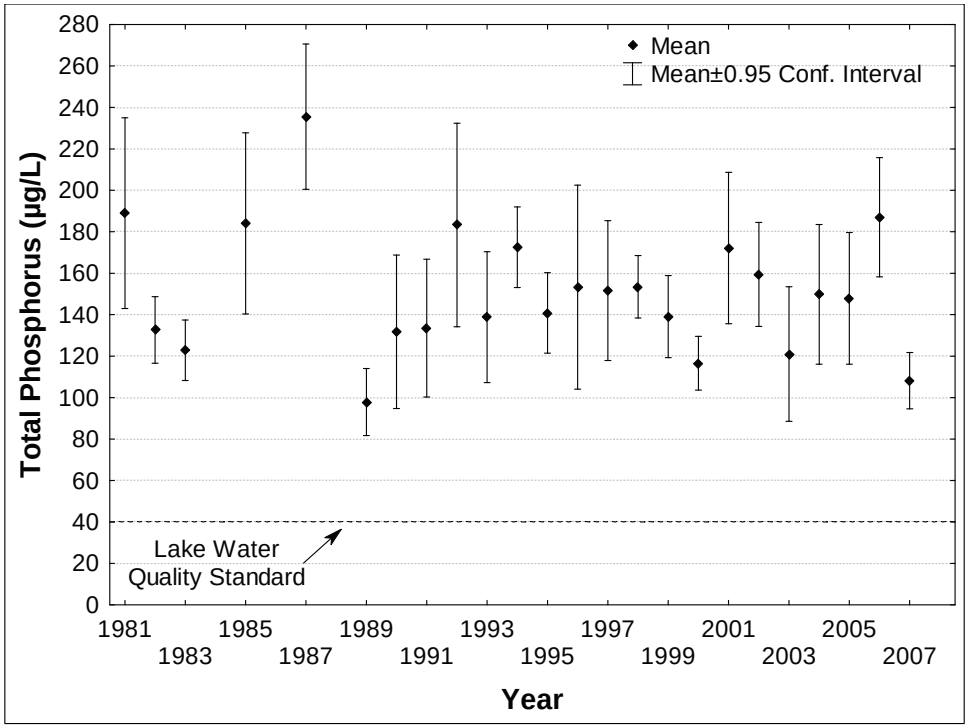


Figure 3. Long Lake North Basin Total Phosphorus

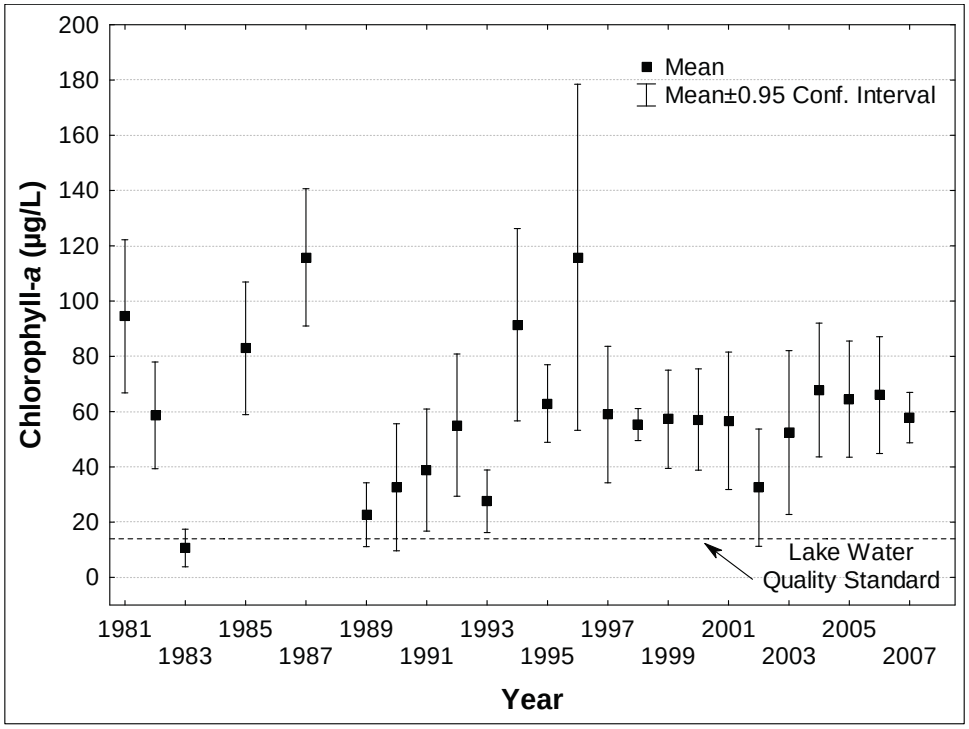


Figure 4. Long Lake North Basin Chlorophyll-*a*

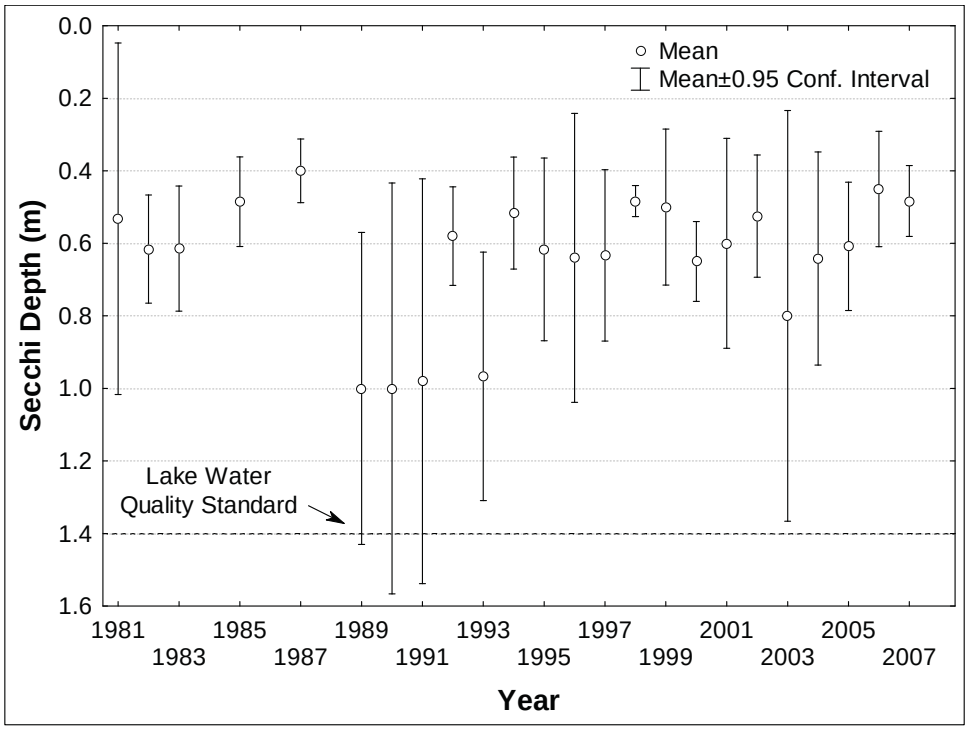


Figure 5. Long Lake North Basin Secchi Depth

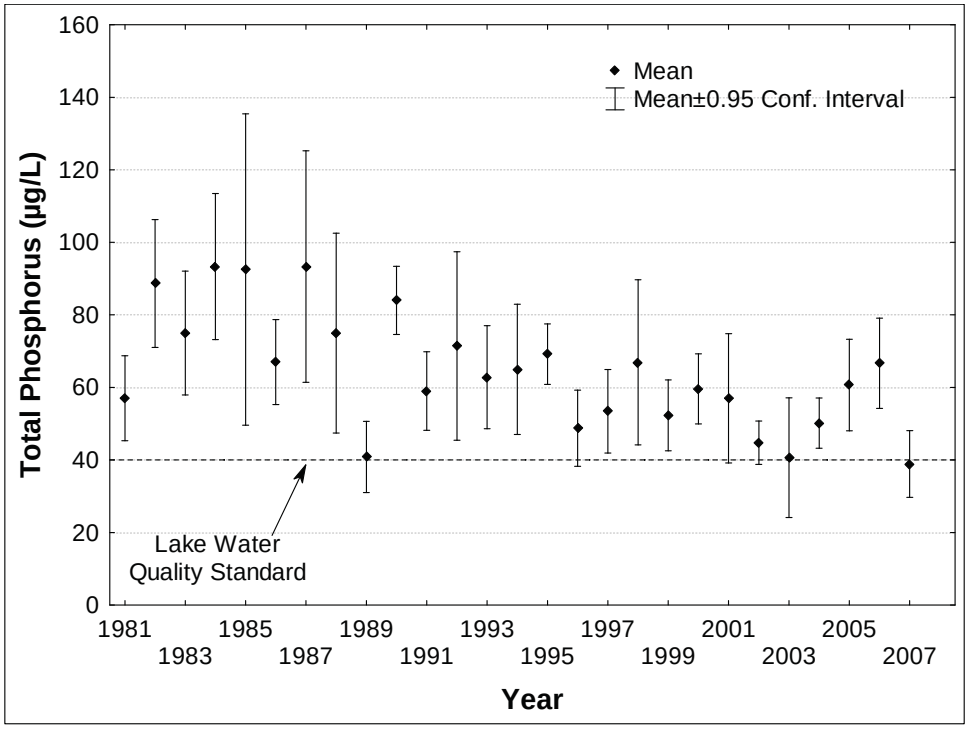


Figure 6. Long Lake South Basin Total Phosphorus

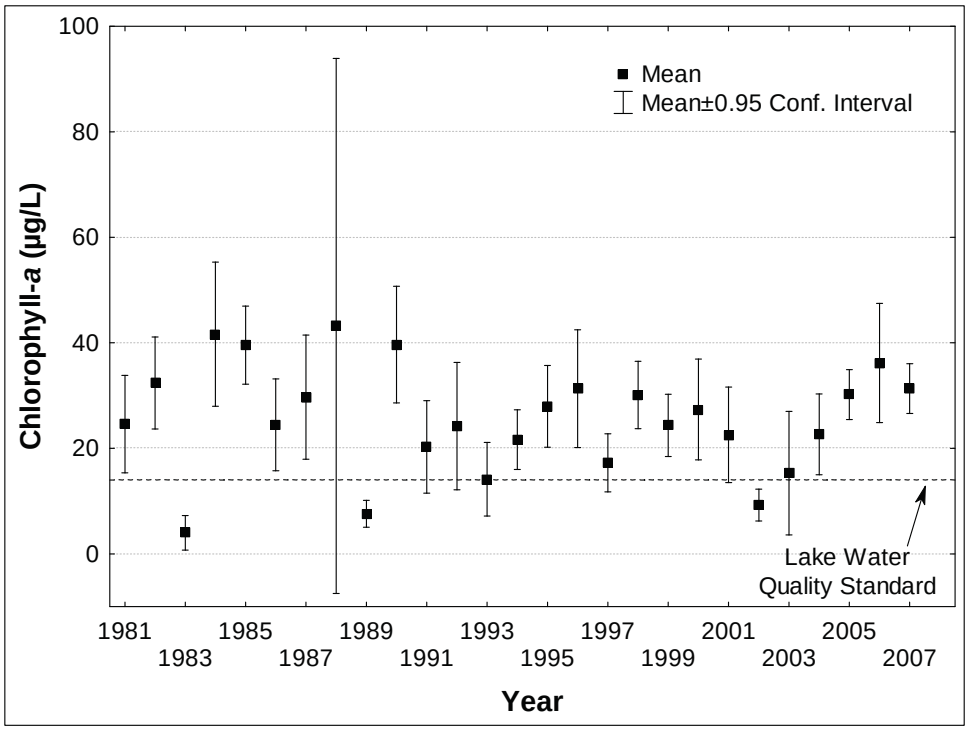


Figure 7. Long Lake South Basin Chlorophyll-*a*

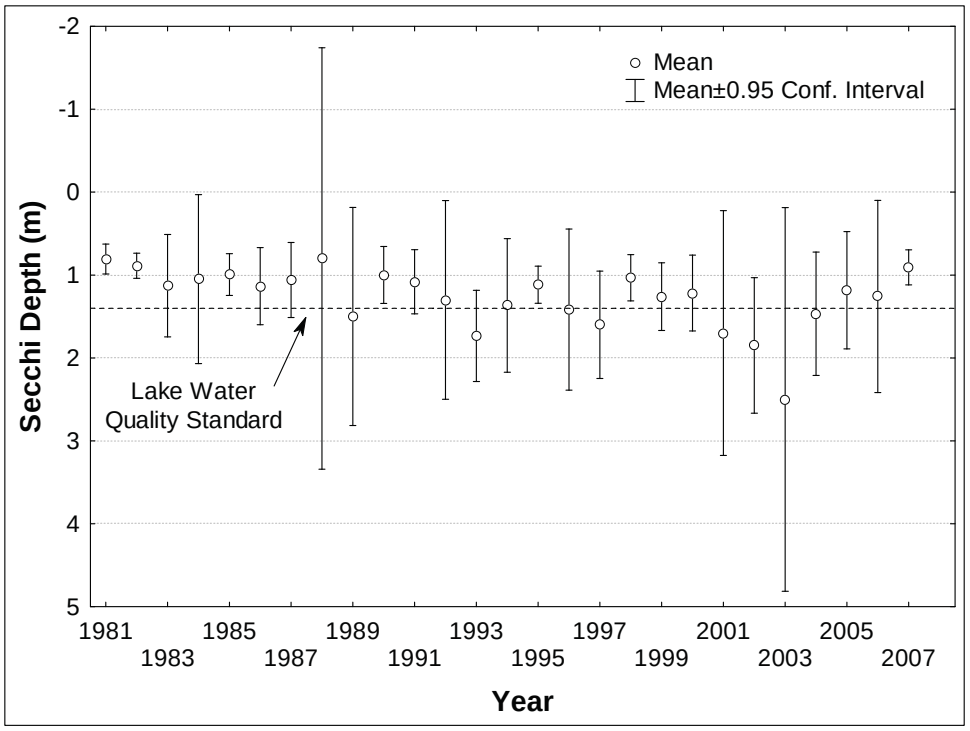


Figure 8. Long Lake South Basin Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to both basins of the lake, and an in-lake model (Bathtub) was used to predict the response of the basins to phosphorus loading. The lake model was calibrated to in-lake monitoring data.

Water quality modeling indicates that for the north basin, watershed inputs account for 96% of the nutrient load, with internal loading accounting for the remaining 4% (Figure 9). To reach the in-lake goal of 40µg/L TP, the phosphorus loading to the lake would need to be reduced by approximately 64%.

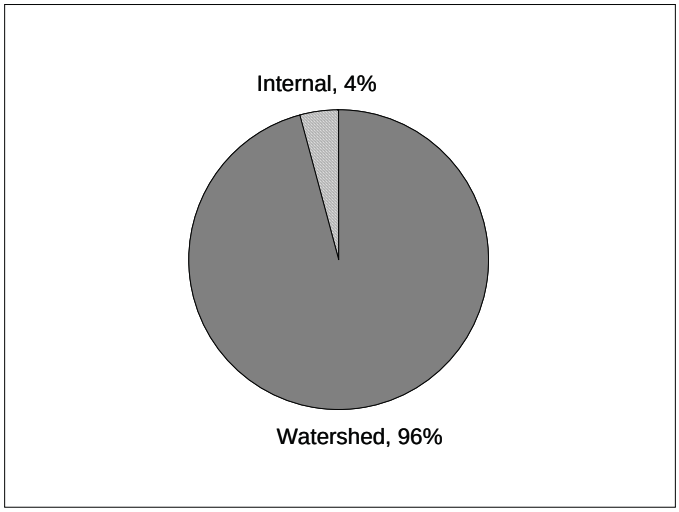


Figure 9. Long Lake North Phosphorus Load Distribution

The south basin modeling indicates that watershed inputs account for 68% of the nutrient load, with internal loading accounting for the remaining 32% (Figure 10). To reach the in-lake goal of 40µg/L TP, the phosphorus loading to the lake would need to be reduced by approximately 40%.

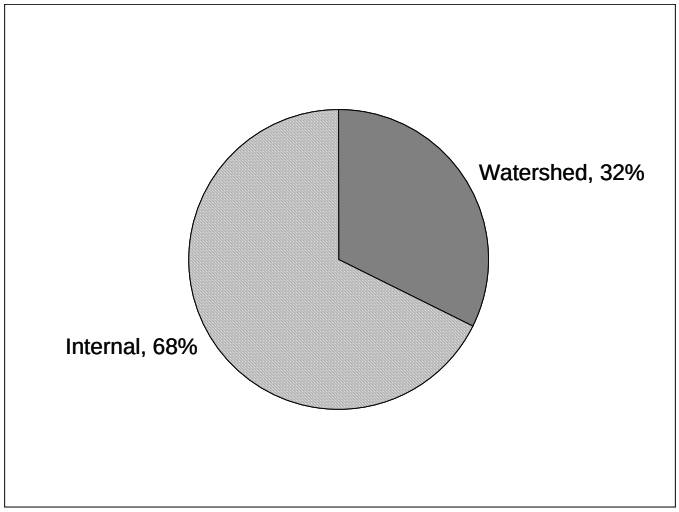


Figure 10. Long Lake South Phosphorus Load Distribution

Public Input

At the public input meetings on June 3, 2008 and January 19, 2009 issues facing Long Lake were addressed.

- The attendees were in support of continued follow-up maintenance for the many Long Lake Chain of Lakes Clean Lakes Partnership (CLP) BMPs that were installed in the 1990s. This effort is intended to keep the installed BMPs in optimum working order. Some attention to macrophyte management was also suggested to supplement the practices already in place.
- The sediment basin that treats Rice Creek inflow just prior to discharge to the lake was cleaned in early 2008. The very large load of TP entering the north basin of the lake can be reduced through effective and routine cleaning of this sediment trap. The attendees acknowledged this key maintenance operation and would like to see it happen as often as needed.
- Residents from around the lake stated their dissatisfaction with the "weedy and green" characteristic of the lake after so much attention was paid to improving it in the CLP effort. Actions they supported include additional BMPs, effective implementation of city and RCWD rules, volume control and infiltration practices, cost-share initiatives, BMP retrofits, and plan coordination. Attendees agreed with staff that no quick fixes are available, but that a long term effort is needed.
- The attendees were interested in what might happen to spur things forward as a result of the lake's impaired status. RCWD staff explained that the Southwest RCWD Lake Study has many attributes of a pre-TMDL study and will likely set the stage for a full-scale TMDL study.
- Shoreline erosion occurs due to wakes from motorized boating.

Water Quality Issues

- The north basin of Long Lake has high phosphorus concentrations mostly due to the high load from Rice Creek, which flows through Long Lake. Both basins are impaired.
- Curly-leaf pondweed is present in moderate densities in both basins. There is a lack of vegetation in many of the shallow areas of the lake.
- High densities of both black bullhead and carp stir up bottom sediments and lead to high rates of internal loading.
- The south basin is directly adjacent to Interstate-694 and likely receives highway runoff.
- Low levels of TCE and DCE have been found in Long Lake. The concentrations are not high enough to warrant concern for human or aquatic life health; however, it appears that there is a continuing source of the chemicals into the lake and it is not known what the source is.
- The lack of aquatic shoreline vegetation coupled with water level fluctuations increases susceptibility to shoreline erosion from motorized recreation and results in additional phosphorus inputs to the lake.

Recommended Management Approach

Watershed Management Recommendations

Management of land in the watershed is a critical element in addressing the nutrient impairment. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, 17 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- The entire southeast portion of the Long Lake watershed flows through Farrel's Wetland, also known as the E-2 Wetland from the Long Lake Chain of lakes CLP. This large wetland serves as a principal treatment site for the flow originating in the Lake Johanna and Valentine Lake chains. In a memo from EOR to RCWD dated January 29, 2008, the poor condition of the weir controlling flow out of the wetland was documented. Figure 11 illustrates the corrosion noted in the memo. It is clear from this picture that the level of water in the wetland is largely controlled by the corroded holes rather than the design weir elevations. Repair or replacement of this structure to its original or revised design is recommended for the treatment of Farrel's Wetland to again be effective. The recommendation in the memo was that RCWD consider replacement of the weir for an approximate cost of $80,000. The memo also indicates that restoring the weir at a slightly higher elevation than current could remove an additional 345 pounds of TP per year, or roughly 60% of the load reductions needed to achieve the water quality standard in the south basin of Long Lake. In addition to repair/replacement of the E-2 outlet, additional assessment of the upstream wetland basins within the overall wetland complex could be completed with an eye towards additional control structures to provide added treatment storage.
- Feasibility and Benefit Level Assessment of the three potential regional BMP locations identified in the *field reconnaissance supplement*.
- Consideration of local partnerships for further assessment of the 10 potential local BMP locations identified in the *field reconnaissance supplement*.
- Follow-up inspection, operation and maintenance of all Long Lake Chain of Lakes Clean Lakes Partnership (CLP) BMPs.
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.

Figure 11. Outlet Weir Corrosion at Farrel's (E-2) Wetland.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

- Develop an aquatic vegetation management plan, focusing on curly-leaf pondweed.
- Shoreline and littoral zone restoration practices should be undertaken. Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide

refugia for zooplankton, but the macrophyte communities are sparse in the shallow regions of the lake.

- Local ordinances to control motorized boating could be developed to reduce the amount of shoreline erosion occurring from boat wakes.
- A fisheries management plan should be developed that will aim to restore the balance of fish in the lake. The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality, and benthivores have been found at high densities in Long Lake. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. Work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.
- Work with MPCA and MDH to further investigate the source of TCE and DCE in Long Lake and to ensure that it does not become a human or aquatic life health risk.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Long Lake. Since there is a long record of in-lake water quality data for Long Lake, additional in-lake data collection is not a high priority at this time. Watershed phosphorus loading data are a high priority, as they will be needed for the future TMDL study.

- TP, chlorophyll, and Secchi depth data: Collect at least five sampling dates per year. The TMDL can be based on the existing monitoring data; additional data should be collected after management actions are implemented to track the response of the lake.
- Macrophyte surveys: Complete one macrophyte survey during early June to evaluate the density of curly-leaf pondweed. Complete macrophyte surveys after aquatic vegetation management practices are implemented, to monitor the success.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.
- Ramsey County Ditch 2 should be monitored close to the inlet to Long Lake South, and Rice Creek should be monitored close to the inlet to Long Lake North, to provide flow and phosphorus loading estimates. These data will be needed in order to estimate the watershed phosphorus load to the lake for the TMDL study.

Long Lake Field Reconnaissance Supplement

Regional Management BMPs

Long 1
Location: E2 wetland looking from the east
Description: E2 wetland looking from 6th Street and 1st Avenue across freeway
Potential Improvements: Enhancements or improvements throughout the E2 wetland complex. An assessment of current effectiveness of the upstream wetland systems should be completed and outlet structure should be replaced.

Long 2
Location: West of New Brighton Road and south of RR tracks
Description: Large low green space (appears to not get much use, except for some storage)
Potential Improvements: Potentially could construct a regional treatment feature (infiltration basin or wetland treatment basin) to serve the drainage area to the south.

Long 3
Location: East of Long Lake Road and south of 17th Street
Description: Large stormsewer pipe running beneath green space.
Potential Improvements: Daylight pipe and create wetland treatment/ponding area.

Local Management BMPs

Long 4
Location: South of 6th Street and west of 1st Avenue
Description: Open green space
Potential Improvements: Pick up street runoff and incorporate a large raingarden.

Long 5
Location: North of County Road E and east of New Brighton Road
Description: Large open green space (appears to be park property)
Potential Improvements: Incorporate ponding or infiltration areas, however appears slightly high and may not be able to route much drainage area to this site.

Long 6
Location: West side of Cleveland Avenue south of 2nd Street
Description: Large open green space
Potential Improvements: Incorporate ponding or infiltration areas for treatment of adjacent roads.

Long 7
Location: West side of Cleveland Avenue south of 1st Street
Description: Large open green space
Potential Improvements: Incorporate ponding or infiltration areas for treatment of adjacent roads.

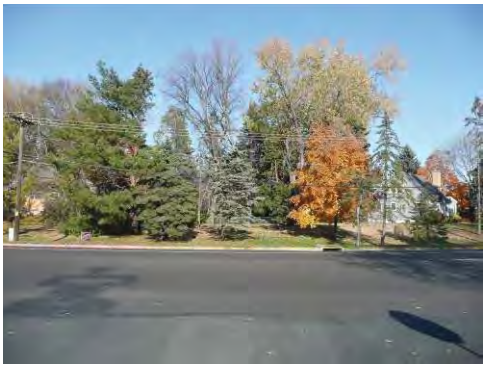
Long 8
Location: West of Round Lake Road and south of County Road 96
Description: Green space along Round Lake Road
Potential Improvements: Incorporate raingardens for treatment of adjacent roadway.

Long 9
Location: North of 10th Street and east of Old Highway 8
Description: Green space at the corner.
Potential Improvements: Use area for treatment of adjacent roadways.

Long 10
Location: North of 10th Street and west of 9th Avenue
Description: Existing ponding basin receiving stormsewer discharges from the east and south.
Potential Improvements: Excavate to provide additional dead storage.

Long 11
Location: South of 10th Street and west of 9th Avenue
Description: Low area adjacent to a small ditch running from south to north.
Potential Improvements: Use low area for creation of a small wetland treatment feature.

Long 12
Location: North of Mississippi Street and east of Long Lake Road
Description: Open space adjacent to roadway
Potential Improvements: Install raingarden to treat a portion of Mississippi Street.



Long 13
Location: East of the intersection of Long Lake Road and 14th Street
Description: Open space adjacent to Long Lake Road.
Potential Improvements: Incorporate raingarden areas for treatment of a portion of Long Lake Road (note: this would require the removal of some trees).

Site Specific Management BMPs

Long 14
Location: East of 8th Avenue and south of 7th Street
Description: Catch basin located at the edge of the parking lot.
Potential Improvements: Use green space behind catch basin to provide treatment. Numerous areas are available onsite for treatment of impervious area.

Long 15
Location: North of 10th Street and west of 7th Street
Description: Green space adjacent to apartment parking lots.
Potential Improvements: Create raingarden or sand filter area for treatment of adjacent parking lots.

Long 16
Location: North of 10th Street and east of Old Highway 8
Description: Green space adjacent to parking lot.
Potential Improvements: Use green space for a raingarden to treat a portion of the adjacent parking lot (note: this maybe within railroad ROW).

Long 17
Location: At the east end of the I-694 service road.
Description: The service road and parking lot at the boat launch all drain to a small treatment feature before discharging to Long Lake. Feature appears undersized for its drainage area.
Potential Improvements: Expand and enhance existing feature.

Marsden Lake Management Action Plan

Marsden Lake (62-0059) is located in the City of Arden Hills, Ramsey County, Minnesota (Figure 1) and is within the boundaries of the Arden Hills Army Training Site (AHATS). Although termed a lake, Marsden is physically and ecologically closer to a wetland. The surface area of the lake is approximately 271 acres with an estimated maximum depth of 5.5 ft[1]. Based on its low estimated maximum depth, it is considered a shallow lake according to MPCA's definition. The watershed draining to the lake is approximately 2285 acres.

Marsden Lake is surrounded on all sides by the AHATS facility, although its watershed extends beyond the AHATS property to the east and south. Marsden Lake has very limited public use at the current time because of its location within the AHATS boundaries. There is some limited access granted by the federal government for study and nature walks, but the general public is not allowed within the AHATS property.

[1] No bathymetric data were available for this lake. The maximum depth was estimated using depth data collected during sediment sampling. The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos.

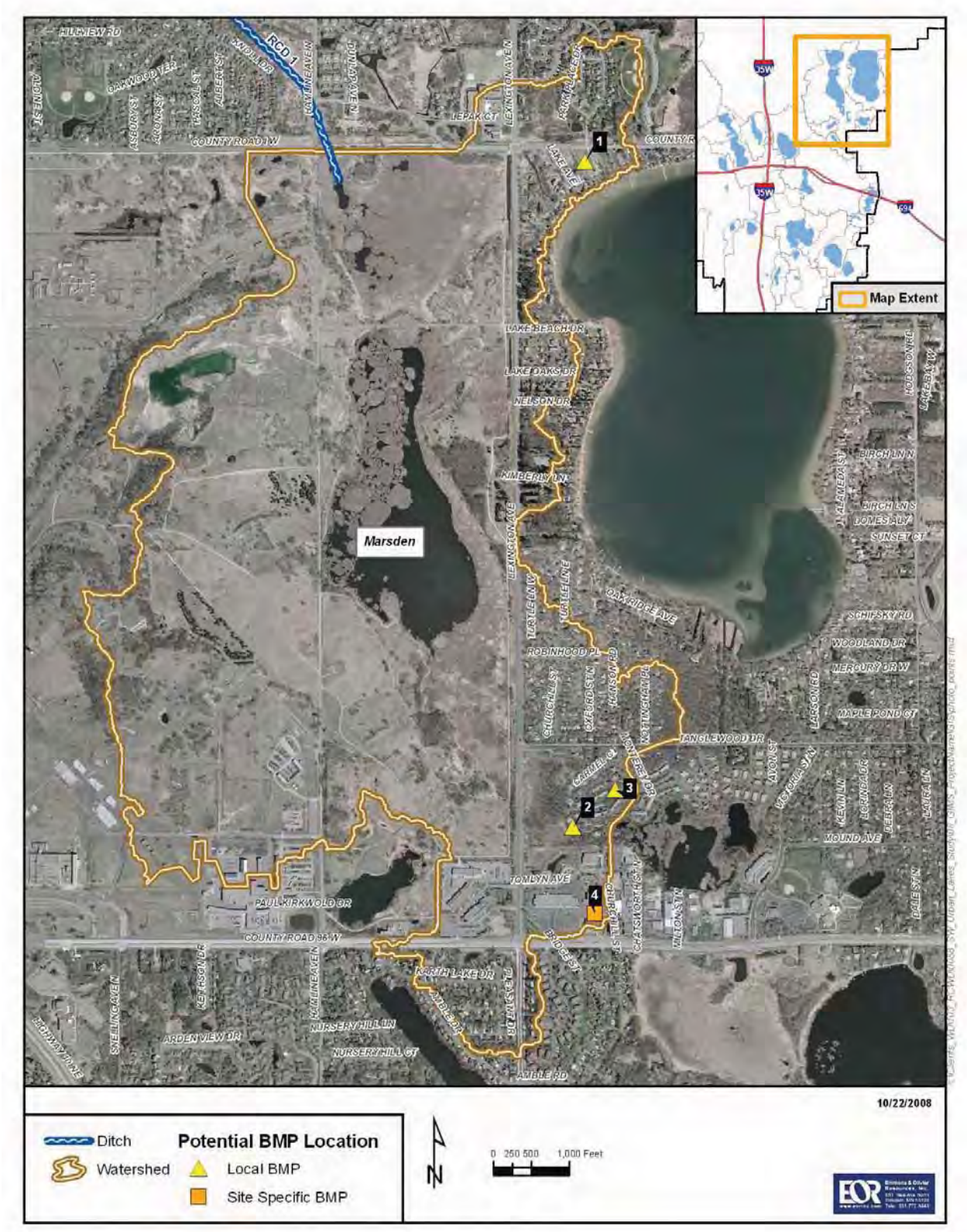


Figure 1. Marsden Lake Potential BMP Location

Water Quality Summary

Water quality and biological data are not available for Marsden Lake. Water clarity data inferred from satellite imagery suggest that the water clarity depth of Marsden Lake is approximately 3 to 6 feet. A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. There are no in-lake monitoring data to calibrate the lake model. Modeling indicates that watershed inputs account for approximately 52% of the nutrient load, with internal loading accounting for the remaining 48% (Figure 2). Without any in-lake nutrient data for the lake for model calibration, the modeling results should be considered preliminary.

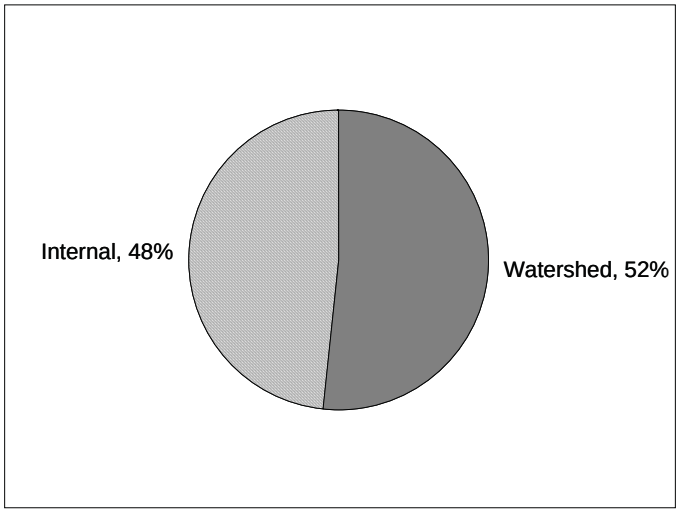


Figure 2. Marsden Lake Phosphorus Load Distribution

In 2007, the U.S. Army tested Marsden Lake for TSS (total suspended solids), total and dissolved aluminum, total and dissolved lead, and total hardness. The total lead standard was exceeded once at two of the three monitoring sites; all other lead samples and all aluminum samples were below the state standard for Class 2B waters. The U.S. Army has completed an ecological risk assessment on Marsden Lake.

Public Input

No attendees spoke on issues related to Marsden Lake at the public input meeting on May 29, 2008.

Water Quality Issues

- Sediment within the lake may be contaminated with toxic substances due to past land use.

Recommended Management Approach

Watershed Management Recommendations

Residential and commercial areas east of Lexington Avenue were developed prior to water quality BMP rules and regulations. While the City of Shoreview retrofitted a regional pond north of and to serve the Shoreview Mall site, further targeting of areas east of Lexington Avenue for future BMP retrofits or for redevelopment attention will help to improve runoff quality reaching the lake. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, 4 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of the three potential local BMP locations identified in the *field reconnaissance supplement*.
- Notice/letter to potential site-specific BMP landowner educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.

Currently all of the area directly surrounding Marsden Lake is under the control of the U.S. Army because the lake is entirely within the AHATS boundary. The Army should maintain its existing management plan for the lake unless water quality data collected in the future dictates that a need in management is warranted.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

With very little in-lake biological data for Marsden Lake, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply to Marsden Lake:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.
- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake. If cooperation is possible, work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

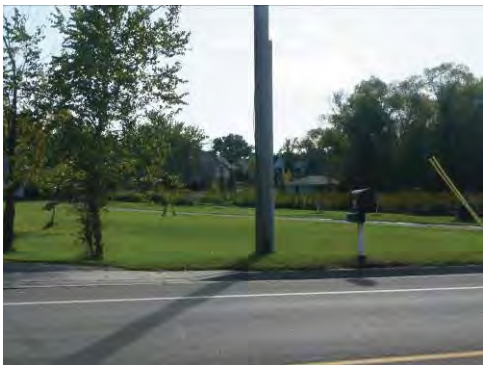
Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Marsden Lake. There are no in-lake water quality data for the lake; if the implementation of management practices for the lake were to move forward, in-lake data would be needed and should be considered a high priority.

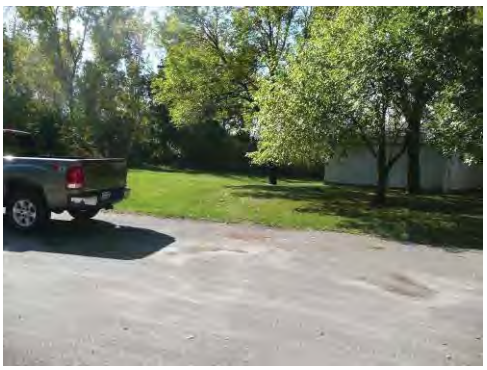
- Bathymetric data collection
- TP, chlorophyll, and Secchi depth data: Collect data for several years, with at least five sampling dates per year.
- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Fish survey: Complete a fish survey to evaluate the fish species composition of the lake.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.

Marsden Lake Field Reconnaissance Supplement

Local Management BMPs



Marsden #1
Location: South of County Road I and west of Chatsworth Street N
Description: Large open area in front yard along County Road I.
Potential Improvements: Incorporate infiltration/ biofiltration feature for treatment of County Road I (note: treatment may already be occurring in downstream wetlands and ponds)



Marsden #2
Location: Southwest of Carmel Court loop
Description: Shallow swale flowing from pavement area back to wetland.
Potential Improvements: Create raingarden for local drainage or pick up stormsewer from Carmel Court and incorporate a slightly larger treatment feature.

Marsden #3
Location: Inside Carmel Court loop
Description: Grass depressional area with catch basin at the bottom.
Potential Improvements: Retrofit to provide infiltration/water quality treatment.

Site Specific Management BMPs

Marsden #4
Location: North of County Road 96 and west of Churchill Street
Description: Appears to be an existing infiltration feature, which outlets to the road.
Potential Improvements: Might be working as is, however the vegetation and storage of features onsite could likely be enhanced to provide more infiltration and treatment.

Martha Lake Management Action Plan

Martha Lake (62-0064) is located in the City of Shoreview, Ramsey County, Minnesota (Figure 1). The surface area of the lake is approximately 34 acres with a maximum depth of 3.5 feet[1] (Figure 2). The lake is a mix of standing water in pools and vegetation (mostly cattails and lily pads).

Martha Lake meets the MPCA definition of wetland and is classified as a Class 2D (wetland) water in accordance with Minn. Rules Ch. 7050. Furthermore its designation as a Public Water Wetland ["W" 62-64] by the DNR Protected Water Inventory and the lack of an aquatic recreational resource management history (MPCA (*Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment,* 2007) substantiates the designation as a Class 2D water. The Class 2D designation means that the wetland resource is protected for the "maintenance of a healthy wetland aquatic community and for wetland based aquatic recreation." Numeric nutrient standards developed for shallow lakes (i.e. 60 µg/L TP) do not apply to Class 2D wetlands.

The watershed draining to Martha Lake is approximately 77 acres and is primarily a mix of light industrial, neighborhood commercial, single family and multi-family residential uses. The lake drains into the Marsden Lake watershed.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from DNR files.

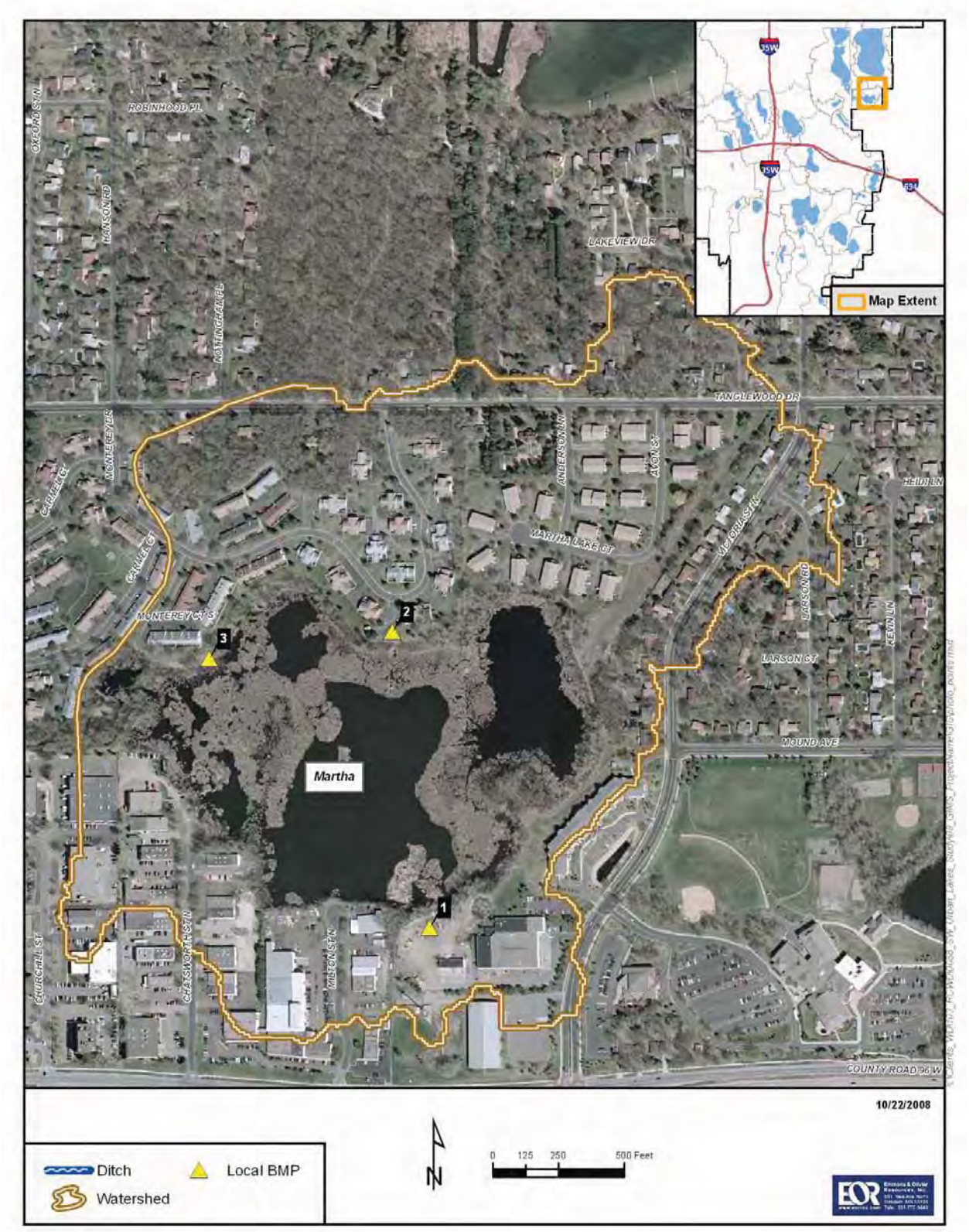


Figure 1. Martha Lake and Potential BMP Locations

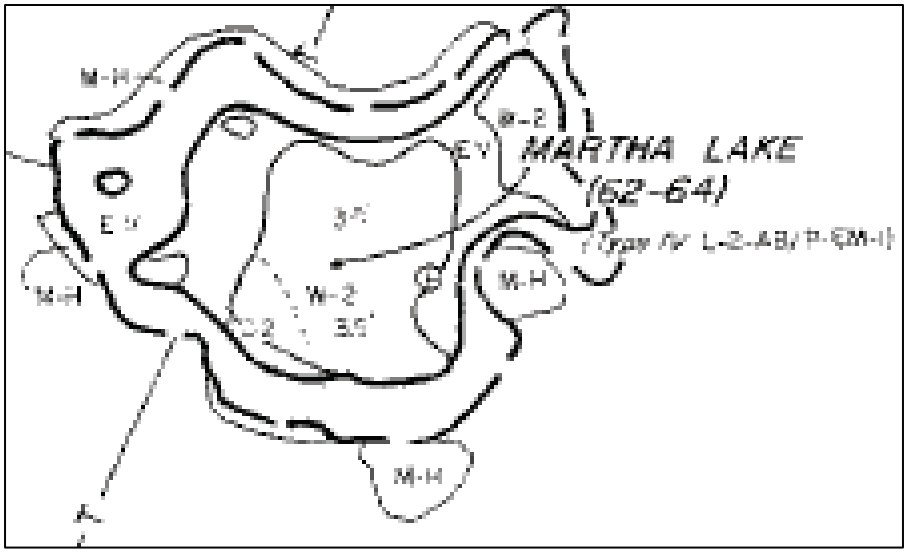


Figure 2. Martha Lake Bathymetry. Map from DNR files, unknown date.

Water Quality Summary

Water quality and biological data are not available for Martha Lake. A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. There are no in-lake monitoring data to calibrate the lake model. Water quality modeling indicates that watershed inputs account for approximately 89% of the nutrient load, with internal loading accounting for the remaining 11% (Figure 3). Without any in-lake nutrient data for the lake for model calibration, the modeling results should be considered preliminary.

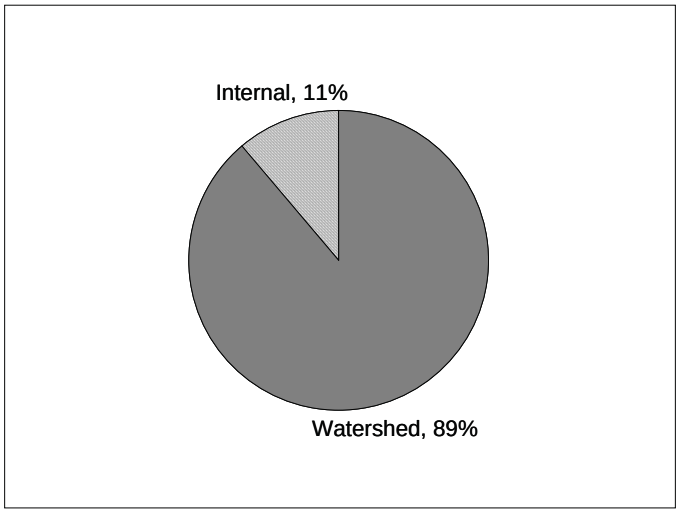


Figure 3. Martha Lake Phosphorus Load Distribution

Public Input

No attendees spoke on issues related to Martha Lake at the public input meeting on May 29, 2008.

Water Quality Issues

- The high density of cattails in Martha Lake suggests that the wetland has been impacted by nutrient enrichment and/or modified surface hydrology.

Recommended Management Approach

Watershed Management Recommendations

Because the Martha Lake watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, three BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of the three potential local BMP locations identified in the *field reconnaissance supplement*.
- Notice/letter to landowners in the commercial/industrial area in the southwest area of the lake educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program. All of this is area running directly to the lake untreated. While there is little opportunity for easy (surface) retrofits, this area could be considered for subsurface retrofits during pavement maintenance or redevelopment activities.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

The water level fluctuations and/or the high nutrient loading presumed in Martha Lake create an environment that makes it difficult for the establishment of native plant communities and supports a dense stands of cattails. Any in-lake restoration project will have a greater likelihood of success after the rate and volume of stormwater runoff to Martha Lake is controlled.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Martha Lake. There are no in-lake water quality data for the lake; if the implementation of management practices for the lake were to move forward, in-lake data would be needed and should be considered a high priority.

- Updated bathymetric data collection
- TP and chlorophyll data: Grab water quality samples should be collected if there is cause to believe that the water body is enriched with nutrients (as evidenced by mid-summer algae blooms) AND the waterbody is contributing flow to adjacent lakes.
- Macrophyte and/or aquatic invertebrate data should be collected in cooperation with the MPCA to determine if the water body is meeting the "healthy aquatic community standards."

Martha Lake Field Reconnaissance Supplement

Local Management BMPs

Martha #1
Location: Southeast corner of Martha Lake
Description: Backside of Shoreview Public Works / Maintenance building. The yard area is immediately adjacent to the lake and appears to be draining to the lake untreated.
Potential Improvements: Assess runoff reaching lake and install BMPs prior to discharge to the lake as needed.

Martha #2
Location: North end of Martha Lake, south of Monterey Drive
Description: Stormsewer from Monterey Drive outlets directly to Martha Lake.
Potential Improvements: Incorporate water quality BMP in green space.

Martha #3
Location: South of Monterey Drive and east of Monterey Court
Description: Stormsewer from Monterey Court outlets directly to Martha Lake.
Potential Improvements: Incorporate water quality BMP in green space.

Moore Lake Management Action Plan

Note: This document was updated in November of 2009 by the RCWD to add Possible BMP Location #13 – Fridley Middle School stormwater infiltration.

Moore Lake (02-0075) is located in the City of Fridley, Anoka County, Minnesota (Figure 1). The lake is bisected by Highway 65 into eastern and western basins connected by a storm-pipe. The western basin is 70 acres, has a maximum depth of 5 feet and is 100% littoral (Figure 2)[1]. Based on its low maximum depth, the western basin is considered a shallow lake according to MPCA's definition. The eastern basin of Moore Lake is approximately 30 acres with a maximum depth of 22 feet and is 79% littoral, and it is not considered a shallow lake according to MPCA's definition. East Moore Lake is listed as an impaired lake on the EPA's 303(d) list of impaired waters. It is impaired for aquatic recreation due to high nutrients.

The lake was bordered by a floating bog to the north in the 1960s but today open water is present up to the developed northern shore. East Moore Lake's watershed is 664 acres; West Moore Lake's watershed is 778 acres (including East Moore Lake and its watershed, which both drain to West Moore Lake). Both watersheds are a highly developed mix of residential and commercial uses with some areas of municipal park. There is a municipal beach on the eastern shore of the lake that is the most visited park in Fridley. There is a smaller park on the western basin connected to the larger Fridley Common Park, primarily composed of managed turf-grass sports fields.

Both East and West Moore Lakes have ditched inflows adjacent to Highway 65 at the south end of the basins, with the western basin receiving runoff from the Medtronic facility along I-694 and the eastern basin receiving runoff from commercial and residential areas. Four additional stormwater inlets to the lake were re-engineered in the late 1980s to improve water quality. These changes were effective in reducing some nutrient and sediment problems according to DNR reports.

A DNR aquatic vegetation survey was performed on Moore East during the end of July in 2004. Curly-leaf pondweed was listed as rare. Water quality in Moore Lake has been consistently recorded as poor, with eutrophic conditions prevailing and frequent fecal coliform and *E. Coli* alerts at the public beaches (mentioned in the minutes of the Fridley City Parks and Recreation Commission meeting in 2005). Excretion by waterfowl was noted by local stakeholders as the primary cause of bacterial outbreaks and beach closings. In 2005 the Fridley City Parks and Recreation Commission discussed a ban on feeding geese and other waterfowl. The City of Fridley participates in a fowl removal program and plans to continue this program as part of their 2030 Comprehensive Plan.

DNR documents show that, in the late 1980s, stormwater system changes appeared to improve total phosphorus (TP) and Secchi depth (but not algal concentrations) in both basins of the lake. In 1986 a plastic sheet was installed in the bottom of the east basin to control macrophytes, including invasive species. In 2004, the DNR reported that this sheet was present but failing.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos. The maximum depth was taken from the DNR Lake Finder.

The fishery of Moore Lake has been managed by the DNR and the City of Fridley as part of the Fishing in the Neighborhood (FIN) program since 1986. The FIN program creates neighborhood fishing opportunities by stocking and providing fishing access. The lake is stocked with bluegill, black crappie, largemouth bass, and channel catfish. Walleye, northern pike, and carp have been sampled in DNR fisheries surveys, but in low numbers. The most recent fisheries survey was conducted in 2004. Spawning habitat is poor for centrarchids (bluegill and crappie) and pike. The major inflow tributary in the southeast corner of East Moore Lake has been the best known spawning run, but now drains a highly developed area, and recent images show that it may no longer exist.

Bullhead dominated fish composition until 1986, when chemical agents were used to kill off fish before re-stocking with centrarchids. Both basins of Moore Lake are subject to winterkill, the western basin likely due to freezing and the eastern due to anoxic hypolimnion (suggested by 2004 data from the DNR). Aeration has been implemented by the City of Fridley for both the east and west basins. The west basin aerator is an on-shore unit that pulls water from the lake. It is under assessment for replacement and typically runs from November to April. The east basin aerator is in the lake and runs year-round.

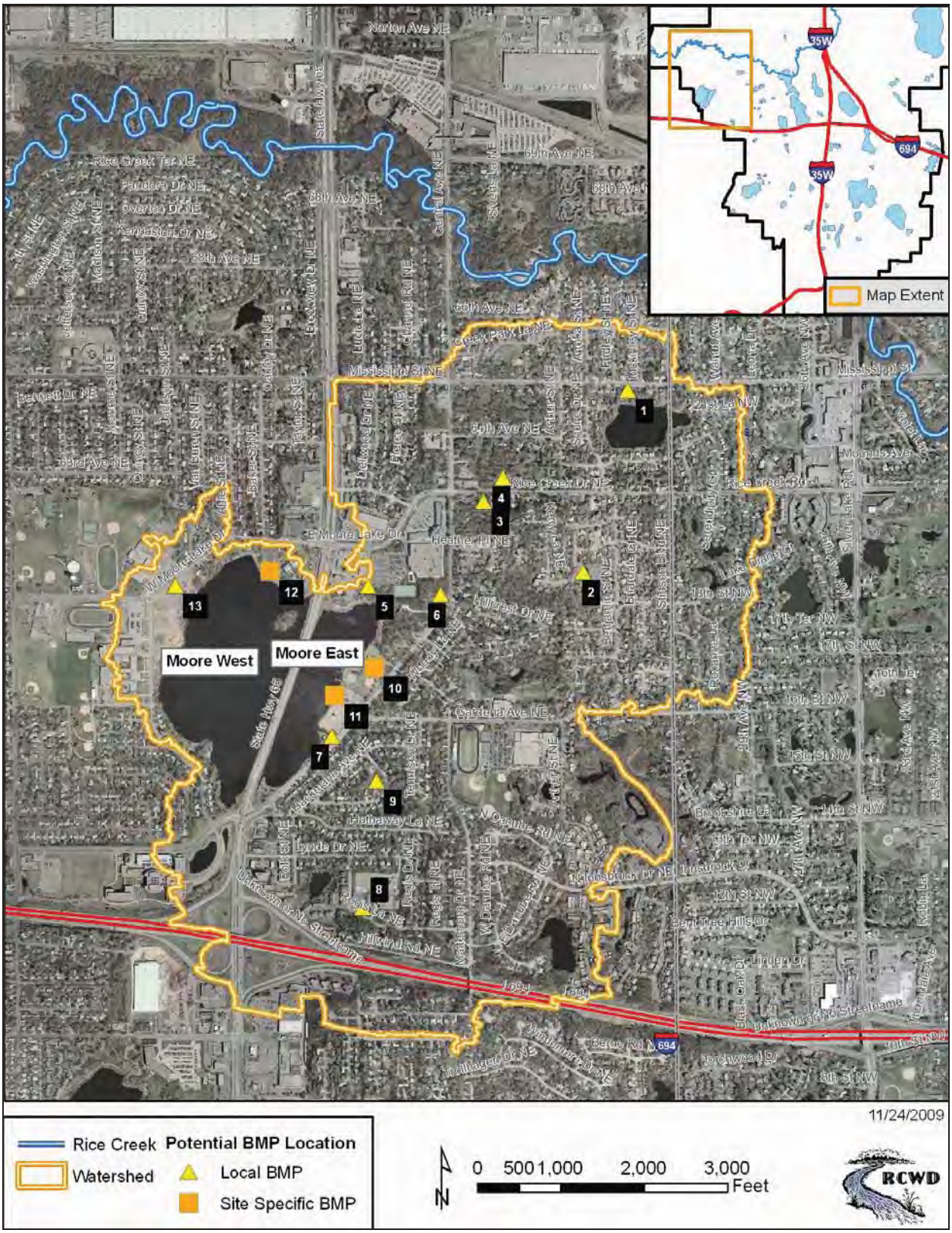


Figure 1. Moore Lake and Potential BMP Locations

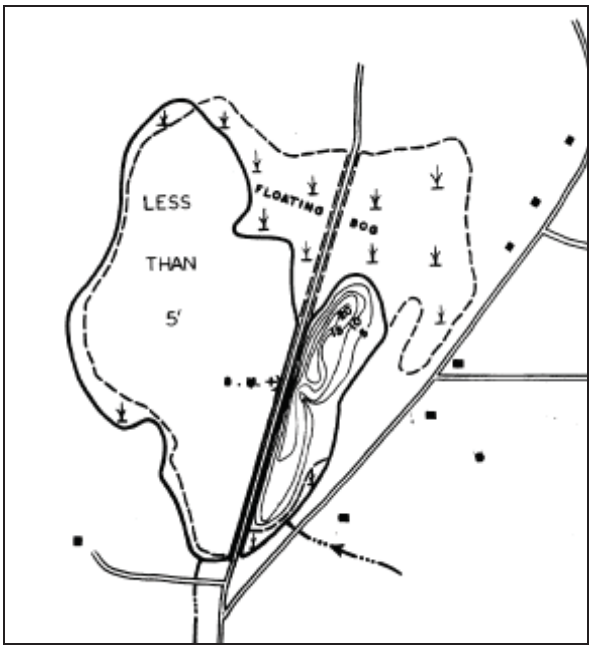


Figure 2. Moore Lake Bathymetry

Water Quality Summary

Water quality data for Moore Lake has been collected since the mid-1970s. Data were collected by the Anoka Conservation District, the MPCA, and the MPCA's Citizen Lake Monitoring Program. Table 1 summarizes the most recent 10 years of water quality information for the lake. Moore West appears to be meeting its standards for all three values, while Moore East is not meeting the standards for TP or chlorophyll-*a*.

Table 1. Average Water Quality Data (1998-2007) and Standards

Parameter	Moore East Lake	Lakes Standard
TP (µg/L)	44	40
Chl (µg/L)	18	14
Secchi Depth (m)	1.7	1.4

Parameter	Moore West Lake	Shallow Lakes Standard
TP (µg/L)	58	60
Chl (µg/L)	11	20
Secchi Depth (m)	1.3	1.0

Figures 3 through 5 show the growing season total phosphorus (TP), chlorophyll-*a*, and Secchi depth (clarity) data for the west basin of Moore Lake. The same series of data is shown in Figures 6 through 8 for the east basin. Recent trends show increasing chlorophyll concentrations in both basins.

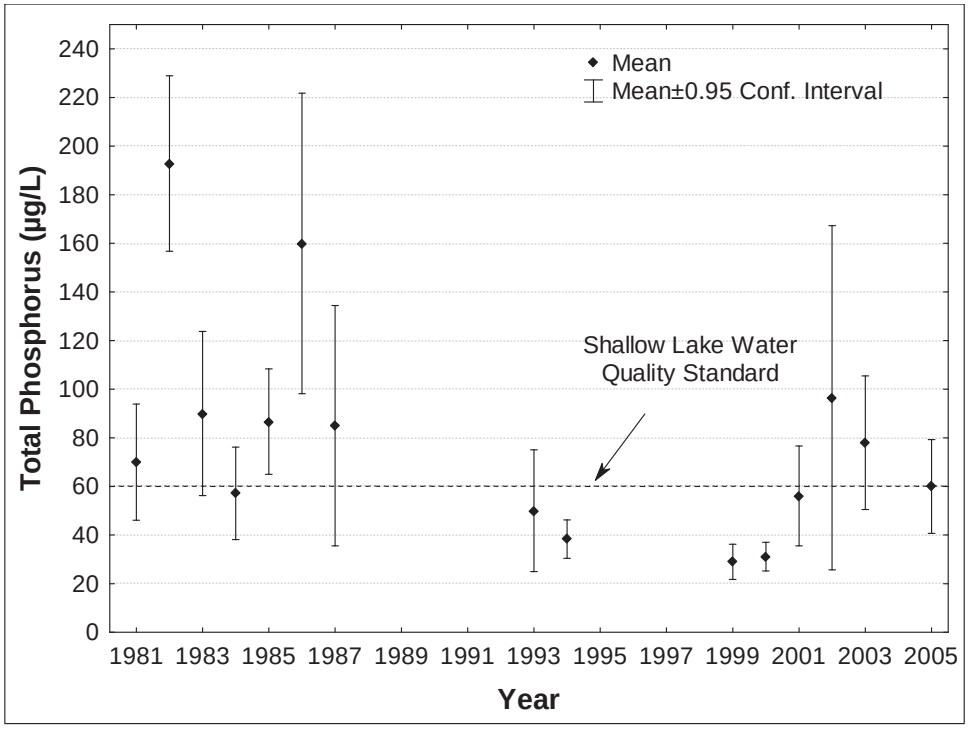


Figure 3. West Moore Lake Total Phosphorus

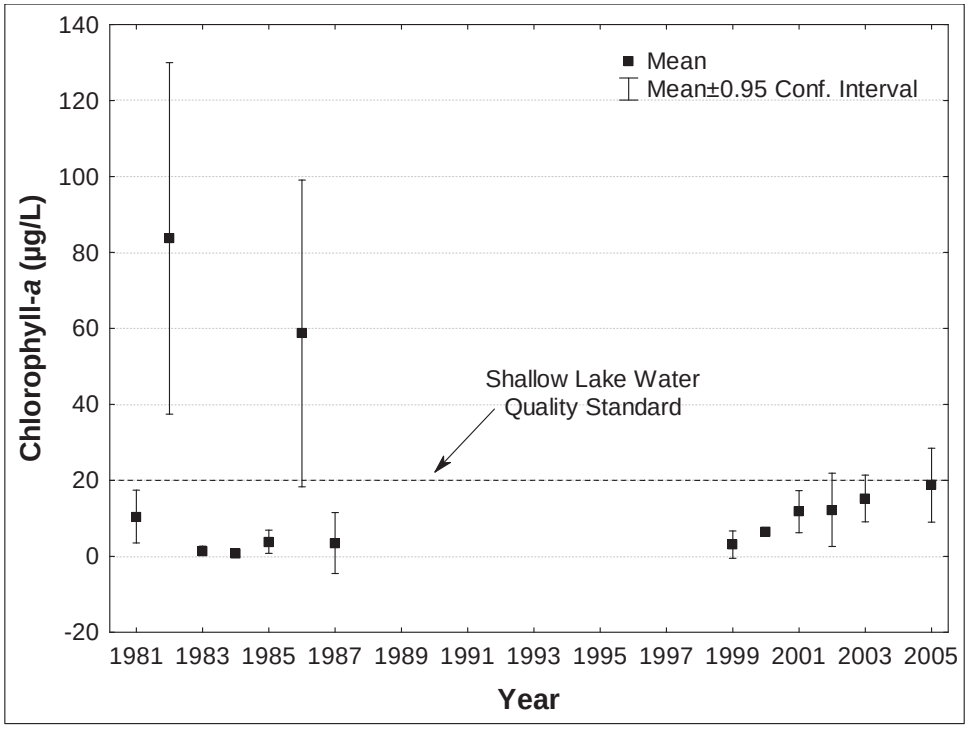


Figure 4. West Moore Lake Chlorophyll-*a*

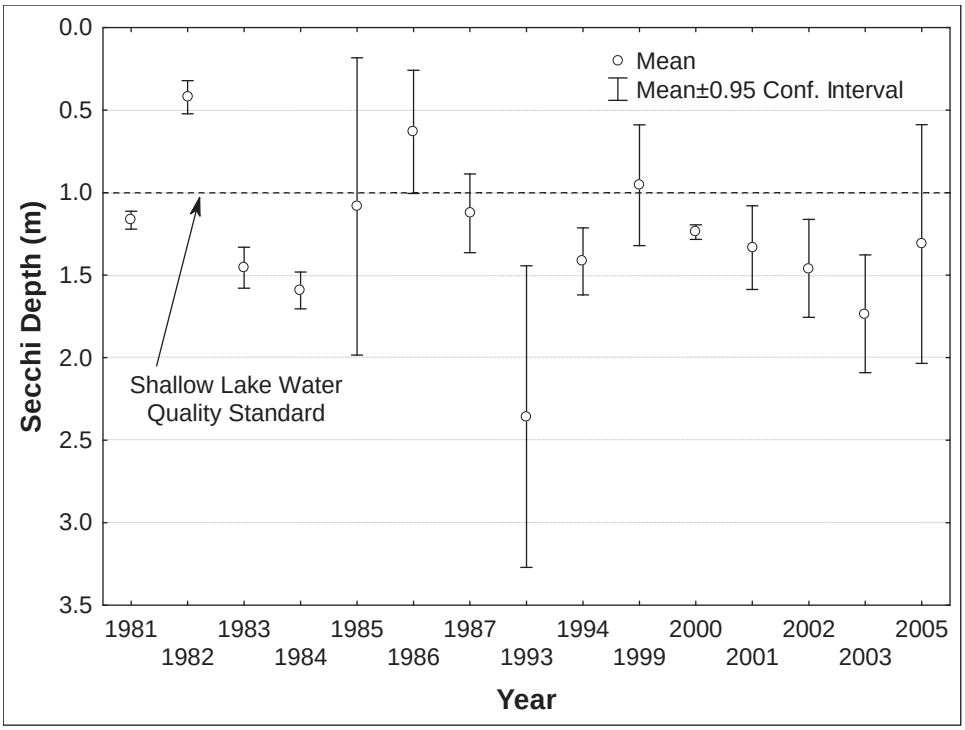


Figure 5. West Moore Lake Secchi Depth

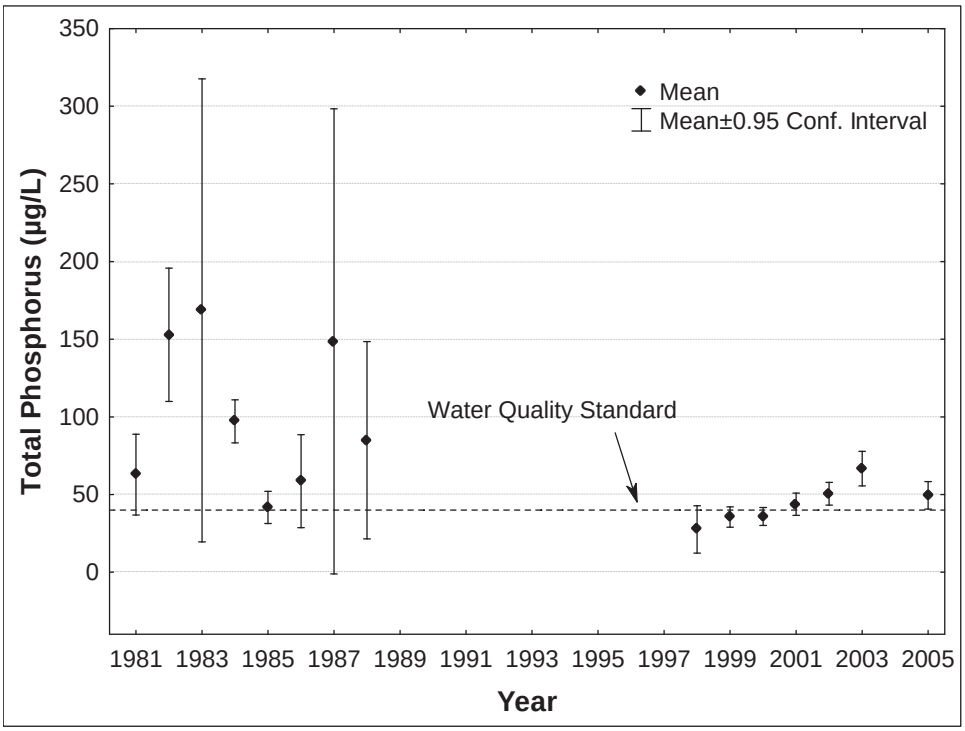


Figure 6. East Moore Lake Total Phosphorus

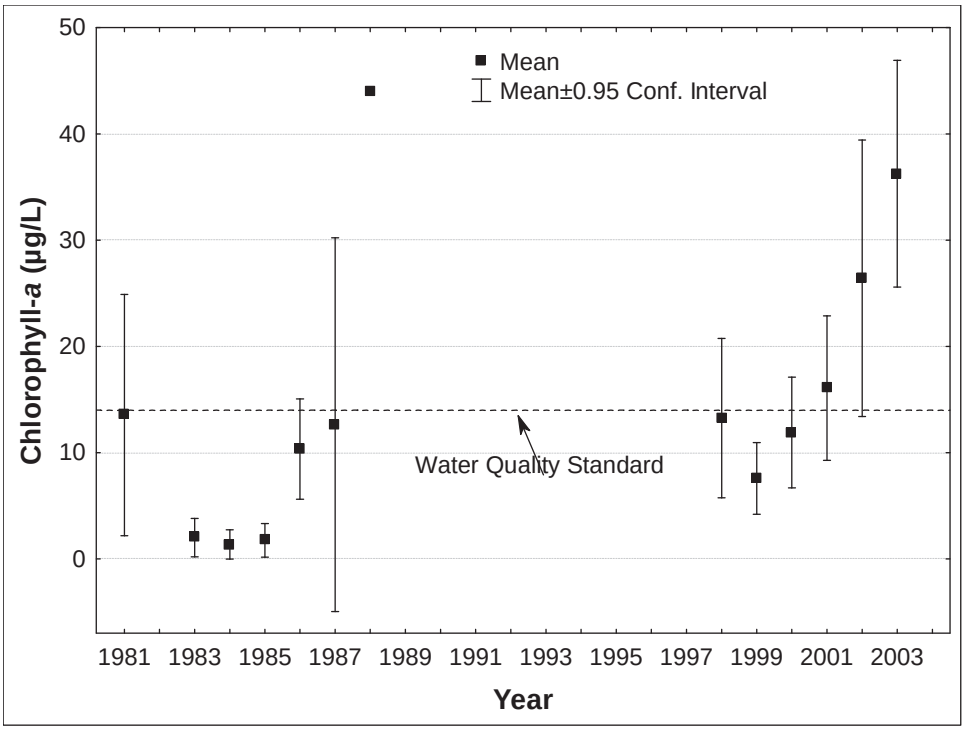


Figure 7. East Moore Lake Chlorophyll-*a*

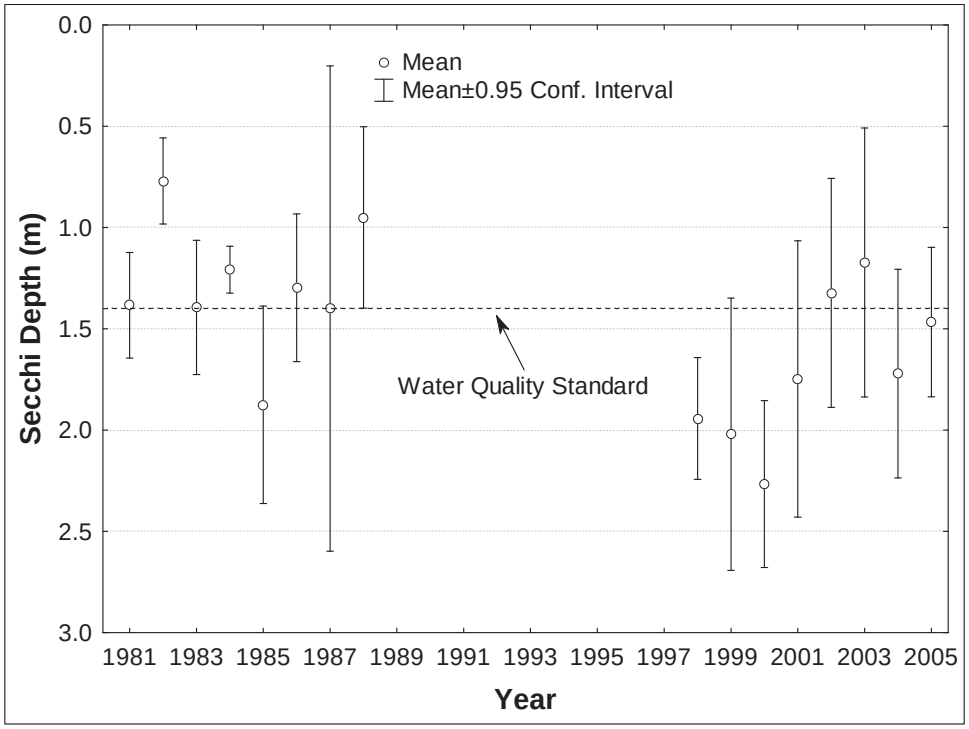


Figure 8. East Moore Lake Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to both basins of the lake, and an in-lake model (Bathtub) was used to predict the response of the basins to phosphorus loading. The lake model was calibrated to in-lake monitoring data.

Water quality modeling for West Moore Lake indicates watershed inputs account for 82% of the nutrient load, with internal loading accounting for the remaining 18% (Figure 9).

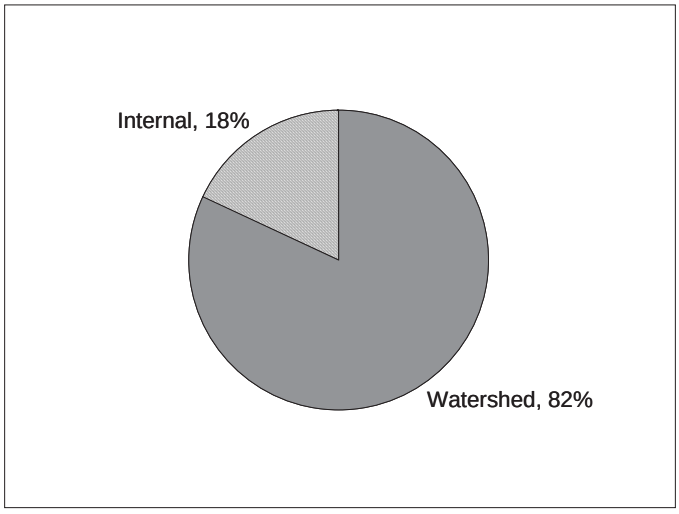


Figure 9. West Moore Lake Phosphorus Load Distribution

The modeling for East Moore Lake indicates that watershed inputs account for 84% of nutrient loading, with only 16% coming from internal loading (Figure 10). In order to achieve a water quality goal of 40 µg/L TP, phosphorus loads in East Moore Lake need to be reduced by 25%.

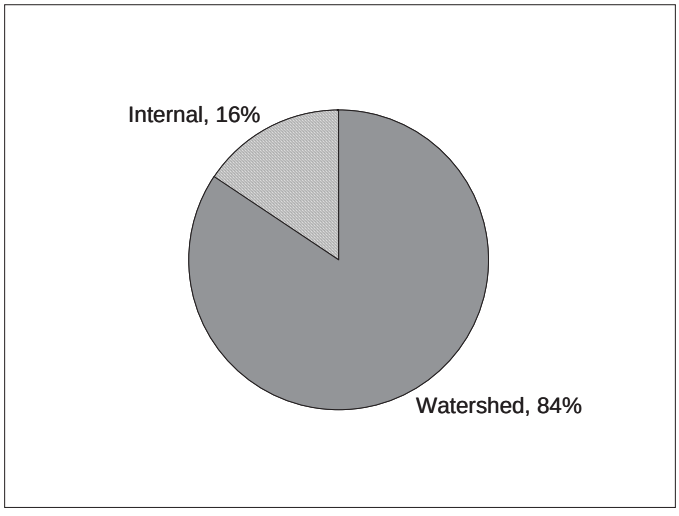


Figure 10. East Moore Lake Phosphorus Load Distribution

Public Input

At the public input meeting held on June 3, 2008, no attendees were present to comment on Moore Lake.

Water Quality Issues

- High densities of planktivorous centrarchids (panfish) can result in higher algal concentrations and/or shift algal species toward more noxious groups. Aeration to prevent winterkill and to reduce the anoxic release of sediment may agitate sediment and also keep non-target (rough) fish alive. These factors can have a large impact on internal phosphorus loading.
- Watershed phosphorus loads contribute to the high phosphorus concentrations observed in East Moore Lake.
- Waterfowl contribute to the high *E. Coli* in the lake.

Recommended Management Approach

Watershed Management Recommendations

Management of land in the watershed is a critical element in addressing the nutrient impairment. Because the Moore Lake watershed is nearly fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, twelve BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of the three potential local BMP locations identified in the *field reconnaissance supplement*.
- The City of Fridley manages the park near Moore Lake. BMPs could be implemented at the park to manage stormwater as well as serve as an example for homeowners within the watershed to institute positive changes. An example of a BMP would be conversion of the channel that drains to the lake through the south-central part of the park (Figure 11 & Field Recon Supplement BMP #7). This channel currently accommodates runoff with very little, if any, water quality treatment. Converting this to a water quality BMP, such as a bioretention swale, could yield some movement toward the 25% TP reduction needed for the lake to meet its goal.
- Identify possible retrofitting opportunities in some of the less effective detention ponds throughout the East Moore sub-watershed.
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.

Figure 11. Drainage Channel through Moore Lake Park

The Moore Lake watershed is almost 70% impervious surface. There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

The internal biology of Moore Lake needs to be better understood to identify the factors mediating the causal chain from nutrient input to algal blooms. After the storm drainage changes in the late 1980s, nutrient conditions improved but algal conditions did not (based on DNR records and narrative), most likely because they were mediated by other factors. Internal recycling of phosphorus and low densities of zooplankton are likely culprits.

- Attention to aeration policy is recommended to be able to balance the benefit to fisheries of preventing winterkills and reducing the anoxic release of phosphorus with the drawbacks of sediment disturbance and the absence of winterkill (winterkills can help water quality). More detailed biological information would make a more rigorous assessment of these processes possible. Evaluate long term impacts of winter aeration, particularly if it is linked to anoxic summer stratification. Work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

- Lake-shore development has decreased the spawning habitat for fish as well as removed buffers that reduce nutrient impacts. These changes increase eutrophication and reduce the value of the lake for fishing and swimming. Future management plans should clearly identify the target uses and coordinate efforts to improve water quality while addressing fishing concerns. Involving all the stakeholders is critical to success in this regard.

- Evaluate the benefits and costs (ecologically and economically) of the plastic lining relative to primary user objectives. In order to control non-native macrophytes, a plastic lining was installed in the 1980s in the eastern basin, but this lining is now degrading. The dominance of invasive macrophytes does not appear to have changed due to this management practice. A detailed evaluation of the relative merits of maintaining the lining should be studied and discussed publicly. Other, more natural methods of removing invasive macrophytes and encouraging native plant species ought to be discussed as well. Native macrophyte stands and buffer zones would act as refugia for zooplankton, which can help reduce algal production and increase water clarity.

- Increase buffers (particularly of native macrophytes) along the lakeshore. Waterfowl are targeted as contributing a large portion of the nutrient load and causing fecal coliform outbreaks. Managing waterfowl is notoriously difficult, but buffer zones seem to help greatly with this input as well.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Moore Lake. Since there is a long record of in-lake water quality data for Moore Lake, additional data collection is not a high priority at this time.

- TP, chlorophyll, and Secchi depth data: Collect at least five sampling dates per year. The TMDL can be based on the existing monitoring data; additional data should be collected after management actions are implemented to track the response of the lake.
- Macrophyte surveys: Complete macrophyte surveys after aquatic vegetation management practices are implemented, to monitor the success.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from fish surveys regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality. If a better understanding of internal loading is needed for an eventual TMDL, collection of these data will be a high priority.

- Fish survey: Complete a fish survey during the same year as the plankton survey to evaluate the fish species composition of the lake.
- The inlets (or a subset) to East Moore Lake should be monitored to provide flow and phosphorus loading estimates. These data will be needed in order to estimate the watershed phosphorus load to the lake for the TMDL study.
- Monitor dissolved oxygen profiles on East Moore Lake during winter and summer to evaluate effectiveness of the aerator. If the aerator is not effective at alleviating hypolimnetic anoxia during the summer, sediment-phosphorus release may be contributing to internal loading.
- Monitor TSS (with attention to volatile:non-volatile ratios) at the surface and at depth on East Moore to determine if the aerator is disturbing sediment.

Moore Lake Field Reconnaissance Supplement

Local Management BMPs

Moore 1
Location: South of Mississippi Street and west of Fridley Street
Description: Green space in Harris Lake Park
Potential Improvements: Incorporate raingardens to provide treatment of Mississippi Street.

Moore 2
Location: East of Rice Creek Drive and south of Briardale Road
Description: Green space in Briardale Park
Potential Improvements: Use open space for treatment of adjacent roadways.

Moore 3
Location: South of Rice Creek Road and east of Old Central Avenue
Description: Open wooded lot adjacent to Rice Creek Road.
Potential Improvements: Use to provide treatment for Rice Creek Road.

Moore 4
Location: North of Rice Creek Road and east of Old Central Avenue
Description: Wetland area adjacent to Rice Creek Road
Potential Improvements: Enhance and use for treatment of adjacent roadways.

Moore 5
Location: South of Moore Lake Drive and east of Highway 65
Description: Existing basin providing minimal treatment.
Potential Improvements: Enhance to provide additional water quality treatment.

Moore 6
Location: West of Old Central Avenue and south of Heather Place
Description: Large open space adjacent to Old Central Avenue
Potential Improvements: Use for treatment of adjacent roadways.

Moore 7
Location: West of Old Central Avenue and south of Gardena Avenue
Description: Stormsewer discharge through park into Moore Lake
Potential Improvements: Enhance area to provide additional treatment (note: current configuration of bridge could limit treatment capacity). If dissolved phosphorus is an issue a permeable limestone weir could potentially be considered as an option.

Moore 8
Location: East of Fillmore Street and north of Regis Lane
Description: Green space on school property
Potential Improvements: Use area for infiltration and/or ponding for adjacent roads and school parking lot.

Moore 9
Location: East of Hackman Avenue and west of Hackman Circle
Description: Open space within Hackman Park
Potential Improvements: Incorporate infiltration areas for treatment of Hackman Circle.

Site Specific Management BMPs

Moore 10
Location: West of Old Central Avenue and south of Gardena Lane
Description: Green space currently receiving runoff from the park parking lot.
Potential Improvements: Enhance area and convert to raingardens prior to discharge to Moore Lake.

Moore 11
Location: Moore Lake
Description: Looking west from park
Potential Improvements: Remove bituminous flume and incorporate treatment.

Moore 12
Location: South of Moore Lake Drive and west of Highway 65
Description: Treatment swale south of Saint Phillips Lutheran Church parking lot
Potential Improvements: Enhance vegetation and treatment storage prior to discharge to Moore Lake.

Moore 13

Location: Fridley Middle School and surrounding property

Description: Raingardens adjacent to Fridley Middle School parking lot and West Moore Lake Drive

Potential Improvements: Infiltrate stormwater from Fridley Middle school rooftop and parking lot, as well as West Moore Lake Drive. Would divert water that current is discharged to West Moore Lake without treatment

Pike Lake Management Action Plan

Pike Lake (62-0069) is located in the City of New Brighton, Ramsey County, Minnesota (Figure 1). The lake has a surface area of about 37 acres, a maximum depth of 16 feet[1] and is 91% littoral (Figure 2). Based on its high percentage of littoral habitat, it is considered a shallow lake according to MPCA's definition. Pike Lake is listed as an impaired lake on the EPA's 303(d) list of impaired water bodies. It is impaired for aquatic recreation due to high nutrients.

The watershed draining to Pike Lake is about 5,888 acres, extending all the way southward to Falcon Heights. The watershed to lake area ratio for Pike Lake is about 160:1. The watershed is fully developed; land use consists primarily of residential and industrial/utility. Interstate 694 is adjacent to the lake on the south side, and the Pike Lake watershed includes portions of Interstate 35E and Minnesota Highway 36. Pike Lake flows directly east into Long Lake, which is impaired for nutrients.

In the period from 1978 to 1990 the RCWD completed an in-depth study of the Long Lake Chain of Lakes. This federally and state funded study evaluated the entire Long Lake watershed, including Pike Lake, and implemented a channel stabilization project (Hansen Park Pond) on RCD2 in New Brighton south of the lake. A city project also increased the size of the detention pond on the south side of Pike Lake. Both of these projects likely reduce the amount of sediment reaching the lake from the watershed.

In an early August 1995 aquatic plant survey completed by the DNR, curly-leaf pondweed was identified in rare abundance. Other plants found were Canada waterweed, blue flag, and narrowleaf pondweed.

A 1995 DNR fisheries survey noted that occasional winter fish kills occurred in Pike Lake. The survey indicated that panfish (mostly black crappie and bluegill), carp, and bullhead were dominant. Some piscivores (perch, walleye, and northern pike) were present, but in small numbers; the piscivores likely migrated from Long Lake. Pike Lake has no public access and the DNR has not conducted a fish stocking program on the lake.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from the Rice Creek Watershed District website.

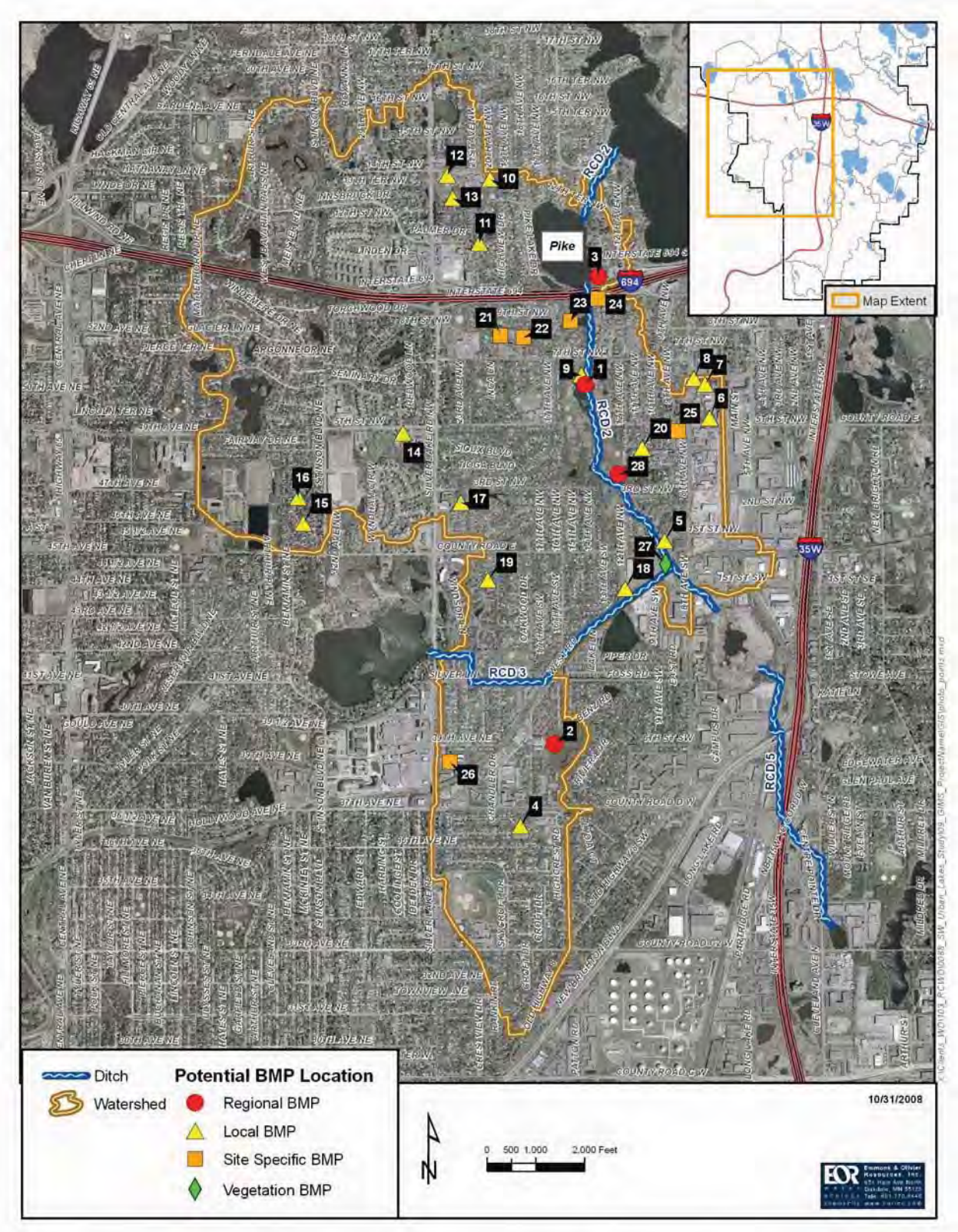


Figure 1. Pike Lake and Potential BMP Locations

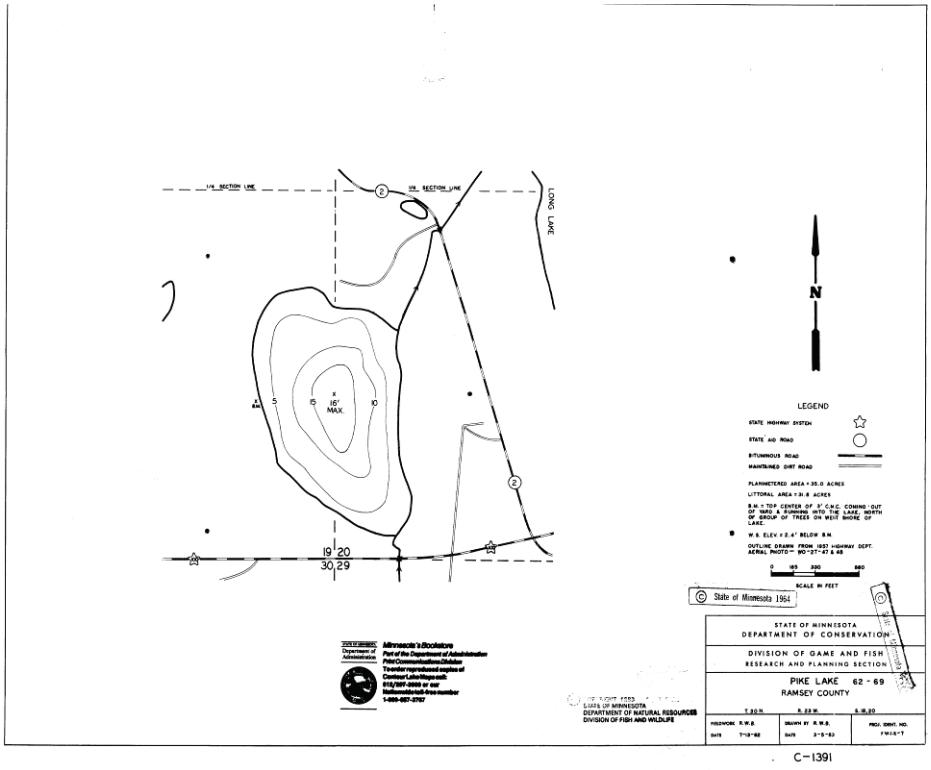


Figure 2. Pike Lake Bathymetry

Water Quality Summary

Data have been collected for Pike Lake water quality from 1980 to 2007. Data are collected by a volunteer through the Citizen Assisted Monitoring Program (CAMP). A summary of the 10 most recent years of water quality data for the lake suggest that Pike Lake is not meeting state water quality standards for any parameters (Table 1).

Table 1. Average Water Quality Data (1998 – 2007) and Standards

Parameter	Pike Lake	Shallow Lakes Standard
TP (µg/L)	91	60
Chl (µg/L)	53	20
Secchi Depth (m)	0.8	1.1

Figure 3-5 shows the growing season TP, chlorophyll-*a* and Secchi depth (clarity) data for the lake.

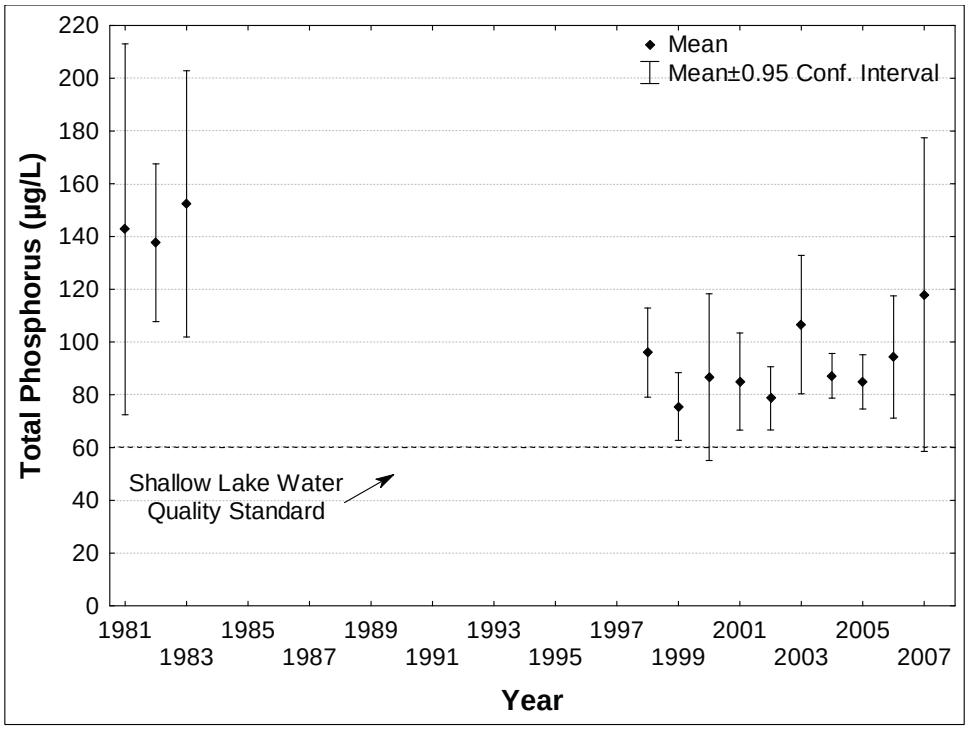


Figure 3. Pike Lake Total Phosphorus

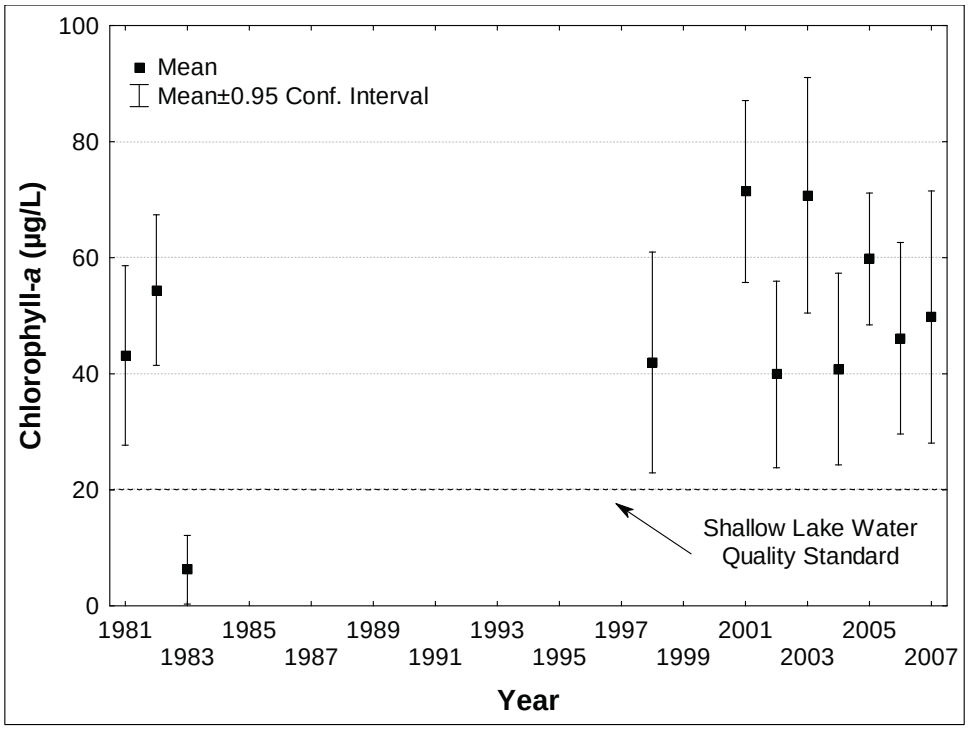


Figure 4. Pike Lake Chlorophyll-*a*

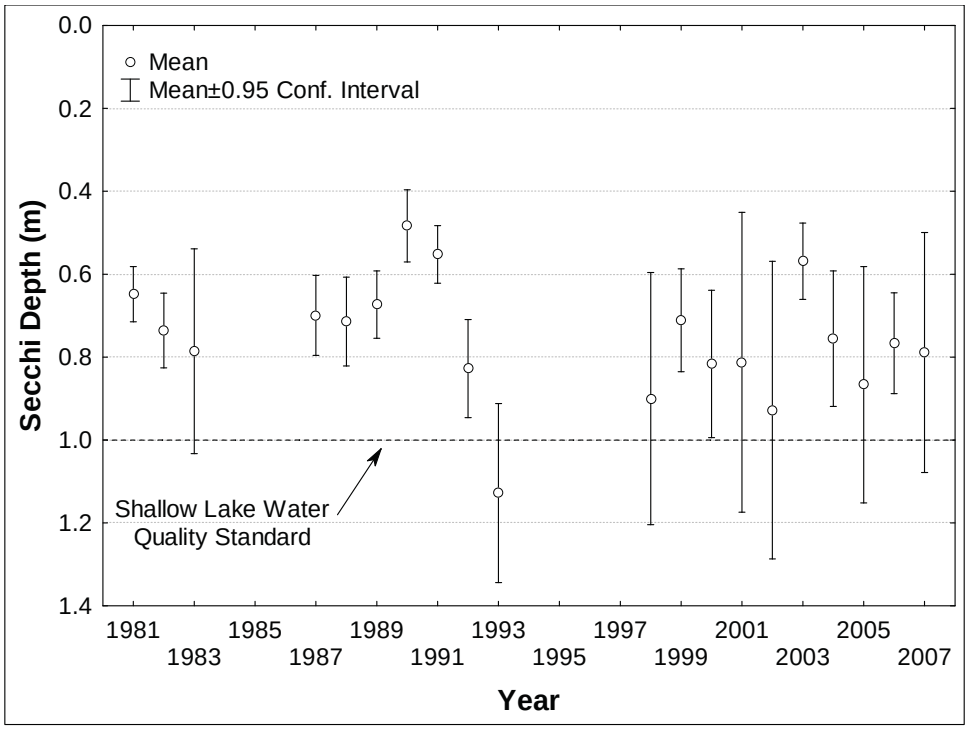


Figure 5. Pike Lake Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. The lake model was calibrated to in-lake monitoring data. Water quality modeling indicates that 82% of nutrient input to Pike Lake comes from its watershed, with the remaining 18% coming from internal lake loading (Figure 6). To reach the in-lake goal of 60 µg/L TP, the phosphorous load needs to be reduced by 43%.

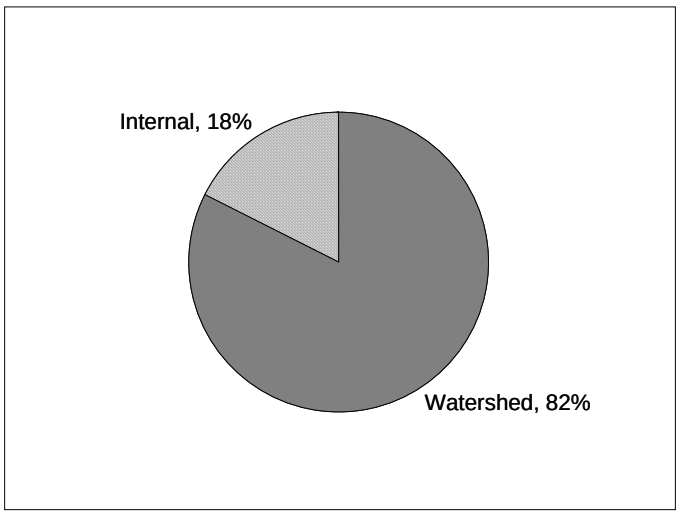


Figure 6. Pike Lake Phosphorus Load Distribution

Public Input

At the public input meeting on June 2, 2008, concerns regarding Pike Lake were addressed. Pike Lake has been impacted by its watershed as it developed. Long-time residents of the lake have remarked on its gradual slip in water quality as they watched the watershed develop.

- One attendee stated that she is still concerned about the runoff entering the lake from I-694 and the Venetian Village apartment complex south of the highway. She referenced a long list of objectionable debris and litter that move through the detention pond on the south end of the lake. She would like the RCWD to investigate measures to decrease this debris. She also requested a study of the effectiveness of the detention pond because she does not believe that it is effective in reducing any pollution. The pond is in place to treat runoff coming from I-694.
- The same attendee verified the deterioration in water quality since she has lived on the lake and mentioned that she no longer swims or fishes in the lake because of it. She asked for both a fish survey to see why the fish population is so bad and for a macrophyte survey to document why little vegetation of any kind is currently in the lake.
- The same attendee identified the need for more BMPs and for better management of those BMPs already in place. She has watched as BMPs were installed and subsequently forgotten. She hoped that more attention to BMPs might clear-up the pea-soup condition that dominates the lake during the growing season.
- She asked the RCWD to take charge and actually get something done, stating that nothing has really happened to improve the lake since she moved there in the 1970s; it continues to degrade. The resident told her story of repeated passing of the buck for responsibility for Pike Lake with none of the agencies she has contacted ever taking charge. Her requests to the city have not been followed through on behalf of the city, leading again to her frustration in trying to find an agency responsible for the lake. She reiterated several times that the lake owners are willing to do their part, but they need agency action to lead the way.
- A common theme expressed by lake residents at the public meeting dealt with government cooperation. All residents felt that state and local government entities needed to improve cooperation related to water quality monitoring, BMP maintenance, and improvement projects.

Water Quality Issues

- Pike Lake is the first lake downstream of Ramsey County Ditch 3, which would appear to be a source of high nutrient concentrations (photo below).
- Pike Lake is directly adjacent to Interstate-694 and likely receives highway runoff.
- DNR surveys and resident comments suggest a lack of aquatic vegetation in the lake. This could indicate that the lake is currently in the turbid, algal-dominated phase common in shallow lakes.
- Curly-leaf pondweed was found in the lake at a rare abundance in an early August 1995 aquatic plant survey. Since curly-leaf pondweed usually dies back after June, its presence in August could indicate that it is abundant earlier in the growing season. Curly-leaf pondweed can contribute to internal loading.
- The fish community in 1995 was composed mainly of bullhead, carp, crappie, and bluegill, with low densities of piscivorous fish. If the fish community composition is

similar today, this prevalence of rough fish and planktivorous fish could lead to high rates of internal loading due to disturbance of the lake bottom sediments and overgrazing of zooplankton.

Recommended Management Approach

Watershed Management Recommendations

Management of land in the watershed is a critical element in addressing the nutrient impairment. Because the Pike Lake watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, 28 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Feasibility and Benefit Level Assessment of the four potential regional BMP locations identified in the *field reconnaissance supplement*.
- Consideration of local partnerships for further assessment of potential local BMP locations identified in the *field reconnaissance supplement.*
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- Perform an evaluation of the effectiveness of the I-694 detention pond to make sure it is as effective as it was designed to be. There are also now available on the market sewer and catch basin inserts that effectively remove debris and litter from stormwater. This kind of device should be installed on all of the runoff inlets coming from the Venetian Village apartment complex.

- The original project on RCD2 (Hansen Park Pond) should be inspected by the RCWD and City of New Brighton to see if any repairs or upgrades are needed at this time. This facility (wetland enhancement) drains a very large watershed and should be removing a lot of the suspended material that otherwise makes its way to Pike Lake. Some additional retrofitted storage could be available at this facility. Additionally, RCWD staff has observed high carp densities in the pond. Re-suspension of fine sediment associated with carp feeding behavior may be limiting the pond's effectiveness. Work with DNR to develop a carp management strategy for the pond.
- The New Brighton 2000 Surface Water Management Plan mapped the areas of the city that are not treated with any runoff BMPs. The largest amount of this acreage occurs directly adjacent to Pike Lake, entering the lake from direct runoff, and in small parcels scattered throughout the city. The date on the map is 1999, so some efforts to treat this previously untreated area could have occurred since then. Work with New Brighton to update the map, and use this map to help target areas that do not currently treat stormwater runoff.
- The City of New Brighton has a street sweeping priority system that has as highest priority the sweeping of streets that directly discharge to major water bodies, which includes some streets around Pike Lake and RCD2. Work with New Brighton to continue this program and encourage additional street sweeping in the area.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management.
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs.
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control.

Internal Lake Management Recommendations

With very little in-lake biological data for Pike Lake, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply to Pike Lake:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.

- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.
- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep algae populations in check. Despite the high densities of panfish, their size structure was more balanced than other lakes in the area; 46% of crappie and 27% of bluegill were larger than 6 inches. Work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Pike Lake. Since there is a long record of in-lake water quality data for Pike Lake, additional data collection is not a high priority at this time.

- TP, chlorophyll, and Secchi depth data: Collect at least five sampling dates per year. The TMDL can be based on the existing monitoring data; additional data should be collected after management actions are implemented to track the response of the lake. Continued support of the CAMP program should ensure sufficient water quality data collection in the future.
- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Fish survey: Complete a fish survey to evaluate the fish species composition of the lake.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.
- Ramsey County Ditch 2 should be monitored close to the inlet to Pike Lake to provide flow and phosphorus loading estimates. These data will be needed in order to estimate the watershed phosphorus load to the lake for the TMDL study.
- Water quality monitoring of discharge from Ramsey County Ditch 3.

Pike Lake Field Reconnaissance Supplement

Regional Management BMPs

Pike Lake #1
Location: Hanson Park
Description: Large wetland/pond treatment area previously enhanced by RCWD
Potential Improvements: An assessment of the current storage capacity versus the original design and the need for maintenance/excavation of accumulated material could be done. Other vegetation enhancements or management strategies could also be evaluated. Carp management/eradication options for small ponds should be reviewed.

Pike Lake #2
Location: North of County Road D and east of Oakwood Drive
Description: Mirror Pond – the water was very green the day of the site visit. This could potentially be a contributing source of the poor water quality at the outlet of RCD 3.
Potential Improvements: Assessment of Mirror Pond should be done. Options could be to chemically treat the outlet or seal sediments to reduce downstream loading.

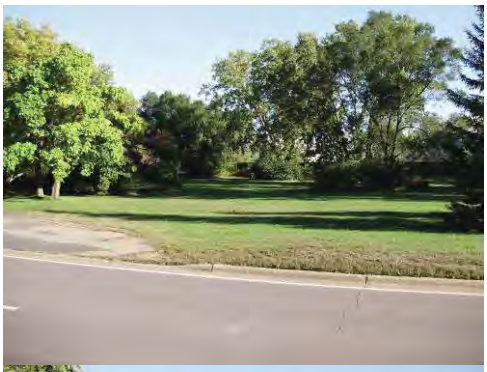
Pike Lake #3
Location: Immediately southeast of Pike Lake
Description: Fenced-in play area on wooded lot.
Potential Improvements: This area could potentially be used as a regional treatment facility.

Local Management BMPs

Pike Lake #4
Location: North of Wendhurst Ave and east of Chelmsford Road
Description: Open grass area next to recently repaved church parking lot
Potential Improvements: Raingarden/water quality BMPs could be installed for runoff from the church parking area or adjacent road. The sloped nature of the area would limit the opportunities to utilize the space.

Pike Lake #5
Location: South of 1st Street and west of Old Highway 8
Description: Large grass area on corner.
Potential Improvements: This site could be used for infiltration or ponding for runoff from adjacent road ways.

Pike Lake #6
Location: North of 5th Street and east of 8th Avenue
Description: Open grass area at New Brighton Public works building.
Potential Improvements: Raingarden/water quality BMPs could be installed for runoff from adjacent roads/buildings.



Pike Lake #7
Location: East of 8th Avenue and north of 6th Street
Description: Large open areas
Potential Improvements: Install ponding or infiltration areas for runoff from adjacent roads

Pike Lake #8
Location: East of 8th Avenue and north of 6th Street
Description: Large open areas.
Potential Improvements: Install ponding or infiltration areas for runoff from adjacent roads.

Pike Lake #9
Location: South of 7th Street and east of 17th Avenue
Description: Open grass area (current use is unclear).
Potential Improvements: Pick up pipe inlet from southwest and provide additional treatment prior to discharge to the regional pond. This area could also be used to treat 7th Street runoff.

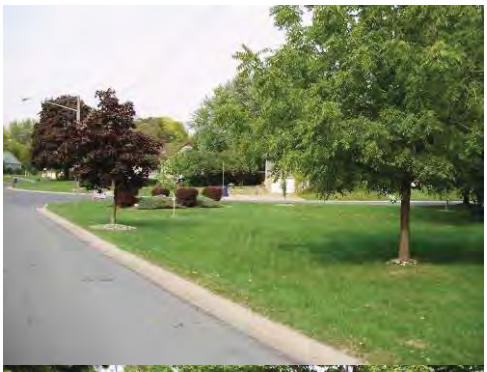
Pike Lake #10
Location: South of 14th Street and west of 20th Avenue
Description: Open grass area on school grounds.
Potential Improvements: Utilize this area to treat school runoff or adjacent roads.

Pike Lake #11
Location: Northwest of intersection of Robin Lane and 12th Street
Description: Dry ponding area along with additional swales/green space onsite.
Potential Improvements: Incorporate water quality treatment prior to discharge (e.g. infiltration and/or ponding).

Pike Lake #12
Location: South of 14th Street and east of Silver Lake Road
Description: Greenspace on school property behind baseball field.
Potential Improvements: Use this area to treat runoff from school or adjacent streets.

Pike Lake #13
Location: West of the intersection of Robin Lane and 13th Street
Description: Large dry pond.
Potential Improvements: Retrofit this site to include water quality treatment and infiltration.

Pike Lake #14
Location: South of the intersection of 5th Street and Driftwood Road
Description: Large open green space.
Potential Improvements: Incorporate a large infiltration area for adjacent road runoff (area is likely already treated by water quality ponds).



Pike Lake #15
Location: East of Heights Drive and south of Maiden Lane
Description: Open green space.
Potential Improvements: Utilize to treat runoff from the adjacent roadway.

Pike Lake #16
Location: East of the intersection of Heights Drive and Golf Place
Description: Open green space.
Potential Improvements: Utilize to treat runoff from the adjacent roadway.

Pike Lake #17
Location: South of 3rd Street and west of 23rd Avenue
Description: Wooded lot
Potential Improvements: Utilize to treat runoff from the adjacent roadways or impervious areas from the south and west (note: the lot has significant grade change from south to north).

Pike Lake #18
Location: South of 1st Street and east of 13th Avenue
Description: Large unused green space.
Potential Improvements: Possibly use the area to treat runoff from the adjacent neighborhood to the west.

Pike Lake #19
Location: South of Windsor Way and west of 20th Avenue
Description: Large grass area at Winsor Park (private common area)
Potential Improvements: Incorporate a large infiltration/filtration feature for treatment of runoff from adjacent roadways.

Pike Lake #20
Location: 11th Avenue looking north from 4th Street
Description: A general example of a neighborhood that would be easy to retrofit raingardens into.
Potential Improvements: Incorporate raingardens throughout the area during road reconstruction projects.

Site Specific Management BMPs

Pike Lake #21
Location: North of 7th Street and east of 22nd Avenue
Description: Existing ponding area on church site.
Potential Improvements: Clean out and expand the pond for additional treatment.

Pike Lake #22
Location: North of 7th Street and west of Oakwood Drive
Description: Grass swale on church site.
Potential Improvements: Retrofit the swale to an infiltration area treating runoff from the adjacent drive.

Pike Lake #23
Location: North of 7th Street and east of Patton Road
Description: Ramsey County Ditch #2 and offline pond (in the background), parking lot flumes straight to ditch (in the foreground). The adjacent Venetian Village apartment complex and parking drains directly to RCD-2 and receives no treatment prior to reaching Pike Lake
Potential Improvements: Assess options that would, at a minimum, remove debris before entering the ditch.

Pike Lake #24
Location: South of 694 and east of Patton Road
Description: Swale adjacent to apartment drive with exposed soils.
Potential Improvements: Improve/enhance the swale to provide treatment for runoff from the adjacent drive.

Pike Lake #25
Location: West of 8th Avenue and south of 5th Street
Description: Roof drainage directed to parking area @ J & B Auto Repair
Potential Improvements: Green space could easily be converted into a raingarden area that could treat the roof top and possibly some of the parking area.

Pike Lake #26
Location: West of Macalaster Drive and south of 39th Avenue
Description: Open green space areas around apartment complex.
Potential Improvements: This location along with other areas onsite could be converted to raingarden areas for treatment of the adjacent apartments and associated parking.

Vegetation Management/Stabilization BMPs

Pike Lake #27
Location: West of Old Highway 8 and south of 1st Street
Description: Confluence of Ramsey County Ditch #2 and Ramsey County Ditch #3
Potential Improvements: Bank Stabilization is needed at the outlet of Ramsey County Ditch #3.

Additional Regional BMP suggested by New Brighton

Pike Lake #28
Location: West of 3rd Terrace NW
Description: Future treatment area suggested by City of New Brighton, existing open space area in Hansen Park
Potential Improvements: Excavation of large, shallow biofiltration feature potentially receiving runoff from redirected stormsewer outfalls currently discharging directly to Ramsey County Ditch 2 from 3rd and 4th Streets NW.

Poplar Lake Management Action Plan

Poplar Lake (62-0077) is located in the City of New Brighton, Ramsey County, Minnesota (Figure 1). The lake has a surface area of 13 acres and a maximum depth of 5 feet[1] (Figure 2). Based on its low maximum depth, it is considered a shallow lake according to MPCA's definition. Poplar lake watershed is approximately 108 acres and is tributary to Jones Lake, Pike Lake, and Long Lake, which are all on the EPA's 303(d) list of impaired waters.

The area immediately surrounding the lake is a mobile home park on the west and south sides, with railroad tracks on the north and a commercial facility on the northeast. The rest of the watershed area, predominantly to the south, is single family residential.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from DNR files.

Figure 1. Poplar Lake and Potential BMP Locations

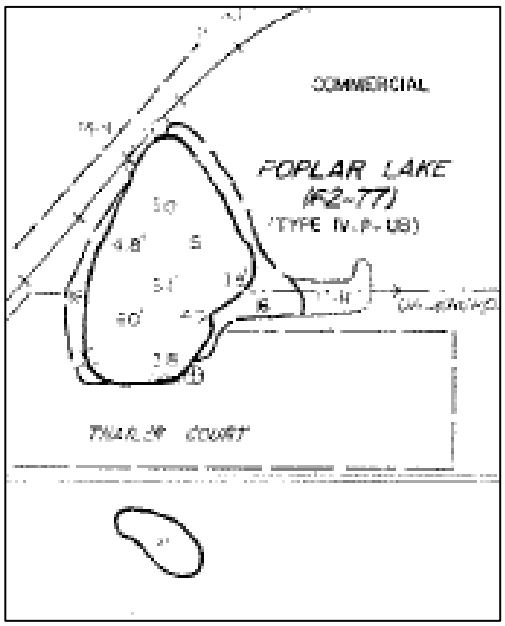


Figure 2. Poplar Lake Bathymetry. Map from DNR files, unknown date.

Water Quality Summary

Water quality and biological data are not available for Poplar Lake. A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. There are no in-lake monitoring data to calibrate the lake model. Water quality modeling indicates that watershed inputs account for approximately 88% of the nutrient load, with internal loading accounting for the remaining 12% (Figure 3).

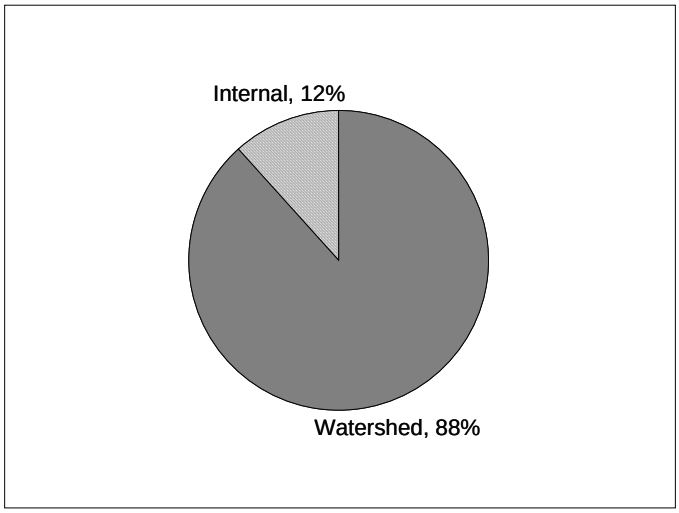


Figure 3. Poplar Lake Phosphorus Load Distribution

Public Input

At the public input meeting held on June 2, 2008, no attendees were present to discuss Poplar Lake. In a phone conversation, a representative of Lakeside Homes, Inc., the mobile home park, mentioned there is a well/pump appropriating water from the lake for the industrial area on the northeast side of the lake. He wondered if the appropriations were related to the low water levels observed in the lake that year (2007).

Water Quality Issues

- Without further data or public input, water quality issues were not able to be defined.

Recommended Management Approach

Watershed Management Recommendations

Management of land in the watershed is a critical element in addressing the water quality of Poplar Lake. Because the Poplar Lake watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, 4 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Feasibility and Benefit Level Assessment of the potential regional BMP location identified in the *field reconnaissance supplement*.
- Consideration of local partnerships for further assessment of potential local BMP locations identified in the *field reconnaissance supplement*.
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- Re-establishing a vegetated buffer strip around the lakeshore would help stabilize the shoreline and prevent erosion and sediment wash-off.
- The existing BMPs on the south side of the lake and in the southern part of the watershed should be evaluated as to their effectiveness in reducing nutrient inflow to the lake.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management

- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

With no in-lake biological data for Poplar Lake, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply to Poplar Lake:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.
- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake. If cooperation is possible, work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Poplar Lake. There are no in-lake water quality data for the lake; if the implementation of management practices for the lake were to move forward, in-lake data and bathymetric data would be needed and should be considered a high priority

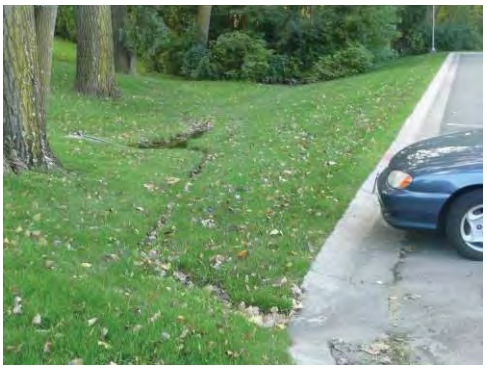
- Updated bathymetric data collection
- TP, chlorophyll, and Secchi depth data: Collect data for several years, with at least five sampling dates per year.
- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Fish survey: Complete a fish survey to evaluate the fish species composition of the lake.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.

Poplar Lake Field Reconnaissance Supplement

Regional Management BMPs

Poplar Lake #1
Location: South of Foss Road and west of Imperial Lane
Description: Large ponding area receiving runoff from neighborhoods to the south. Pond was pea-soup green the day of the photo.
Potential Improvements: Assess the effectiveness and perform maintenance or other improvements as needed to ensure that the pond is providing the treatment needed before discharging to Poplar Lake.

Local Management BMPs



Poplar Lake #2
Location: Near parking area north of Mooney Drive and just east of Poplar Lake
Description: Curb cut from parking area and an additional piped discharge enter a grassed swale that then flows through a small patch of woods before reaching Poplar Lake.
Potential Improvements: A raingarden could be incorporated in the available green space. Removal of some trees would allow for a larger feature. Appropriate sizing would be dependent on a determination of the drainage area from the piped discharge.

Poplar Lake #3
Location: Intersection of Champion Drive and West Road
Description: Stormsewer discharge into swale area flows into wooded swale and eventually discharges at the northwest corner of Poplar Lake.
Possible Improvements: Swale could easily be expanded into a treatment feature providing storage or infiltration as needed.

Site Specific Management BMPs

Poplar Lake #4
Location: Trend Enterprises west of 9th Avenue SW
Description: Site has swales and low areas currently collecting stormwater.
Possible Improvements: Some fairly simple retrofits and vegetation enhancements onsite may provide water quality/quantity benefits for Poplar Lake.

Round Lake Management Action Plan

Round Lake (62-0070) is located in the City of Arden Hills, Ramsey County, Minnesota (Figure 1). The lake has a surface area of 130 acres, a maximum depth of 7 feet and is 100% littoral[1]. Based on its low maximum depth, it is considered a shallow lake according to MPCA's definition. The watershed draining into Round Lake is 465 acres.

Round Lake is located within a transportation triangle bounded by Highway 10 to the east and north, I-35W to the west, and I-694 to the south. It has some homes located along its shoreline and in the watershed to the north, and commercial uses to the west. It also drains the southwest corner of the Twin Cities Army Ammunition Plant (TCAAP), which is under consideration for re-development by the City of Arden Hills.

Round Lake drains southeast into the Valentine Lake sub-watershed, which eventually drains to Long Lake. Both Long Lake and Valentine Lake are on the EPA's 303(d) list of impaired waters, due to excessive nutrients.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from the Rice Creek Watershed District website.

Figure 1. Round Lake and Potential BMP Locations

Water Quality Summary

Water quality and biological data are not available for Round Lake within the past 10 years. MPCA collected water quality data between 1985 and 1992. The mean TP concentration over that time period was 49 µg/L.

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. Water quality modeling indicates that watershed inputs account for approximately 70% of the nutrient load, with internal loading accounting for the remaining 30% (Figure 2). The model suggests that the in-lake goal of 60 µg/L TP is being met. Without current in-lake nutrient data for the lake for model calibration, the modeling results should be considered preliminary.

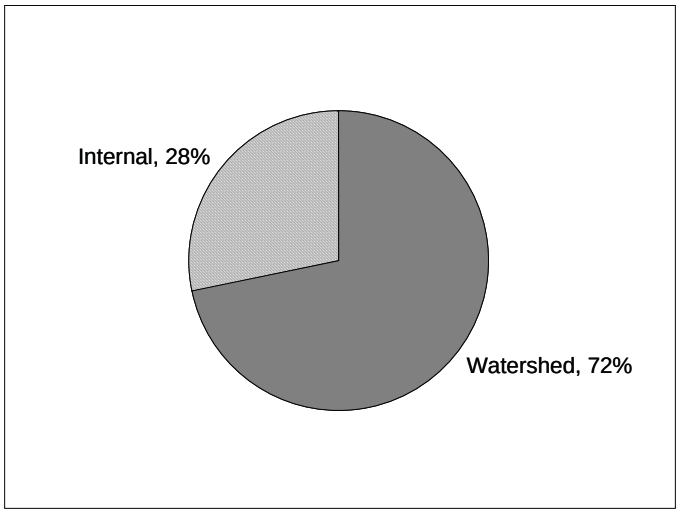


Figure 2. Round Lake Phosphorus Load Distribution

Public Input

At the public input meeting on June 3, 2008 issues facing Round Lake were addressed.

- Round Lake has received toxic material input from past industrial land use in its watershed related to the production of ammunition. It was stated that the U.S. Army still controls the lake surface and that use of the surface for any recreation is not allowed because of the potential to disturb bottom sediments and re-introduce settled contaminants. This was not verified with the US Army.
- A City of Arden Hills employee spoke about the purchase of TCAAP land by the city. Arden Hills is in the process of acquiring over 500 acres from the western part of TCAAP. A portion of this property drains into Round Lake.

Water Quality Issues

- Sediment within the lake may be contaminated with toxic substances due to past land use.
- The purchase of TCAAP land by the City of Arden Hills may lead to increased development in the watershed.

Recommended Management Approach

Watershed Management Recommendations

The primary management recommendation for the lake's watershed is to make sure strict application of RCWD and local runoff related regulations are followed throughout the watershed draining to the lake, especially during the future re-development of the TCAAP site. RCWD and the city should also look for BMP retrofit opportunities as they review other re-development and transportation projects within the watershed. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, three BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of the potential local BMP location identified in the *field reconnaissance supplement*.
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

Any assessment of internal management control should include the consideration of possible re-suspension of toxic contamination from the sediment. With no in-lake biological data for Round Lake, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply to Round Lake:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are

determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.

- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep algae populations in check. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake. If cooperation is possible, work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Round Lake. There are no in-lake water quality data for the lake; if the implementation of management practices for the lake were to move forward, in-lake data and bathymetric data would be needed and should be considered a high priority.

- Sediment analysis: If in-lake management practices are implemented, further study of the lake sediments should be completed to determine the extent of the contamination and the possibilities of containing the contamination so as not to release it or transport it downstream. This work would be done in cooperation with state agencies, such as the MPCA and MN Department of Health.
- Bathymetric data collection
- TP, chlorophyll, and Secchi depth data: Collect data for several years, with at least five sampling dates per year.
- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Fish survey: Complete a fish survey to evaluate the fish species composition of the lake.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.

Round Lake Field Reconnaissance Supplement

Local Management BMPs

Round 1
Location: North of County Road 96 and west of Highway 10
Description: Cul-de-sac at the south end of the Highway 10 service road. Southern end of road (and cul-de-sac) does not appear to serve any homes or businesses.
Possible Improvements: Shorten roadway and remove or relocate cul-de-sac. Use current cul-de-sac area for treatment of Highway 10.

Site Specific Management BMPs

Round 2
Location: South of County Road 96 and west of Snelling Avenue
Description: Open space adjacent to church parking lot.
Possible Improvements: Incorporate raingardens (likely filtration) to treat sheet flow runoff from the northern North Heights Lutheran Church parking lot.

Round 3
Location: East of Round Lake Road and north of Gateway Court
Description: Green space east of parking lot
Possible Improvements: Incorporate raingarden to treat adjacent parking lot.

Rush Lake Management Action Plan

Rush Lake (62-0068) is located in the City of New Brighton, Ramsey County, Minnesota (Figure 1). The surface area of the lake is about 55 acres, with a maximum depth estimated at 6 feet[1]. Based on its low estimated maximum depth, it is considered a shallow lake according to MPCA's definition. Rush Lake drains to the north, eventually into Rice Creek.

The watershed draining to Rush Lake is approximately 277 acres and includes Long Lake Regional Park and surrounding commercial/residential land. A portion of the drainage area contains the Northwest Quadrant re-development project in New Brighton. This effort involves the re-development of underutilized land into a mixed-used neighborhood with retail, residential, office, and parkland uses. The project also addresses some long-standing contamination problems from a previous dump site.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos. No bathymetric data were available for this lake. The maximum depth was estimated using depth data collected during sediment sampling.

Figure 1. Rush Lake and Potential BMP Location

Water Quality Summary

Water quality and biological data are not available for Rush Lake. A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. There are no in-lake monitoring data to calibrate the lake model. Water quality modeling indicates that watershed inputs account for approximately 55% of the nutrient load, with internal loading accounting for the remaining 45% (Figure 2). Without any in-lake nutrient data for the lake for model calibration, the modeling results should be considered preliminary.

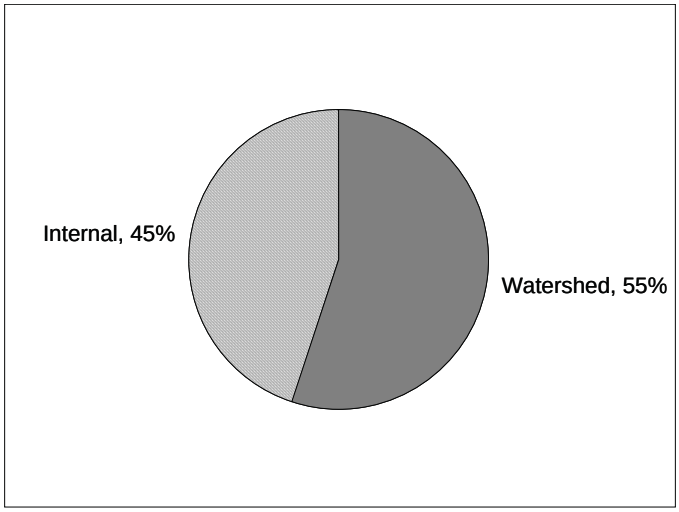


Figure 2. Rush Lake Phosphorus Load Distribution

Public Input

At a public meeting held on June 3, 2008 by the RCWD, an attendee offered his opinion that the former stockyards surrounding Rush Lake likely contributed a large amount of nutrient-laden runoff that probably still resides in the lake sediments.

Water Quality Issues

- Without further data or public input, water quality issues were not able to be defined.

Recommended Management Approach

Watershed Management Recommendations

The primary management recommendation for the lake's watershed is to make sure strict application of RCWD and local runoff related regulations are followed throughout the watershed draining to the lake, especially during the future re-development of the TCAAP site. RCWD and the city should also look for BMP retrofit opportunities as they review other re-development and transportation projects within the watershed. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, four BMP retrofit

opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of the four potential local BMP locations identified in the *field reconnaissance supplement.*

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

With no in-lake biological data for Rush Lake, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply to Rush Lake:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.
- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake. If cooperation is possible, work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Rush Lake. There are no in-lake water quality data for the lake; if the implementation of management practices for the lake were to move forward, in-lake data and bathymetric data would be needed and should be considered a high priority.

- Bathymetric data collection
- TP, chlorophyll, and Secchi depth data: Collect data for several years, with at least five sampling dates per year.
- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Fish survey: Complete a fish survey to evaluate the fish species composition of the lake.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.

Rush Lake Field Reconnaissance Supplement

Local Management BMPs

Rush 1
Location: West of the intersection of Old Highway 8 and Mound Street
Description: Large open space behind an existing home.
Possible Improvements: Use for treatment of adjacent businesses or Old Highway 8.

Rush 2
Location: West of the intersection of Old Highway 8 and County Road 96
Description: Open space near outlet of stormsewer from Old Highway 8
Possible Improvements: Incorporate wetland treatment/ponding area.

Rush 3
Location: West of Old Highway 8 and south of County Road 96
Description: Open space near outlet of stormsewer from Old Highway 8
Possible Improvements: Incorporate wetland treatment/ponding area.

Rush 4
Location: West of Old Highway 8 and north of 1st Avenue
Description: Open space near outlet of stormsewer from Old Highway 8
Possible Improvements: Incorporate wetland treatment/ponding area.

Spring Lake Management Action Plan

Spring Lake (02-0071) is located in the Cities of Spring Lake Park and Mounds View, on the boundary of Anoka and Ramsey Counties, Minnesota (Figure 1). The lake has a surface area of approximately 46 acres, a maximum depth of 18 feet and is over 95% littoral (Figure 2). Based on its high percentage of littoral habitat it is classified as a shallow lake according to MPCA's definition.[1] The watershed draining to Spring Lake is approximately 303 acres and consists of primarily residential, with some commercial, institutional, and mixed use areas. Much of the north western shoreline is Lakeside Park, a park managed by the City of Spring Lake Park, which includes a swimming beach and a fishing dock.

A presence of curly-leaf pondweed has been reported by residents. A macrophyte survey completed in late June of 2007 by RCWD did not show a presence of curly-leaf pondweed, but instead an abundance of coontail, white water lily, and clasping leaf pondweed. Another macrophyte survey completed by DNR in early June 2008 found curlyleaf at nearly all sampling locations throughout the lake, but in moderate density. A 2003 DNR lake survey found the lake to have northern pike and abundant populations of bluegill and black bullheads. Largemouth bass have also been observed by RCWD staff. The lake is susceptible to winterkill. In 2007 a winter aeration pump was installed in the lake to prevent winterkill.

Water level in Spring Lake has fluctuated dramatically over the years (Figure 3). Most of the periods of low water level are preceded by periods of low precipitation, suggesting that the lake is fed by surficial groundwater and that water levels are tied to long-term precipitation patterns. Historical records show that water levels in the lake used to be maintained by the county through groundwater pumping. However, after this practice contributed to the spread of several non-native plant and animal species in other water bodies, the DNR restricted pumping of groundwater for the maintenance of surface water levels in the late 1980s. Currently, other than encouraging practices that infiltrate water in the watershed, there are few (if any) options for augmenting surface water levels.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos. The maximum depth was taken from the Rice Creek Watershed District website.

Figure 1. Spring Lake and Potential BMP Locations

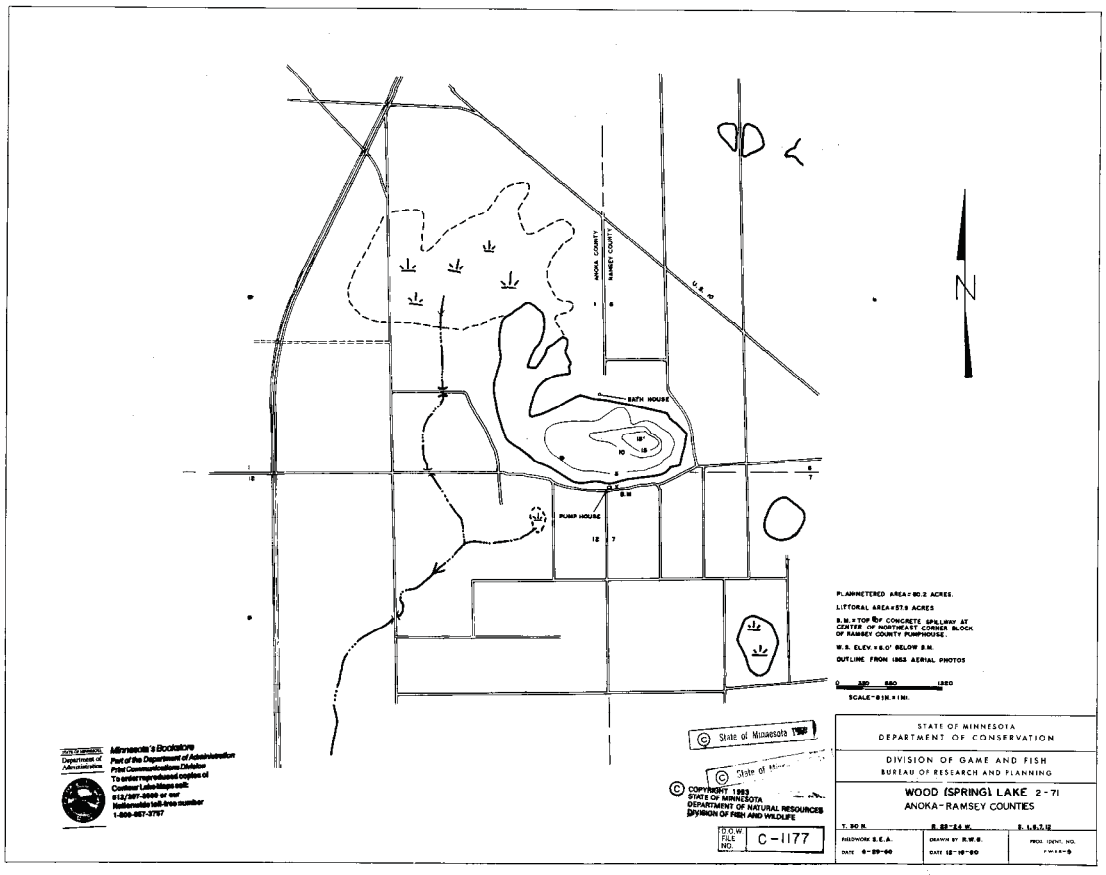


Figure 2. Spring Lake Bathymetry

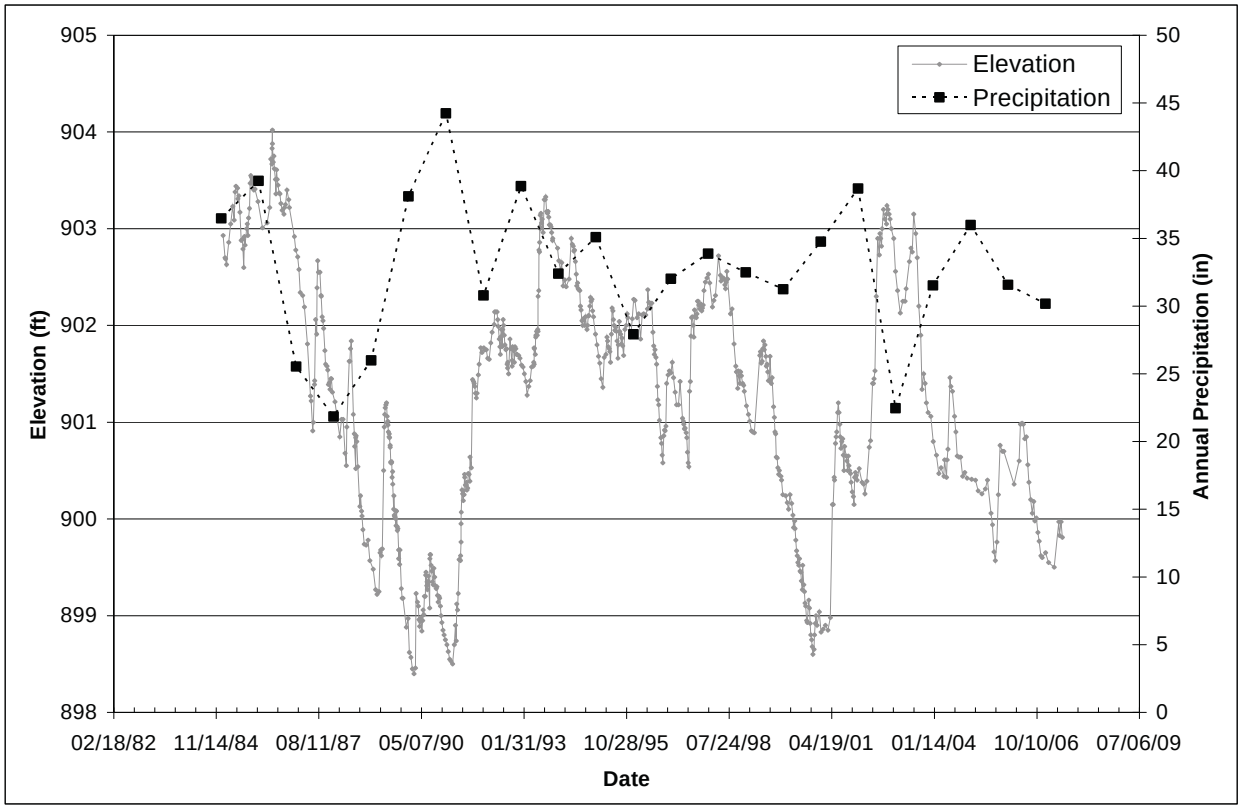


Figure 3. Spring Lake Water Levels

Water Quality Summary

One full year of water quality data exist for Spring Lake. Data were collected by MPCA. Water quality data were also collected in 2008 by RCWD, although only the phosphorus data were ready in time for this report. A summary of data from 2001 suggests that the lake is meeting all of the shallow lake water quality standards (Table 1).

Table 1. Average Water Quality Data (2001) and Standards

Parameter	Spring Lake	Shallow Lakes Standard
TP (µg/L)	33[2]	60
Chl (µg/L)	2.9	20
Secchi Depth (m)	2.4	1.0

Figures 4-6 show the growing season available TP, chlorophyll-*a*, and clarity (Secchi depth) data from Spring Lake.

[2] Includes preliminary data collected in 2008 by RCWD.

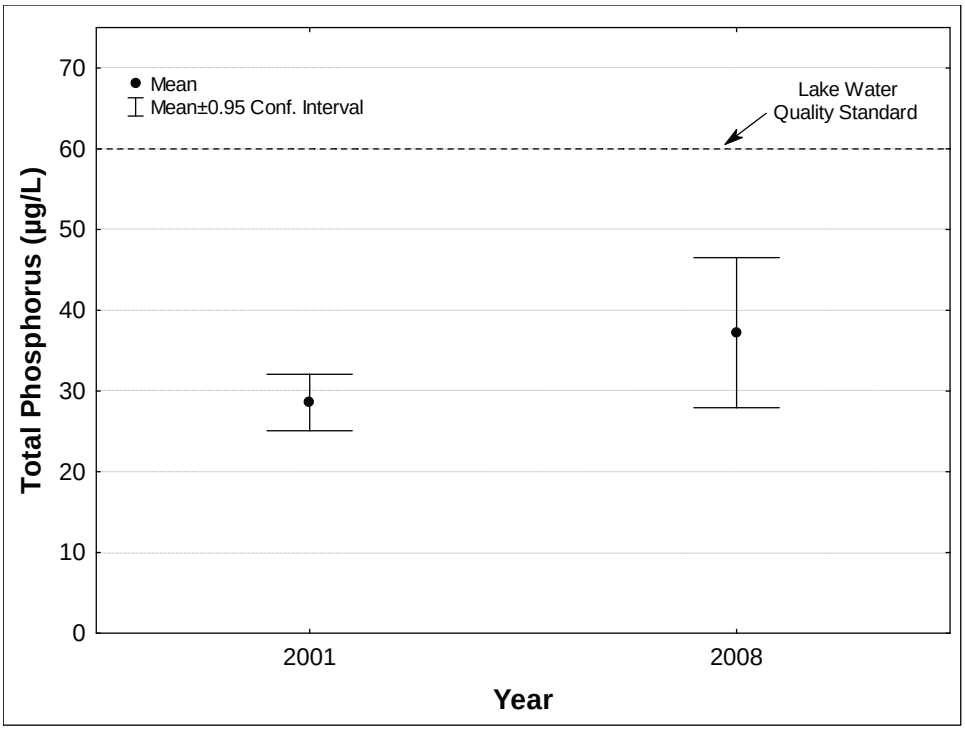


Figure 4. Spring Lake Total Phosphorus

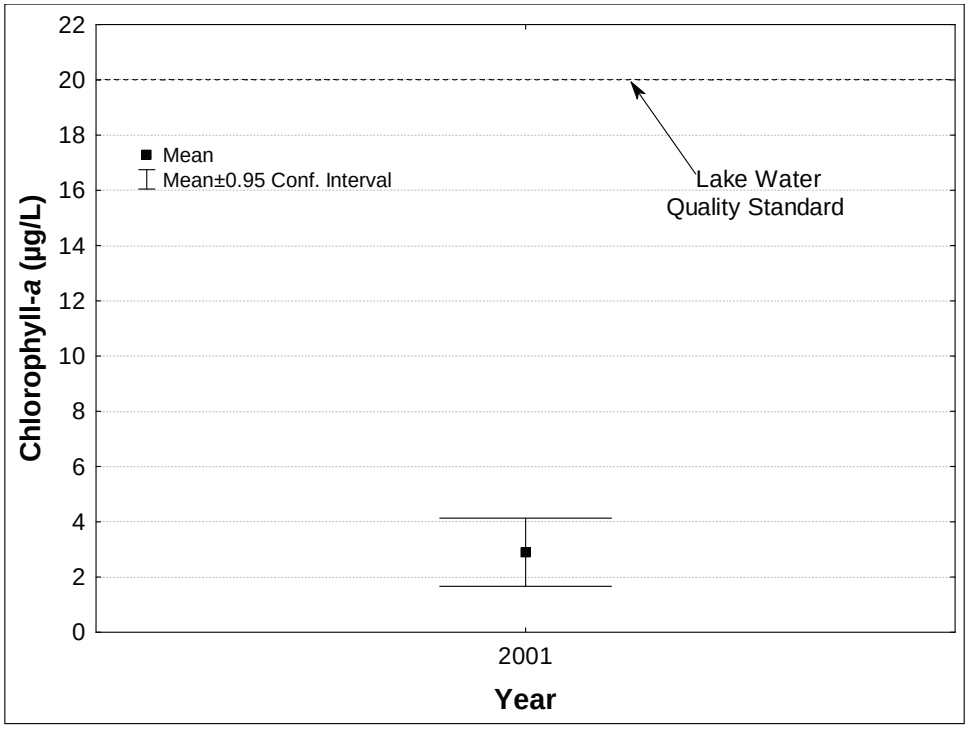


Figure 5. Spring Lake Chlorophyll-*a*

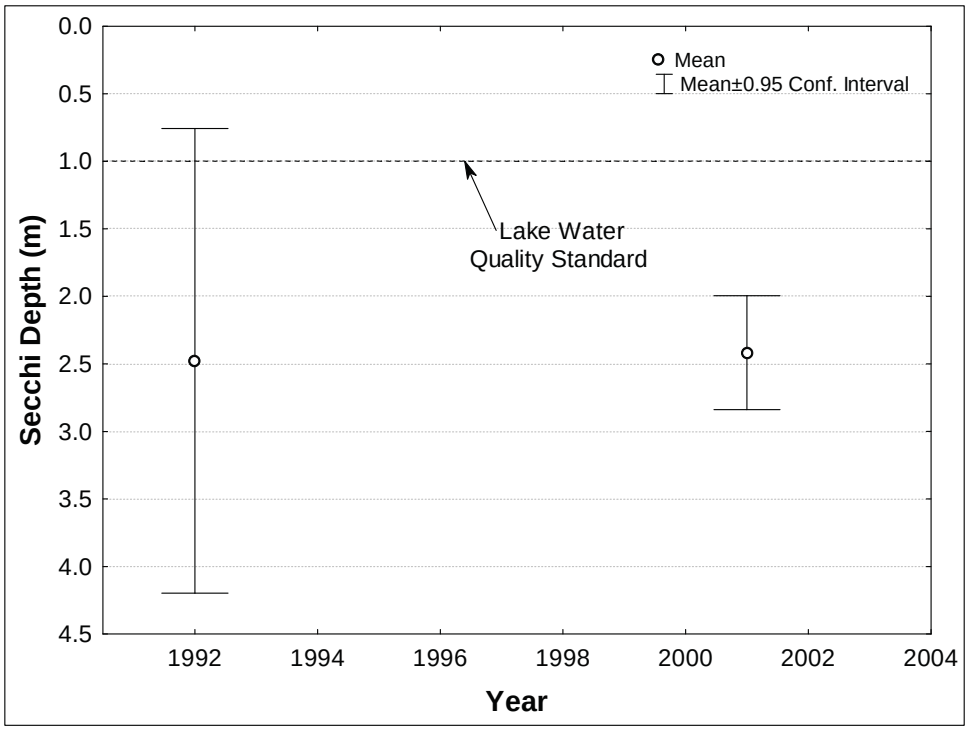


Figure 6. Spring Lake Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. The lake model was calibrated to in-lake monitoring data. Water quality modeling indicates that the primary source of nutrients affecting the lake's quality originates from watershed runoff. Watershed inputs account for about 98% of the nutrient load, with internal loading accounting for the remaining 2% (Figure 7). With only one year of monitoring data for model calibration, these results should be considered preliminary.

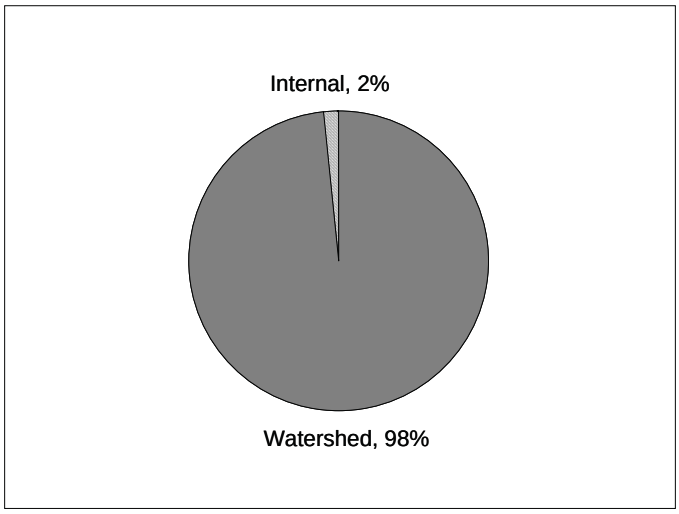


Figure 7. Spring Lake Phosphorus Load Distribution

Public Input

The water level of Spring Lake has been a point of discussion for the past few years and is a main concern of residents.

- The decrease in water levels is promoting the growth of vegetation that does not support the recreational goals of the lake.
- Residents suggest that curly-leaf pondweed is present in the lake.
- According to a certificate of title from 1955, the county is responsible for maintaining or attempting to maintain the water level at 903 feet above sea level. The most current water level data from the MPCA from June of 2007 has the water level at 899.81 feet above sea level. Data show that, over time, there is a natural fluctuation in the water levels of Spring Lake. Further study needs to be done to look into what the natural water level should be and what is a natural amount of water level fluctuation for this particular lake.
- Residents have discussed that if water is needed to bring the lake level up, water could be supplied to the lake from the Mississippi River with DNR approval. RCWD felt this option was not feasible, and it was unlikely that DNR would permit it.
- Additional concerns have been shared over erosion filling in the northwest portion of the lake and continued development in that area. Residents feel that the increased runoff and sediment coming from the northwest area could be causing the decrease in water levels. It should be noted that these areas were developed in accordance with RCWD stormwater management rules.
- Residents worked to get a winter aerator to prevent the winter kill of fish due to the low water levels.

Water Quality Issues

- Water levels in the lake fluctuate over time, impeding certain recreational uses of Spring Lake. These fluctuations have been determined to be driven by natural changes in groundwater levels and precipitation.
- Curly-leaf pondweed is present in the lake, and contributing to internal loading.

Recommended Management Approach

Watershed Management Recommendations

Because the Spring Lake watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, six BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of the two potential local BMP locations identified in the *field reconnaissance supplement*.

- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Given the concerns regarding lake levels, and the likelihood that lake levels are dependent on surficial groundwater, RCWD should work to educate local land owners on the importance of infiltration features. Infiltrating rainwater in hopes of boosting local surficial groundwater levels is likely the best course of action for increasing lake water levels.

Internal Lake Management Recommendations

- Develop an aquatic vegetation management plan. Shoreline restoration should be undertaken and actively managed to improve the habitat of the areas of the lake that dry up under low water conditions.
- A model and monitoring plan could be developed that would predict changes in lake level based on parameters such as precipitation and nearby groundwater levels. This would allow proactive management of the lake's shoreline in anticipation of low surface water levels.
- Assess the feasibility and cost of curly-leaf pondweed control options. Whole lake treatments would require an aquatic vegetation management plan. Controlling curlyleaf pondweed may be the key to reducing internal loading. (The internal loading estimate presented here is based solely on sediment phosphorus release and does not include internal loads from curlyleaf pondweed senescence. The actual internal load therefore may be greater than indicated here.)

Recommended Data Collection

With two years of in-lake data showing that Spring Lake has high water quality, additional data collection is not a high priority at this time.

- TP, chlorophyll, and Secchi depth data: Collect data for several years, with at least five sampling dates per year.

- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the density of curly-leaf pondweed and other invasive aquatic vegetation. . Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.

Although the focus of this study is on water quality, water levels are also addressed here since it is an issue that local residents are concerned about. To confirm the cause of the water level fluctuations, groundwater data could be collected to better identify the surrounding shallow groundwater depths, flow patterns, natural fluctuations, and the groundwater connection to Spring Lake. From the results of the study, targeted BMP recommendations addressing water level fluctuations could be made.

Spring Lake Field Reconnaissance Supplement

Site Specific Management BMPs

Spring 1
Location: North of Hill View Road and east of Pleasant View Drive
Description: Open space adjacent to church.
Possible Improvements: Incorporate raingarden area for treatment of church and/or adjacent roadways.

Spring 2
Location: South of the intersection of Pleasant View Drive and 79th Avenue
Description: Swale receiving runoff from the Lakeside Park parking lot located within the park north of Spring Lake.
Possible Improvements: Incorporate raingarden prior to discharge to Spring Lake.

Spring 3
Location: West of Pleasant View Drive and south of 81st Avenue
Description: Large bituminous parking lot at VFW
Possible Improvements: Remove east stalls or southeast corner of parking and incorporate treatment feature.

Spring 4
Location: East of Spring Lake Road and south of County Road 10
Description: Green space adjacent to parking lot
Possible Improvements: Incorporate raingarden area for treatment of adjacent parking lot.

Spring 5
Location: East of Spring Lake Road and south of County Road 10
Description: Green space adjacent to parking lot at Spring Lake Park Auto
Possible Improvements: Incorporate raingarden area for treatment of adjacent parking lot.

Spring 6
Location: West of Spring Lake Road and north of County Road 10
Description: Green space adjacent to parking lot at Thrifty Car Rental
Possible Improvements: Incorporate raingarden area for treatment of adjacent parking lot.

Sunfish Lake Management Action Plan

Sunfish Lake (02-0065) is located in the City of Arden Hills, Ramsey County, Minnesota (Figure 1) and fully within the borders of the Arden Hills Army Training Site (AHATS). The surface area of the lake is about 14 acres, with a maximum depth of approximately 5 feet (Figure 2)[1]. Based on its low maximum depth, it is considered a shallow lake according to MPCA's definition.

The watershed draining into Sunfish Lake is approximately 112 acres and contains a stretch of Highway 96 and part of the Ramsey County Public Works facility. The majority of runoff from impervious surfaces is served by the treatment pond located on the southeast corner of the Public Works facility before discharge to Sunfish Lake.

Sunfish Lake has very limited public use at the current time because of its location within the AHATS boundaries. There is some limited access granted by the federal government for study and nature walks, but the general public is not allowed within the AHATS property.

A significant portion of the Sunfish Lake watershed is impervious, most notably the Ramsey County government building complex to the west. This facility stores large salt piles in the winter and all stormwater from this complex is routed through a large stormwater pond, located just west of Hamline Avenue, to Sunfish Lake.

[1]The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from DNR files.

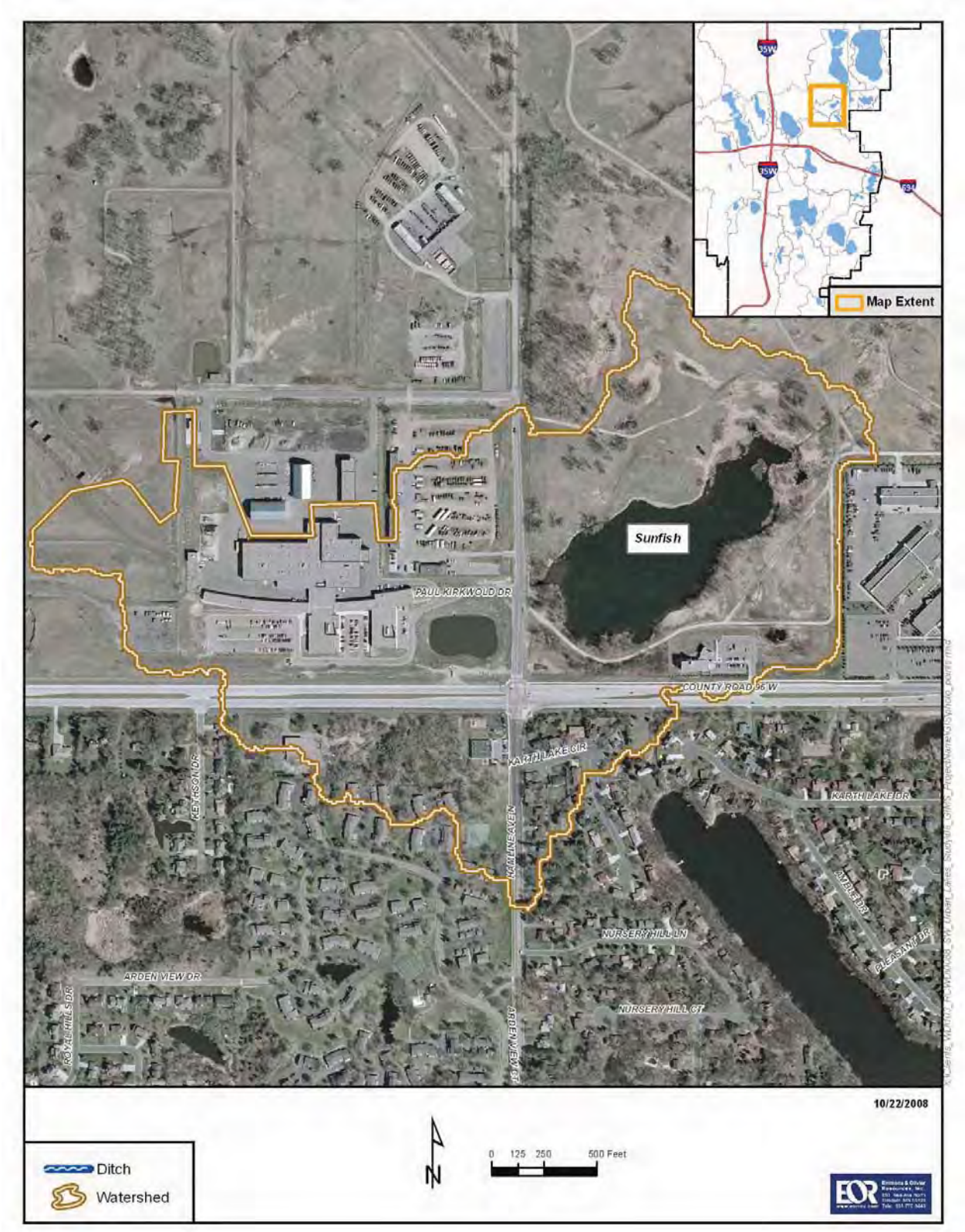


Figure 1. Sunfish Lake

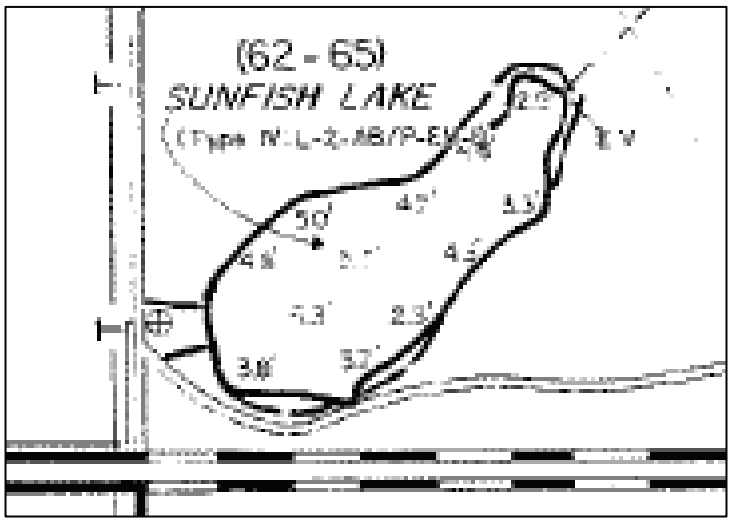


Figure 2. Sunfish Lake Bathymetry. Map from DNR files, unknown date.

Water Quality Summary

Water quality in Sunfish Lake was monitored by the RCWD in 2008. A preliminary data summary (Table 1) suggests that that lake is meeting the state water quality standards for total phosphorus (TP). Chlorophyll-a data were not available at the time of the report. Secchi depth (clarity) data were deemed unreliable; dense macrophyte growth in the lake prevented accurate readings. Field observations suggest good clarity, generally 3 to 5 feet. Water clarity data inferred from satellite imagery suggest that the water clarity depth of Sunfish Lake is approximately 3 to 6 feet, and it has ranged from the 1.5 to 3 feet category to the 6 to 12 feet category since 1985. Low phosphorus concentrations, good clarity, and abundant macrophyte growth suggest that Sunfish Lake is functioning as a healthy shallow lake in the "clear-water" state.

Table 1. Average Water Quality Data (2008) and Standards

Parameter	Sunfish	Standard
TP (µg/L)	37	60
Chl (µg/L)	n/a	20
Secchi Depth (m)	n/a	1.0

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. There were no in-lake monitoring data available to calibrate the lake model. Water quality modeling indicates that watershed inputs account for approximately 88% of the nutrient load, with internal loading accounting for the remaining 12% (Figure 3). Without any in-lake nutrient data for the lake for model calibration, the modeling results should be considered preliminary.

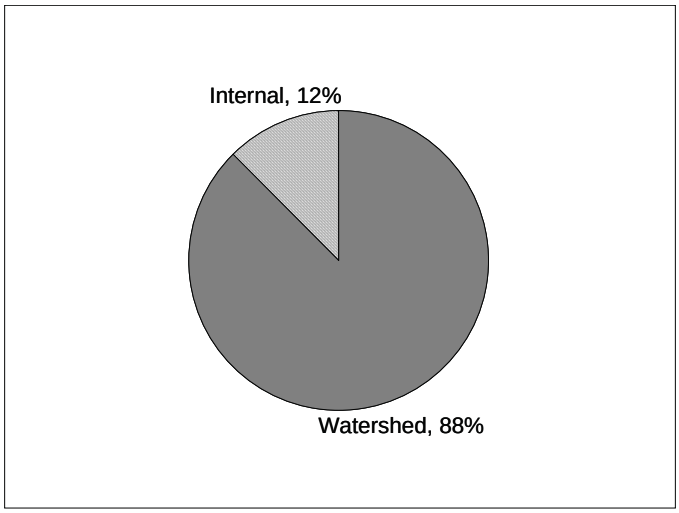


Figure 3. Sunfish Lake Phosphorus Load Distribution

In 2008, high levels of conductivity (~750 to 780 µS/cm) were measured in Sunfish Lake. It is not known if the high conductivity is due to high chloride concentrations in the lake or due to other dissolved solids. Chloride should be sampled in the lake to help identify the cause of the high conductivity.

Public Input

At the public input meeting held on May 29, 2008, the following was brought up by the participants:

- Some speculation was heard that the sediment in the lake is contaminated from past waste on the AHATS property.

Water Quality Issues

- Sediment within the lake may be contaminated with toxic substances due to past land use.
- There is some evidence of a sediment delta in the stormwater pond pipe inlet at the west end of the lake.
- High conductivity has been observed in the lake, although cause is unknown.

Recommended Management Approach

Watershed Management Recommendations

Currently all of the area directly surrounding Sunfish Lake is under the control of the U.S. Army because the lake is entirely within the AHATS boundary. The Army should maintain its existing management plan for the lake unless water quality data collected in the future dictates that a need in management is warranted.

The following are general practices will decrease nutrient loads to the lake:

- Nutrient and stormwater volume absorbing raingardens
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management

- Active inspection programs for and routine maintenance of previously installed stormwater BMPs

Internal Lake Management Recommendations

With very little in-lake biological data for Sunfish Lake, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply to Sunfish Lake:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- The balance of benthivores, planktivores, and piscivores in the lake can influence the lake's water quality. Benthivores disturb the bottom sediments and release phosphorus into the water column, and high densities of planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake. If cooperation is possible, work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.
- If it is determined that there is a sediment delta on the west inlet to the lake, removal should be considered.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Sunfish Lake. There is currently only one year of in-lake water quality data for Sunfish Lake; if the implementation of management practices for the lake were to move forward, updated bathymetric data and at least an additional year of in-lake data (including chloride data) would be needed and should be considered a high priority.

- Updated bathymetric data collection
- TP, chlorophyll, and Secchi depth data: Collect data for several years, with at least five sampling dates per year.
- Chloride data: Collect data for at least one year (including early spring during snowmelt runoff) to determine if chloride in the lake is high.
- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Fish survey: Complete a fish survey to evaluate the fish species composition of the lake.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.

Turtle Lake Management Action Plan

Turtle Lake (62-0061) is located in the City of Shoreview, Ramsey County, Minnesota (Figure 1). The lake has a surface area of 447 acres, a maximum depth of 28 feet, and a mean depth of about 10 feet[1] (Figure 2). Turtle Lake is on the state's 303(d) list of impaired water bodies due to the mercury content in fish. The MPCA has completed a statewide TMDL study and implementation plan to address the state's mercury impairments.

The watershed draining to Turtle Lake is approximately 288 acres. The watershed is relatively small compared to the surface area of the lake. This leads to a smaller amount of surface water runoff into the lake, but also means water levels can be hard to maintain. The surrounding watershed area is primarily residential with some commercial uses nearby. Turtle Lake Park is on the southeast side of the lake and is a major recreation attraction for swimming, boating, and picnicking.

A macrophyte survey performed by the DNR during the first week of July in 2002 indicated that Eurasian watermilfoil is present but rare.

The lake is popular as a recreational fishing lake. A 2007 DNR fisheries survey indicates that bluegills are the most abundant species in the lake, although the average size is smaller than normal. Crappies, sunfish, largemouth bass, and northern pike are also present. The lake has been stocked by the DNR in the past with walleye. The lake has been managed as a largemouth bass experimental lake since 1997. The goal of this program is to establish a population characterized by 40% of the bass exceeding 16 inches in length. A DNR regulation requires the release of all largemouth bass. Overall, Turtle Lake has a healthy and balanced fish population that helps maintain the lake's excellent quality.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth and percent littoral were taken from the DNR Lake Finder website.

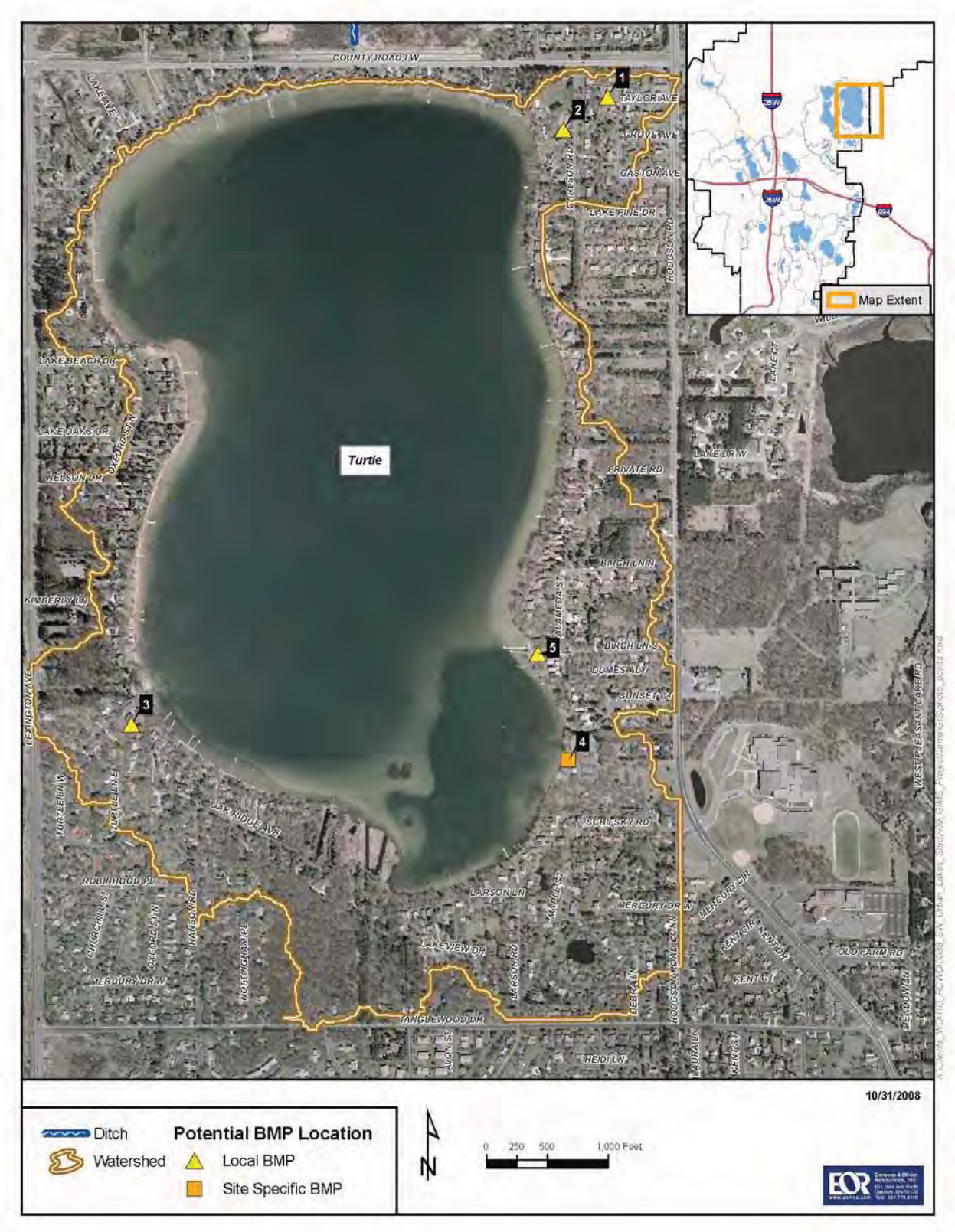


Figure 1. Turtle Lake and Potential BMP Locations

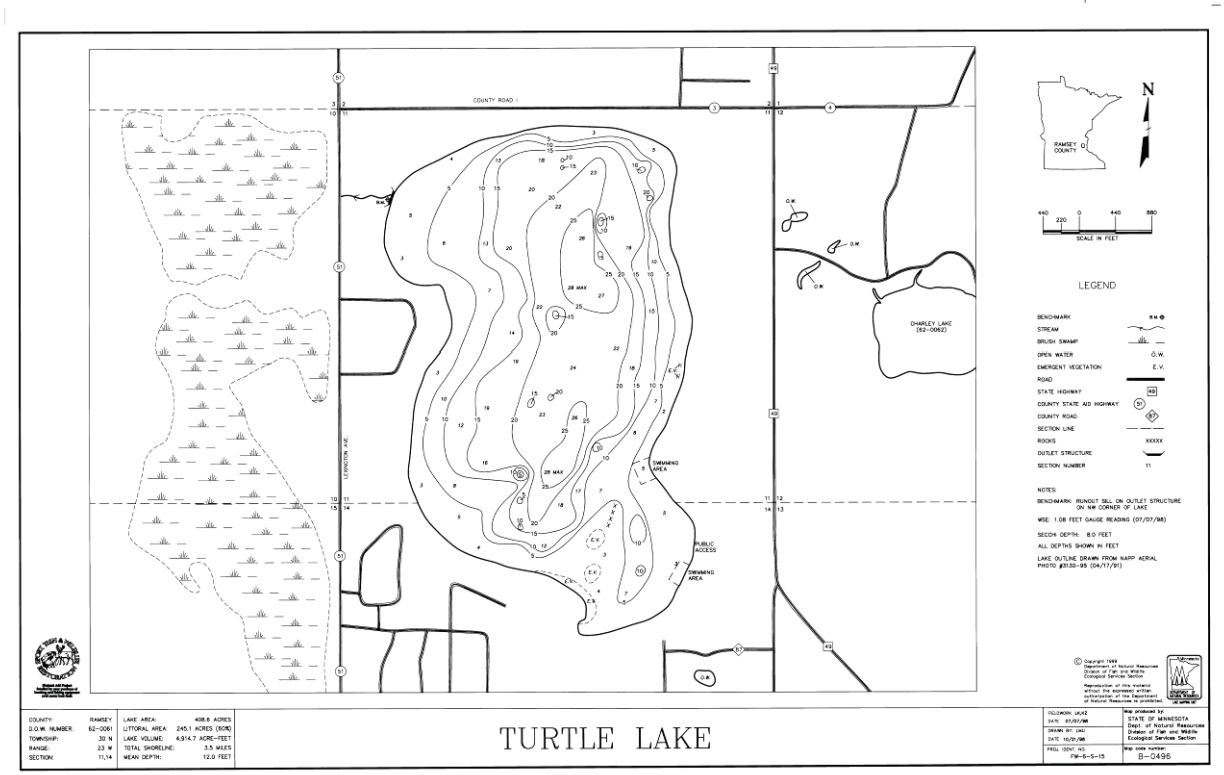


Figure 2. Turtle Lake Bathymetric Map

Water Quality Summary

Turtle Lake has an abundance of water quality data that have been collected over recent years. Data are collected by Ramsey County Public Works and Metropolitan Council Environmental Services. A summary of the most recent ten years of water quality data suggest that it is meeting all of the state standards. The lake is the second highest quality lake in the RCWD (behind only White Bear Lake).

Table 1. Average Water Quality Data (1998-2007) and Standards

Parameter	Turtle Lake	Standard
TP (µg/L)	20	40
Chl (µg/L)	4.9	14
Secchi Depth (m)	2.4	1.4

Figures 3 through 5 show the TP, chlorophyll-*a* and Secchi depth (clarity) data from Turtle Lake for the period of record for the CAMP data. Turtle Lake has exceeded the TP standard of 40 µg/L only once since 1980 (Figure 3), and it has never exceeded the chlorophyll or Secchi depth standards.

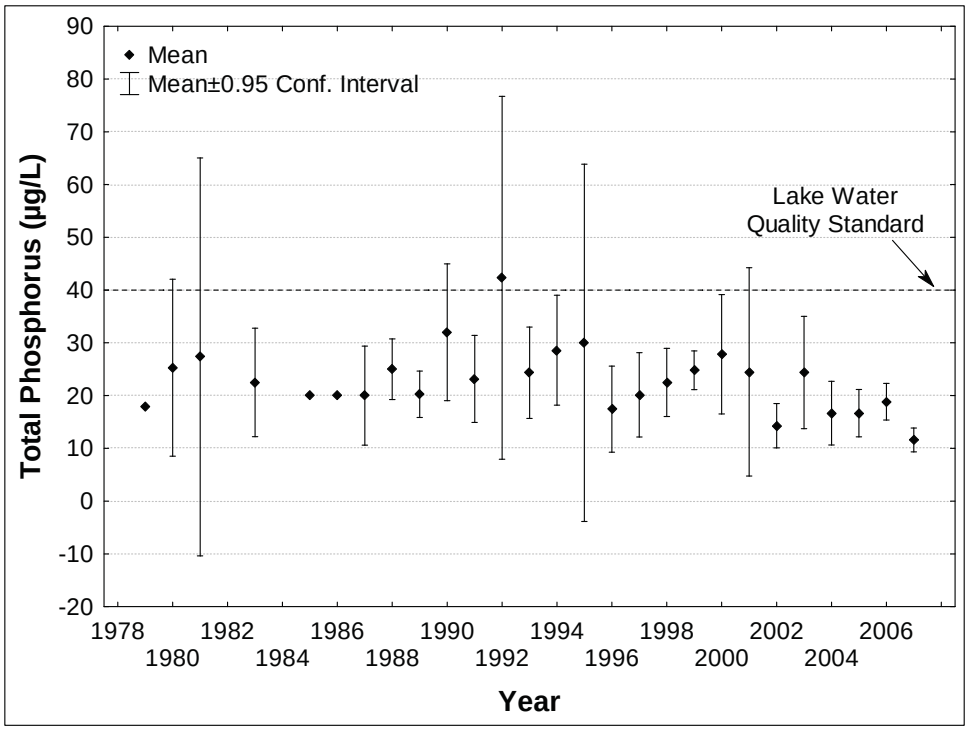


Figure 3. Turtle Lake Total Phosphorus

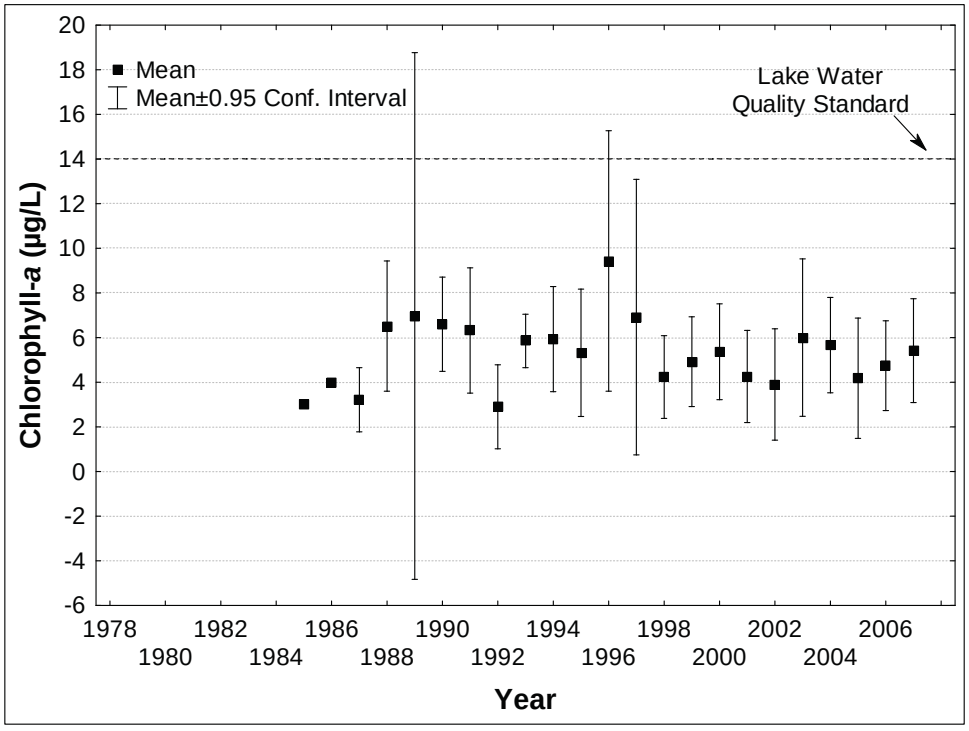


Figure 4. Turtle Lake Chlorophyll-*a*

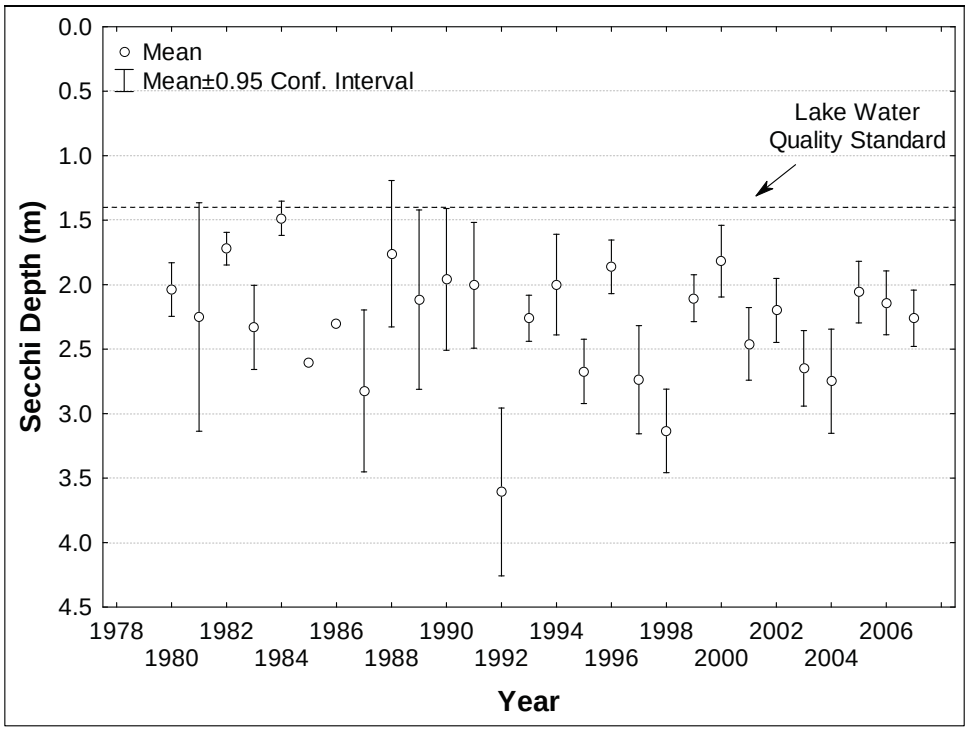


Figure 5. Turtle Lake Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. The lake model was calibrated to in-lake monitoring data. Water quality modeling indicates that the sources of nutrients affecting overall lake quality are almost evenly split between watershed runoff (53%) and internal (47%) loading (Figure 6).

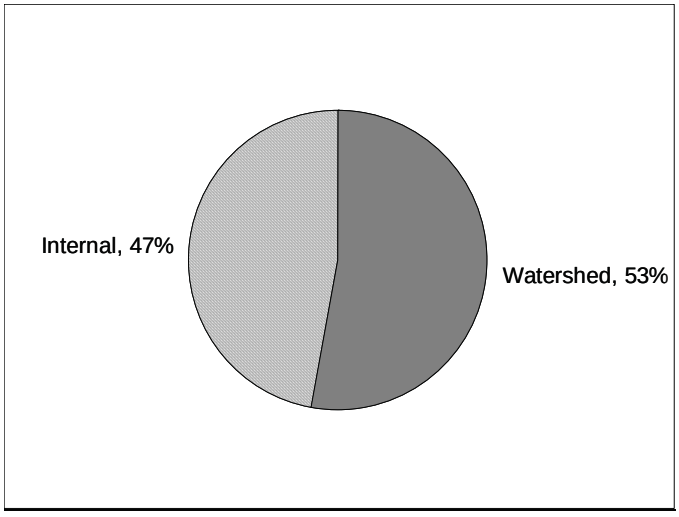
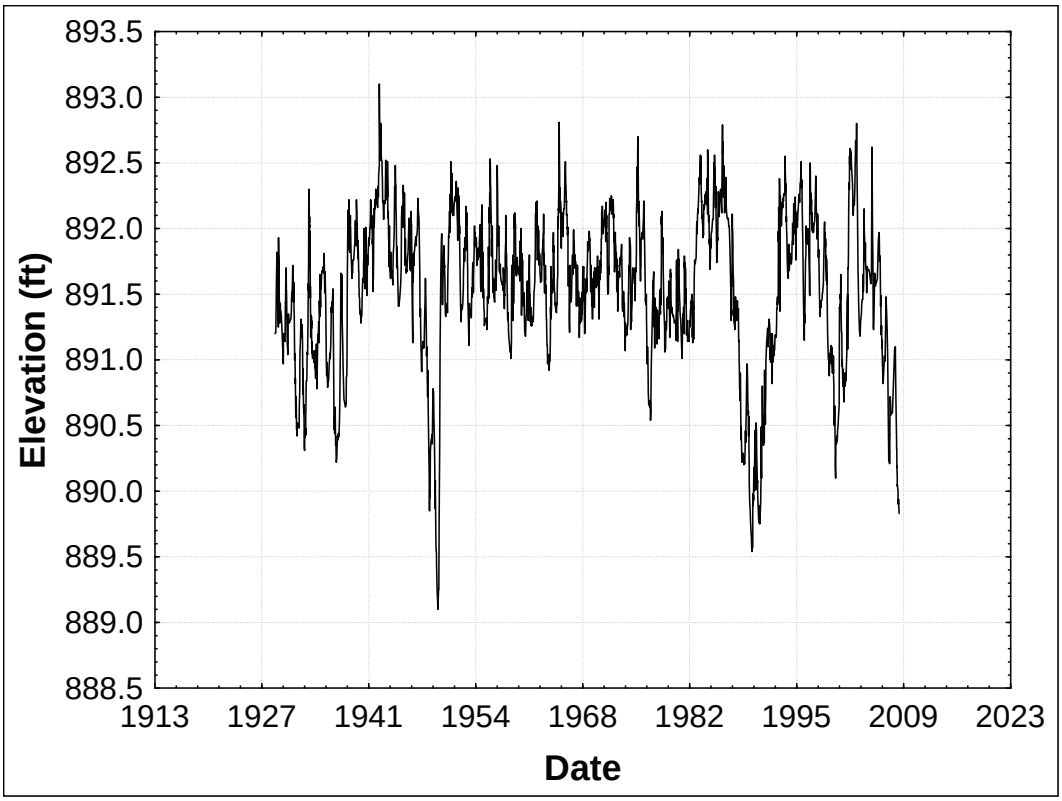


Figure 6. Turtle Lake Phosphorus Load Distribution

Public Input

At the public input meeting held on May 29, 2008, lake residents offered local insight into Turtle Lake. Residents are very interested in keeping the lake at its current excellent quality, recognizing the value that this lake holds for the watershed.

- Attendees noted that there are some opportunities for BMP retrofitting that could yield further nutrient load reductions for the lake. The northeast corner of the lake receives runoff that passes through what was referred to as a treatment chamber. The resident noted that the chamber is very ineffective and that it could be supplemented with additional treatment possibly via a bioretention system. The resident also referenced the Lexicon BMP system as likely an effective approach and suggested that the RCWD work with Ramsey County (Terry Noonan) to monitor its effectiveness. The Lexicon BMP system was installed in 2008 near the SW stormwater inlet to the lake.
- Residents at the meeting also wondered if water levels in the lake decrease as a result of pervious lake sediment in the southeast corner of the lake and if this could be sealed. RCWD and EOR staff discussed the small watershed draining to the lake and the difficulty of maintaining lake levels with the small contributing drainage area. Under these situations, it is not likely that lowered lake levels result from seepage out the bottom of the lake.
- Also with respect to water levels in the lake, residents question whether the reconstruction of County Road I has limited the influx of groundwater from the north. Based on the information available, shallow groundwater flow in this area is northwest towards Rice Creek. Therefore it is unlikely that the reconstruction of County Road I have negatively impacted the groundwater influx to Turtle Lake.
- Subsequent communications from one of the attendees indicates that he is interested in seeing if the pump and treat system at TCAAP is affecting the water level of Turtle Lake. Figure 7 shows the water levels for the lake: the top graph illustrates data since 1929, and the bottom graph focuses in on the last ten years of data. An overall fluctuation of over 2.5 feet has occurred over this ten year period.



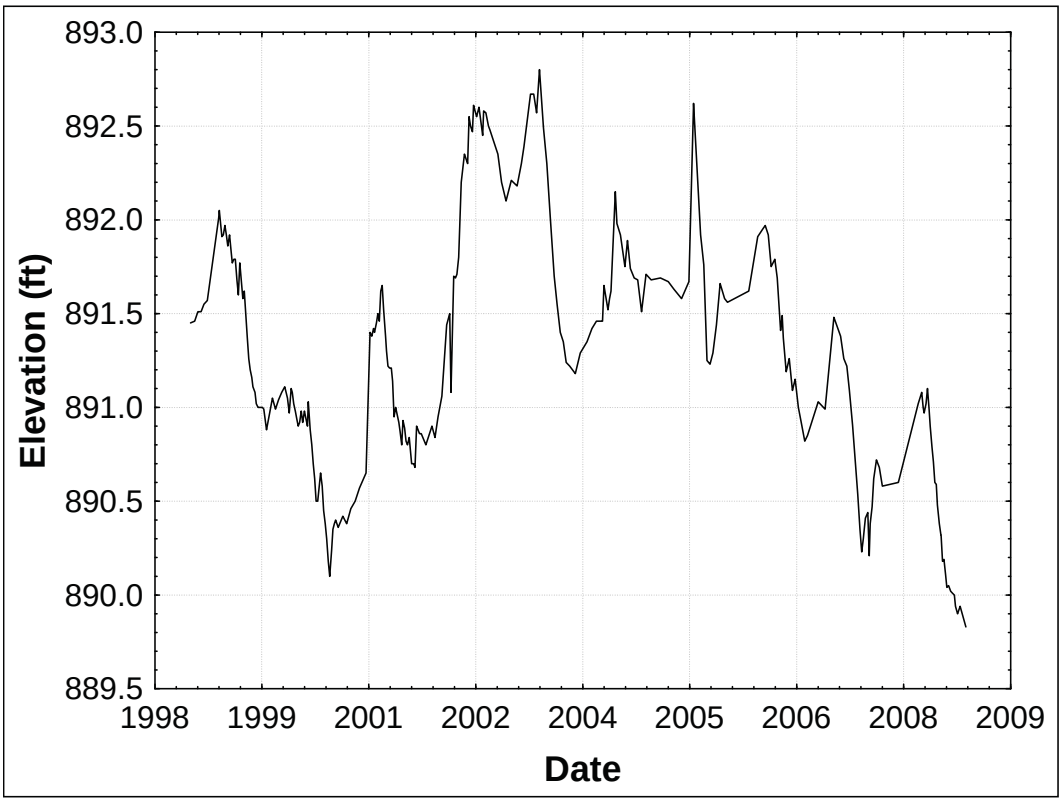


Figure 7. Turtle Lake Water Levels

Water Quality Issues

- Residents are concerned about water level fluctuation. However, water levels have fluctuated over the years, and the current downward trend in water level fits within the historical range of water levels observed since the 1930s. Precipitation has been low over the last several years, and, due to the lake's small watershed size, the lake takes longer than other nearby lakes to return to higher water levels.
- The lake sediment data suggests that internal loading rates in Turtle Lake are high. However, due to the good water quality of the lake, internal loading does not appear to be an issue.

Recommended Management Approach

Turtle Lake is overall a high quality lake that is used for different types of recreation. New runoff control efforts are not needed to meet state standards, but managers and residents should protect the existing water quality conditions and prevent any degradation of lake water quality. Effective enforcement of RCWD Rules should help protect the lake as development and re-development occur.

Watershed Management Recommendations

Some of the runoff entering Turtle Lake is untreated or under-treated. Opportunities to incorporate or improve BMPs would ensure that the existing conditions are at least maintained or potentially improved. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local, and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, four BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of potential local BMP locations identified in the *field reconnaissance supplement.*
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- The Turtle Lake Pre-treatment Facility Project (Local BMP #3) was recently constructed by the City of Shoreview for the southwest side of the lake, through the RCWD Urban Remediation Grant Program. This project on Turtle Lane treats stormwater from an 11-acre area via an underground infiltration system. The RCWD predicts that about 65% of the TP from this area would be eliminated. Survey of the pavement elevations is warranted to ensure that runoff is not bypassing the infiltration system.
- Another possibility is in the Birch St. neighborhood on the east side of the lake (BMP#5). Although some infiltration tubes exist in this neighborhood, residual stormwater enters the lake via a rip-rap channel. Retrofit of this rip-rap channel to incorporate biofiltration could improve the runoff from this sub-watershed and help to further improve the lake.

The following general practices will decrease nutrient loads to the lake:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

No specific internal lake management recommendations are warranted, due to the high quality of Turtle Lake. The existing water quality conditions should be protected to prevent any degradation of lake water quality.

Recommended Data Collection

Turtle Lake is fortunate to have a large amount of water quality and fish data collected in the past. At this time, continuing the current level of data collection is sufficient. If problems persist with water levels and citizens remain concerned, a water level study looking at runoff into the lake and losses from it could be undertaken to quantify the fluctuation and its causes.

Turtle Lake Field Reconnaissance Supplement

Local Management BMPs

Turtle #1
Location: West of Saint Albans Street and north of Taylor Avenue
Description: Open area in front/side yard
Potential Improvements: Incorporate large raingarden to treat adjacent roadways.

Turtle #2
Location: West of Carlson Street and south of County Road I
Description: Stormwater discharge into Turtle Lake from adjacent neighborhood.
Potential Improvements: Incorporate infiltration/ biofiltration BMPs at this location. This site would require using areas that already appear to have uses (e.g. tennis court or garden areas).

Turtle #3
Location: North end of Turtle Lane Loop
Description: Catch basin intended to route water across the street to an underground infiltration feature. It appears that some of the runoff may bypass to the inlet behind the catch basin that flow directly to Turtle Lake.
Potential Improvements: Assess whether flows are bypassing the treatment feature, and if so, modify grades to ensure that runoff is directed to the treatment feature prior to discharge to Turtle Lake.

Site Specific Management BMPs

Turtle #4
Location: West of Hodgson Road and north of Schifsky Road
Description: Existing small treatment feature (4-6 inches of storage with a skimming structure) treating a large amount of the park's drives and parking lots
Potential Improvements: Increase treatment capacity. The onsite oak trees are an issue; however, with some creativity another cell could be added to the south of the existing feature.

Turtle #5
Location: Western terminus of Birch Lane South
Description: Existing grouted rip rap open channel with dead pool storage
Potential Improvements: Retrofit this channel to incorporate biofiltration in lieu of dead pool storage.

Valentine Lake Management Action Plan

Valentine Lake (62-0071) is located in the City of Arden Hills, Ramsey County, Minnesota (Figure 1). The lake has a surface area of about 64 acres, with a maximum depth of 14 feet and a mean depth of 4.5 ft[1] (Figure 2). Based on its low maximum depth, it is considered a shallow lake according to MPCA's definition.

The watershed that flows into Valentine Lake is approximately 2,566 acres and is fully developed with mixed use commercial, transportation, industrial and residential land uses. Valentine Lake is directly surrounded on three sides by Bethel University.

Valentine Lake is listed as an impaired lake on the EPA's 303(d) list of impaired water bodies. It is impaired for aquatic recreation due to high nutrients. High chloride concentrations may also be an issue. Valentine Lake is the only monitored lake in Ramsey County that has an average chloride concentration near the state standard.

Bethel University has collected data on plants in or near Lake Valentine from 1986 through 2000. Of the species identified, curly-leaf pondweed has the potential to become a nuisance species.

A 2000 fish survey available from Bethel University shows a presence of bluegills, bullhead, pumpkinseed sunfish, crappie, perch, and shiners. In 2001, the university reported a partial winter fish kill that included carp, northern pike, and bluegills.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; the maximum depth was taken from the Rice Creek Watershed District website.

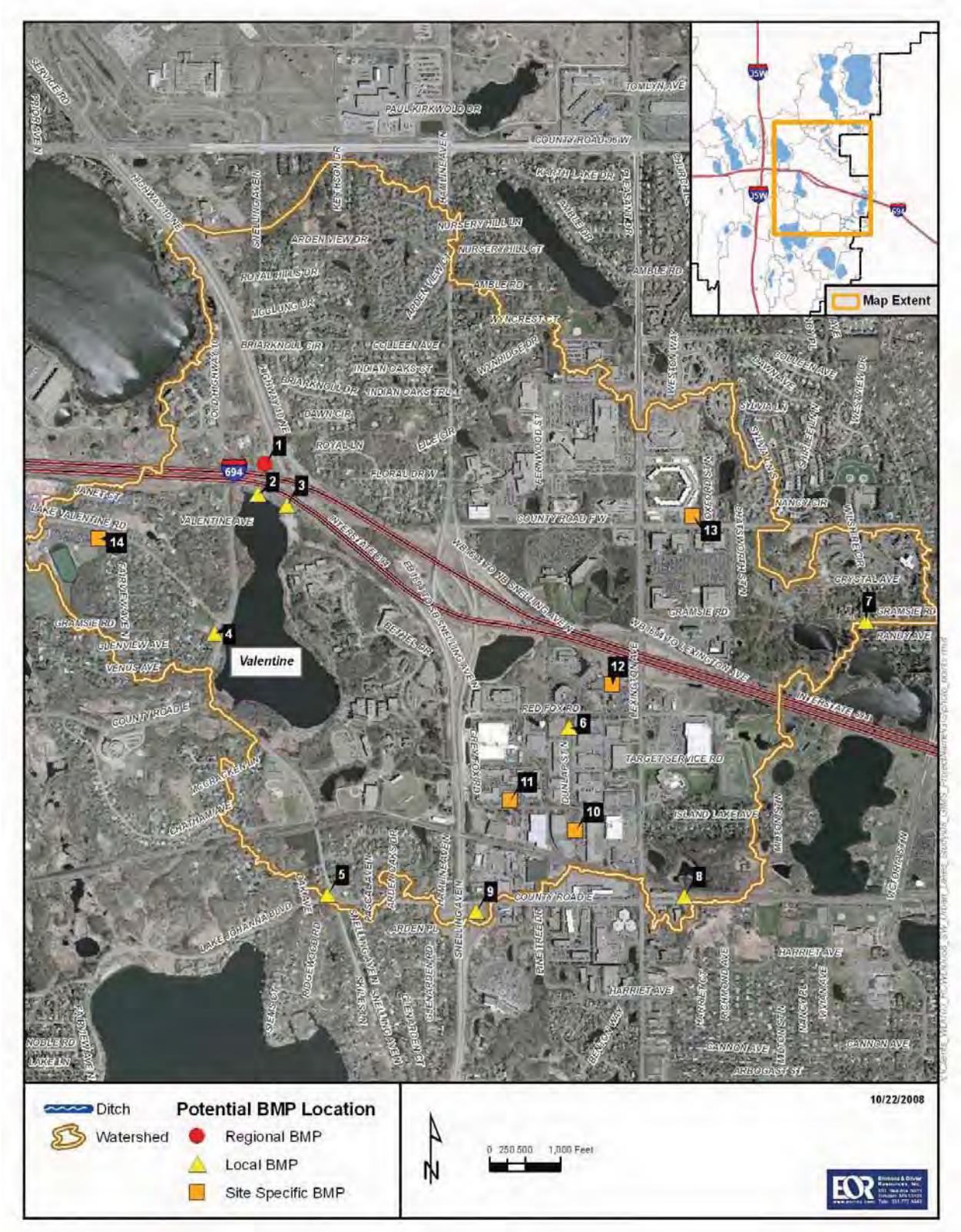


Figure 1. Valentine Lake and Potential BMP Locations

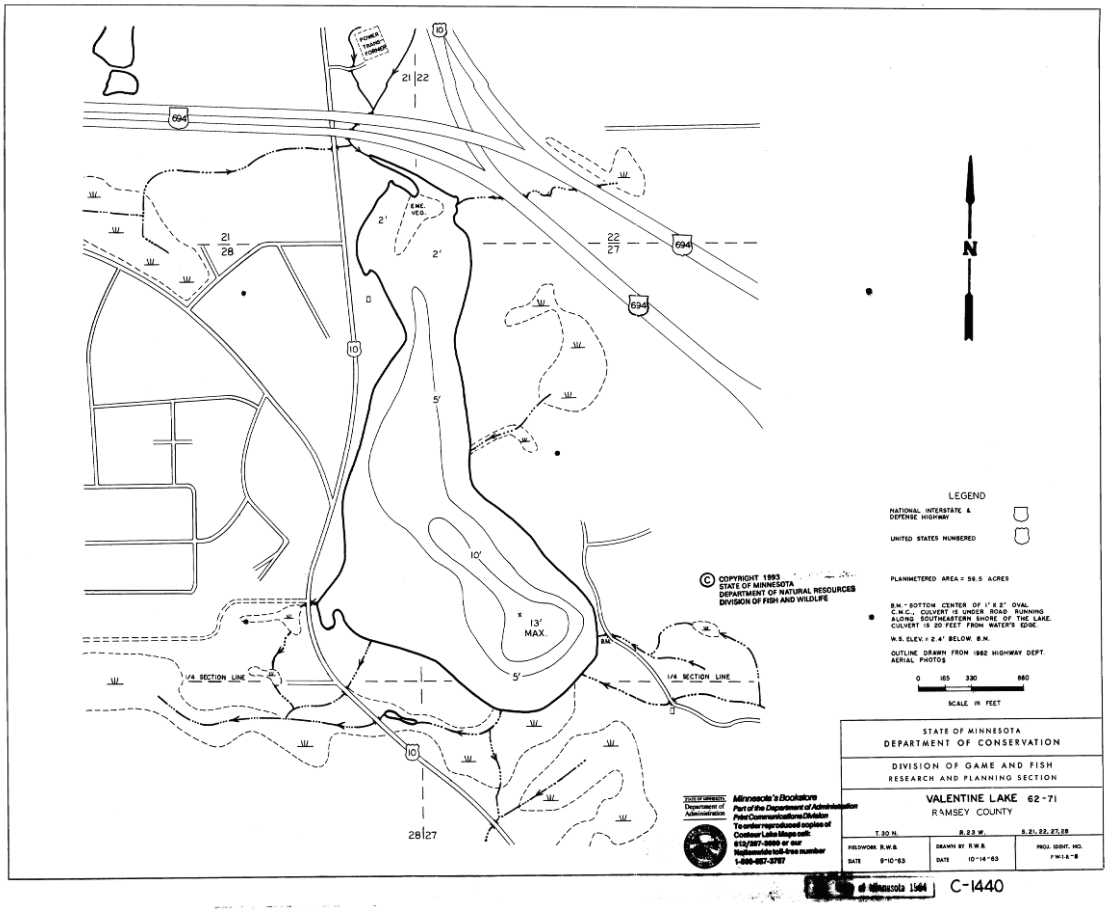


Figure 2. Valentine Lake Bathymetry

Water Quality Summary

Water quality data for Valentine Lake are available from 1980-2007. Data are collected by Ramsey County Public Works and through the Citizen Assisted Monitoring Program (CAMP). A summary of the most recent 10 years of water quality information for the lake suggest that Valentine Lake is meeting water quality standards for chlorophyll-*a* and Secchi depth (clarity) but not for total phosphorus (TP). Although the TP is moderately high, the lake appears to be functioning as a healthy shallow lake, with suspended algal growth under control and relatively high water clarity.

Table 1. Average Water Quality Data (1998-2007) and Standards

Parameter	Valentine Lake	Shallow Lakes Standard
TP (µg/L)	70	60
Chl (µg/L)	18	20
Secchi Depth (m)	1.7	1.0

Figures 3-5 show the growing season TP, chlorophyll-*a* and Secchi depth (clarity) data over that period. Water quality was poorer in the early 1990s and has improved since then.

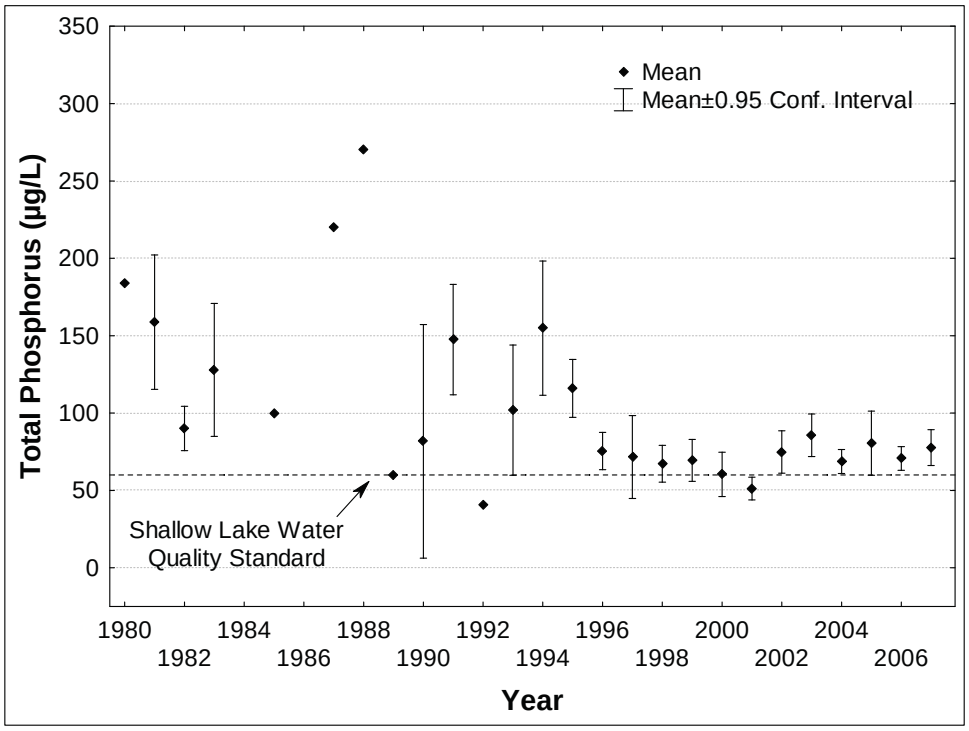


Figure 3. Valentine Lake Total Phosphorus

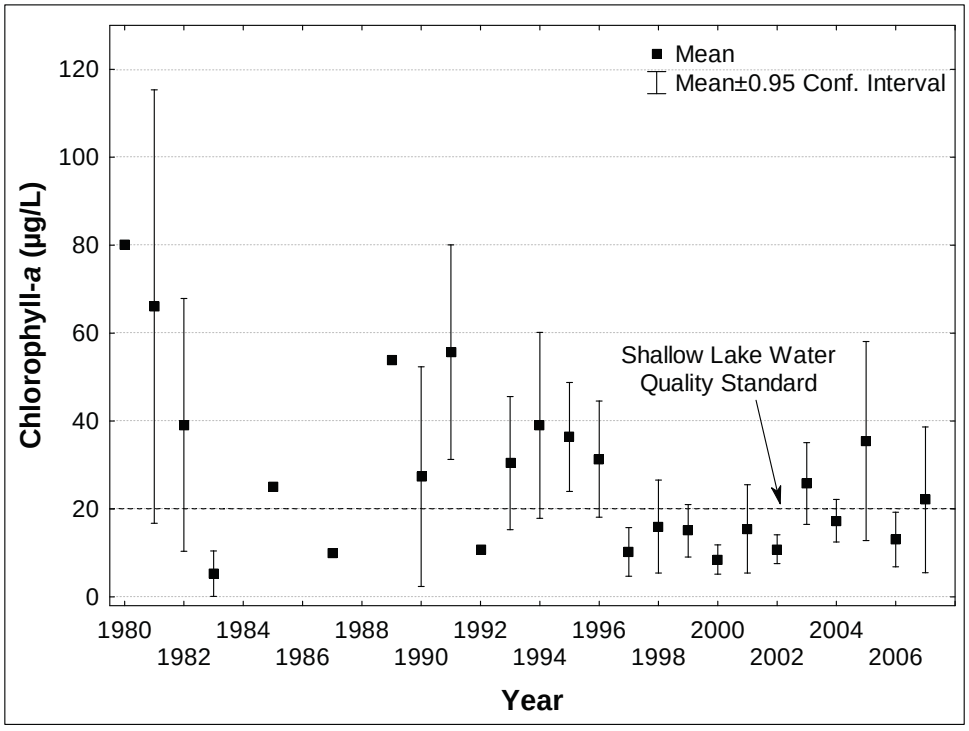


Figure 4. Valentine Lake Chlorophyll-*a*

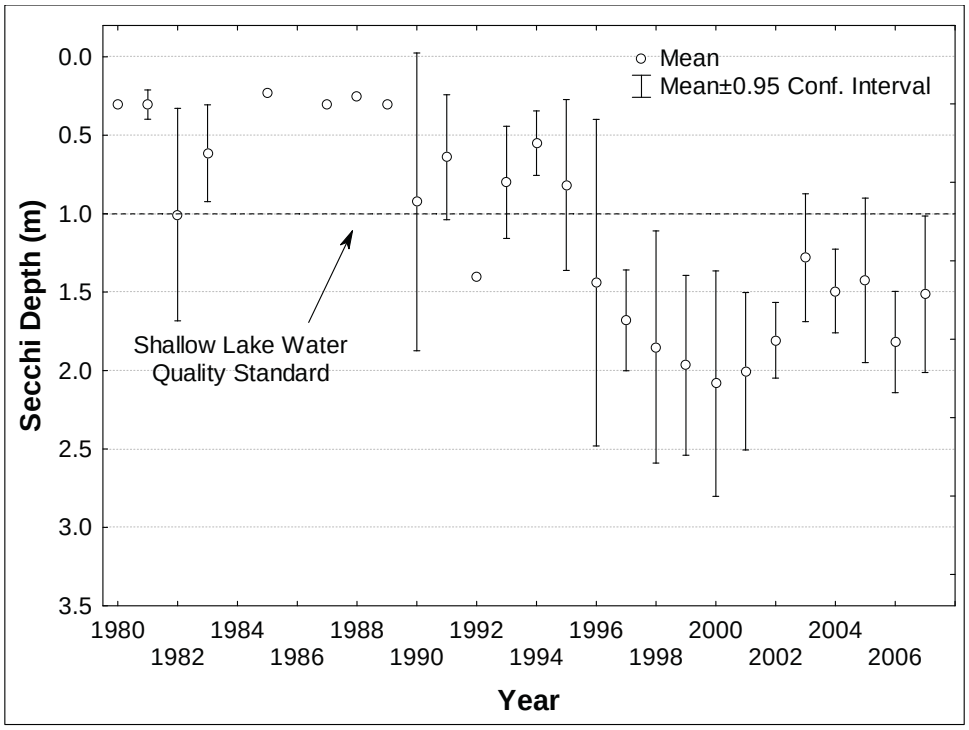


Figure 5. Valentine Lake Secchi Depth

A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. The lake model was calibrated to in-lake monitoring data. Water quality indicates that watershed inputs account for approximately 80% of the nutrient load, with internal loading accounting for the remaining 20% (Figure 6). To reach the in-lake goal of 60 µg/L TP, the phosphorus load needs to be reduced by 13%.

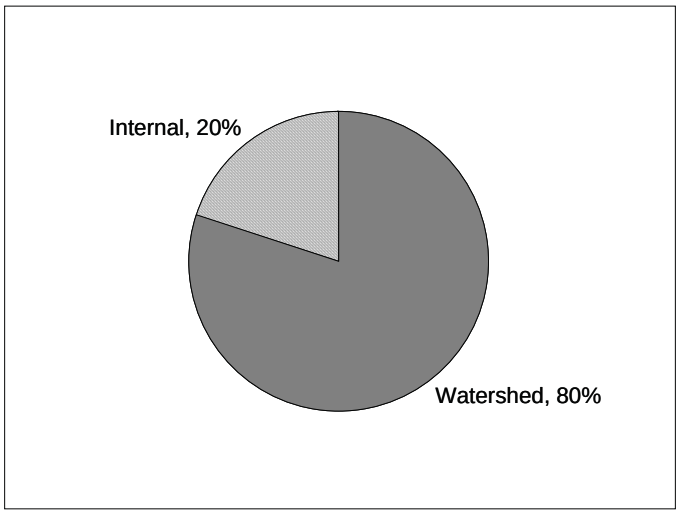


Figure 6. Valentine Lake Phosphorus Load Distribution

Average chloride concentrations are available in Valentine Lake from 1990 – 2007 (Figure 7). The data seems to indicate an upward trend, with the most recent year's data exceeding the water

quality standard. However, the state chloride standard is based on a 4-day average, not a seasonal average; it is possible that the chloride concentrations exceeded the 4-day standard in many years during spring runoff. Prolonged chloride concentrations exceeding approximately 230 mg/L can have lethal effects for fish and invertebrates.

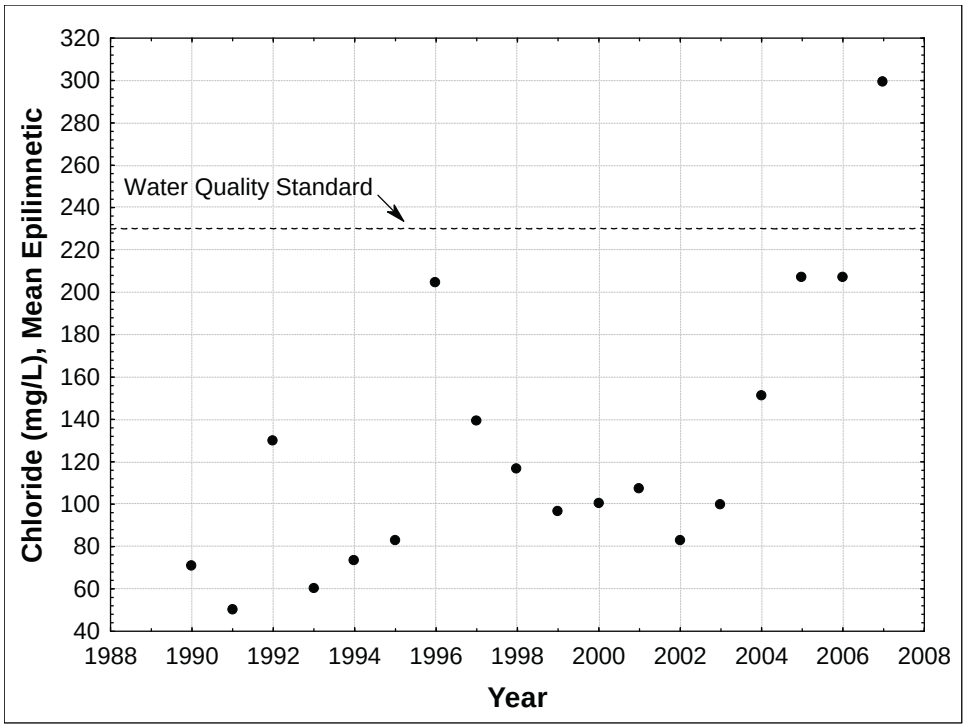


Figure 7. Valentine Lake Chloride Concentrations

Public Input

At the public input meeting on May 29, 2008, concerns surrounding Valentine Lake were addressed.

- A possible shift from a turbid lake condition to a clear lake condition might have occurred when a new diversion cut off flow from a large portion of the watershed to the east and was diverted through a wetland treatment system prior to discharge into the lake. Concerns were expressed over the possible change back to turbid conditions since the lake is still over the 60 µg/L TP goal. Continued careful monitoring of the lake's condition, with some additional ecological monitoring was noted as important.
- The possible shift from the turbid- to clear-water state was observed in the late 1980s – these observations are consistent with observed changes in the water quality dataset. At the time of the "switch," large colonies of filamentous blue-green algae were replaced with coontail.
- A Bethel University representative discussed some of the efforts underway on the campus to improve water quality of runoff to the lake. The university is also undertaking a buckthorn removal effort on the lake shoreline.

- It was noted that occasional high flow and assumedly high nutrient input problems have occurred when the outflow of Round Lake (tributary to Valentine) is plugged and suddenly releases. The outflow from Valentine similarly plugs.

Water Quality Issues

- Total phosphorus concentrations in the lake exceed the standard and the lake is listed as impaired.
- Bullhead are present in the lake and may contribute to high internal loading rates.
- Bluegill are the most abundant fish found in Valentine Lake. Without any piscivorous fish, the bluegill density may get high enough to overgraze the lake's zooplankton.
- Sudden inflows from Round Lake may be leading to water quality problems within Lake Valentine.
- Curly-leaf pondweed is present in the lake, potentially contributing to internal phosphorus loading.
- The north lobe of the lake is directly adjacent to Interstate-694 and likely receives highway runoff.
- High concentrations of chloride have been measured in Valentine Lake, possibly having negative effects on biota.

Recommended Management Approach

Watershed Management Recommendations

Management of land in the watershed is a critical element in addressing the nutrient impairment. Because the Valentine Lake watershed is nearly fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, 14 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Feasibility and Benefit Level Assessment of the potential regional BMP location identified in the *field reconnaissance supplement*.
- Consideration of local partnerships for further assessment of potential local BMP locations identified in the *field reconnaissance supplement.*
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- Continue working with Bethel University on water quality stewardship to Valentine Lake. In 2001, a study was done by the RCWD looking at infiltration BMP feasibility on the Bethel University Campus. After finding that the soils were not conducive for large-scale infiltration BMPs, the report suggests a number of non-infiltration BMPs, such as bio-swales, rain gardens and biofiltration, along with stability measures to control swale slope.
- Continue working with Boston Scientific (formerly Guidant Campus) on the Master Stormwater Management Plan for phased redevelopment of the site.

- Work with the Minnesota Department of Transportation during road improvement projects to provide additional treatment for sections of Interstate 694 and Highway 10.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

A number of shallow lake management principles likely apply to Valentine Lake:

- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.
- A more recent fisheries survey will indicate the balance of benthivores, planktivores, and piscivores in the lake. Benthivores disturb the bottom sediments thereby releasing phosphorus into the water column, and planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as bullhead, which were found in the 2000 survey) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake. If cooperation is possible, work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Valentine Lake. Since there is a long record of in-lake water quality data for Valentine Lake, additional in-lake data collection is not a high priority at this time. Watershed phosphorus loading data are a high priority, as they will be needed for the future TMDL study

- TP, chlorophyll, and Secchi depth data: Collect at least five sampling dates per year. The TMDL can be based on the existing monitoring data; additional data should be collected after management actions are implemented to track the response of the lake.
- Chloride data: Collect chloride data for at least one year (including early spring during snowmelt runoff) to determine if chloride in the lake is high. Due to the proximity of the northern part of the lake to highways and other roads, samples should be taken from this northern lobe, in addition to the main sampling location. Since high chloride can be due to road salt in watershed runoff or to high chloride concentrations in the groundwater, samples should be taken throughout the year to examine fluctuations in chloride and how they relate to weather and road salt.
- Macrophyte surveys: Complete one macrophyte survey during June to evaluate the presence/absence of curly-leaf pondweed and other invasive aquatic vegetation. Complete another survey during August to evaluate the quality of the macrophytes after senescence of curly-leaf pondweed, when native macrophytes may dominate.
- Fish survey: Complete a fish survey to evaluate the fish species composition of the lake.
- Plankton survey: Collect zooplankton and phytoplankton data for one full season. This will supplement the information from the fish survey regarding the food web, which influences nutrient cycling within the lake. Management recommendations can then be targeted towards manipulating the food web dynamics to improve water quality.
- The following inlets to Valentine Lake should be monitored to provide flow and phosphorus loading estimates. These data will be needed in order to estimate the watershed phosphorus load to the lake for the TMDL study; the data will also provide guidance on site selection for larger scale improvement projects.
    - Northern inlet from Round Lake: This inlet also receives drainage from the developed area to the northeast of Valentine Lake. Additional data collection could be undertaken further upstream in this subwatershed to differentiate the Round Lake load from the northeast load.
    - Eastern inlet from Bethel Ditch: This inlet receives drainage from the large portion of the subwatershed to the east of the lake, including Bethel University. Additional data collection could be undertaken further upstream in this subwatershed to differentiate loads between the two branches of the ditch.

  There are multiple other smaller-scale inlets (ditches and pipes) to the lake that have a lower monitoring priority.

Valentine Lake Field Reconnaissance Supplement

Regional Management BMPs

Valentine #1
Location: North of I-694 and west of Highway 10
Description: Large open space with ditch running to the south under I-694 and then into Valentine Lake (large contributing drainage area).
Potential Improvements: Use space for large regional facility to treat the highways and upstream discharges. An assessment should first be done to assess the effectiveness of the upstream treatment features and determine if this ditch is a significant source of phosphorous to the Lake. Additional treatment may not be needed for upstream discharges because portions of the drainage area are already routed through wetland treatment features, however the area should at a minimum be considered for treatment of the adjacent highways when this area is reconstructed.

Local Management BMPs

Valentine #2
Location: North end of Valentine Lake
Description: Area receiving stormwater from I-694.
Potential Improvements: Enhance area to provide better treatment prior to discharge to Valentine Lake

Valentine #3
Location: North end of Valentine Lake
Description: Rusted out pipe delivering runoff from Mn/DOT right-of-way
Potential Improvements: Repair pipe and look into upstream BMPs to reduce sediment transport from I-694 to Valentine Lake.

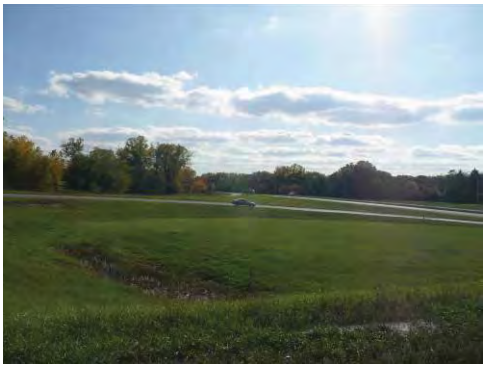
Valentine #4
Location: West of Snelling Avenue and south of Valentine Road
Description: Swale/ditch draining neighborhood from the west and draining under Snelling Avenue to Valentine Lake. Parking lot is in poor shape and not much higher than Valentine Lake. Water in photo is backwater from Valentine Lake.
Potential Improvements: Enhance/expand swale or remove parking and incorporate larger wetland treatment feature. Parking could be potentially moved out along Valentine Road.

Valentine #5
Location: West of Snelling Avenue and north of Lake Johanna Boulevard
Description: Low open space northwest of the intersection of Snelling Avenue and Lake Johanna Boulevard
Potential Improvements: Use for infiltration/ treatment of adjacent roadway

Valentine #6
Location: Dunlap street between Grey Fox Road and Red Fox Road
Description: Large green spaces between road and adjacent businesses
Potential Improvements: Use green spaces to treat impervious from adjacent businesses.

Valentine #7
Location: South of Gramsie Road and west of Randy Avenue
Description: Open space
Potential Improvements: Use to provide treatment for Gramsie Road

Valentine #8
Location: North of County Road E
Description: Large gravel area adjacent to County Road E
Potential Improvements: Use area for a new treatment feature when County Road E is repaired or upgraded.



Valentine #9
Location: SE Loop at Snelling and County Road E
Description: Both loops at Snelling and County Road E could be better used for stormwater treatment.
Potential Improvements: Provide additional treatment within loops (e.g. infiltration or ponding)

Site Specific Management BMPs

Valentine #10
Location: South of Grey Fox Road and east of Dunlap Street
Description: Treatment swale receiving runoff from adjacent parking areas.
Potential Improvements: Maintain/enhance to provide additional treatment.

Valentine #11
Location: North of Grey Fox Road and west of Dunlap Street
Description: Existing treatment pond
Potential Improvements: Maintain and retrofit to provide additional treatment. Remove concrete, add native vegetation, and get rid of geese.

Valentine #12
Location: North of Red Fox Road and east of Northwoods Drive
Description: Open areas adjacent parking lot.
Potential Improvements: Incorporate infiltration/ water quality treatment BMPs

Valentine #13
Location: North of County Road F and east of Lexington Avenue
Description: Apartment complex, no onsite treatment. This area is treated by a downstream pond; however, infiltration/biofiltration could be incorporated in the onsite green spaces to provide volume control and additional water quality treatment for a large amount of impervious area routed directly to stormsewer.
Potential Improvements: Incorporate infiltration/ biofiltration BMPs.

Valentine #14
Location: Mounds View High School
Description: Large swale running to a dry pond
Potential Improvements: Enhance swale and dry pond to provide additional infiltration/water quality treatment.

Walsh Lake Management Action Plan

Walsh Lake (62-0214) is located in the City of Roseville, Ramsey County, Minnesota (Figure 1). The lake has a surface area of about 8.5 acres, a maximum depth of 16 ft[1], and a watershed of 372 acres.

Walsh Lake meets the MPCA definition of wetland and is classified as a Class 2D (wetland) water in accordance with Minn. Rules Ch. 7050. Furthermore its designation as a Public Water Wetland ["W" 62-214] by the DNR Protected Water Inventory and the lack of an aquatic recreational resource management history (MPCA (*Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment*, 2007) substantiates the designation as a Class 2D water. The Class 2D designation means that the wetland resource is protected for the "maintenance of a healthy wetland aquatic community and for wetland based aquatic recreation." Numeric nutrient standards developed for shallow lakes (i.e. 60 µg/L TP) do not apply to Class 2D wetlands.

The watershed draining to Walsh Lake includes residential area, the Midland Hills Country Club golf course, and the University of Minnesota Les Bolstad golf course. The lake consists of a north and smaller south basin. The lake has two outlets to control water levels on the lake with the lift station utilized to control the bounce of Walsh Lake. The lift station pumps water north into the Jones Lake watershed and a small gravity pipe drains west leaving the Rice Creek Watershed District. The drainage to the north eventually drains to Jones Lake via a series of holding ponds and drainage ditches entering Jones Lake just after joining RCD 5. Jones Lake is on the EPA's 303(d) list of impaired waters as an impaired wetland, and therefore Walsh Lake and its watershed will be addressed in the Jones Lake TMDL study.

Walsh Lake is at times used by the Midland Hills Country Club for golf course irrigation.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos; No bathymetric data were available for this lake. The maximum depth was estimated from the depth data collected during sediment sampling.

Figure 1. Walsh Lake and Potential BMP Locations

Water Quality Summary

Water quality and biological data are not available for Walsh Lake. A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. There are no in-lake monitoring data to calibrate the lake model. Water quality modeling indicates that watershed inputs account for approximately 86% of the nutrient load, with internal loading accounting for the remaining 14% (Figure 2). Without any in-lake nutrient data for the lake for model calibration, the modeling results should be considered preliminary.

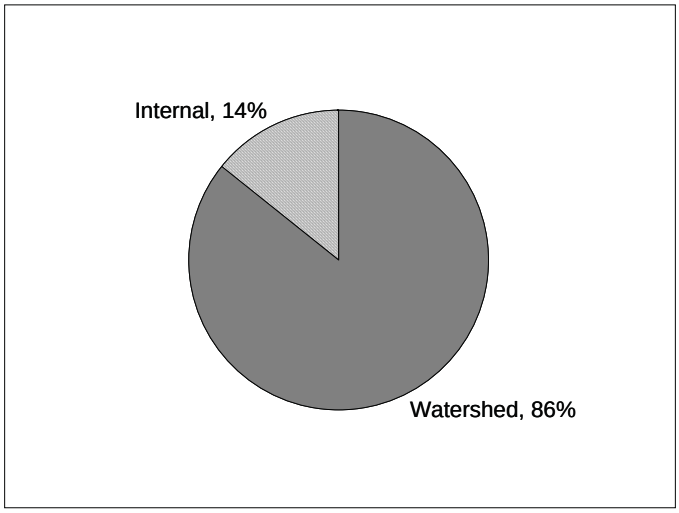


Figure 2. Walsh Lake Phosphorus Load Distribution

Public Input

No attendees spoke on issues related to Walsh Lake at the public input meeting on June 5, 2008. However, a resident lakeshore homeowner indicated in the past that there is occasional flooding of the west side of the south basin. The homeowner described flow coming from Roselawn Avenue and north on Pleasant Street. The homeowner has seen water mid-way up his driveway on past flooding occasions. The property is located in Roseville, with runoff water causing the problem originating in both Roseville and Falcon Heights adjacent to Roselawn Ave. It is the District's understanding that this concern has been minimized to the extent feasible through a modeling and pump operation assessment by the City of Lauderdale.

Water Quality Issues

- Without further data or public input, water quality issues were not able to be defined.

Recommended Management Approach

Watershed Management Recommendations

Management of land in the watershed is a critical element in addressing the water quality of Walsh Lake. Because the Walsh Lake watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, 8 BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of potential local BMP locations identified in the *field reconnaissance supplement.*
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- The primary management recommendation for the lake's watershed is to make sure strict application of RCWD and local runoff related regulations are followed throughout the watershed draining to the lake. BMP retrofit opportunities should be identified during future re-development processes within the watershed.
- Nutrient management for the two golf courses (Midland Hills Country Club and the University of Minnesota) with tributaries to the lake should be considered. The U of M course is located to the east of the lake, on the south side of Roselawn Ave. and is slightly buffered from directly discharging to the lake. It does, however, contribute runoff to the lake via runoff down Roselawn. The Midland Hills Country Club directly surrounds the north basin of the lake. Nutrient management practices on this course directly affect the quality of the lake.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

With very little in-lake biological data for Walsh Lake, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply to Walsh Lake:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.
- A fisheries survey will indicate the balance of benthivores, planktivores, and piscivores in the lake. Benthivores disturb the bottom sediments thereby releasing phosphorus into the water column, and planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Walsh Lake. There are no in-lake water quality data for the lake; if the implementation of management practices for the lake were to move forward, in-lake data would be needed and should be considered a high priority.

- Bathymetric data collection
- TP and chlorophyll data: Grab water quality samples should be collected if there is cause to believe that the waterbody is enriched with nutrients (as evidenced by mid-summer algae blooms) AND the water body is contributing flow to adjacent lakes.
- Macrophyte and/or aquatic invertebrate data should be collected in cooperation with the MPCA to determine if the water body is meeting the "healthy aquatic community standards."

Walsh Lake Field Reconnaissance Supplement

Local Management BMPs

Walsh Lake #1
Location: South of Summer Street and east of Carl Street
Description: Private corner lot
Potential Improvements: Create stormwater treatment feature for adjacent street runoff.

Walsh Lake #2
Location: West side of Lauderdale Community Park off of Pleasant Street
Description: Open park space
Potential Improvements: Create stormwater treatment feature for adjacent street runoff.

Walsh Lake #3
Location: Fulham Street-between Ione St. and Roselawn Avenue
Description: Swales/green space in right-of-way
Potential Improvements: Maintain/improve routing of runoff through green space or convert to raingarden areas.

Walsh Lake #4

Location: East side of Lauderdale Community Park off of Fulham Street

Description: Large grass swale areas both north and south of parking lot drive. The swale north of the entrance is supposed to be filled with sandy soils and a large raingarden was to be created in northeast corner to promote infiltration per RCWD Permit 00-001.

Potential Improvements: Verify presence of sandy soils in swale, and improve treatment via excavation of depressional storage and vegetation enhancement in northeast corner.

Walsh Lake #5

Location: East of Midland Hills Road and North of Rosewood Lane North

Description: Wetland area

Potential Improvements: Looks fairly good as is, however an assessment could be made to determine the benefit of increasing storage or other modifications that could be made to provide additional treatment. (Note: there may have low floor issues with 2211 Rosewood Lane.) Roseville has identified this area for implementation of an expansion project in 2009.

Walsh Lake #6

Location: Midland Hills Golf course, north of Walsh Lake

Description: Ponding area that receives several stormsewer inputs and discharges to Walsh Lake

Potential Improvements: Excavation/maintenance to increase storage, native vegetation around pond perimeter, and the addition of a skimming structure at the outlet.

Vegetation Management BMPs

Walsh Lake #7
Location: West side of Walsh Lake
Description: Golf course area immediately adjacent to Walsh Lake
Potential Improvements: Replace turf with native vegetation buffer along western shore of the lake.

Walsh Lake #8
Location: Pond at the corner of Roselawn Avenue and Cleveland Avenue
Description: Large pond, very green, and several geese on the day of the site visit.
Potential Improvements: Replace grass with native vegetation along the shoreline on the adjacent church property.

Zimmerman Lake Management Action Plan

Zimmerman Lake (62-0053) is located in the City of Roseville, Ramsey County, Minnesota (Figure 1). The lake has a surface area of about 13 acres with a mean depth of approximately 4 feet.[1]

Zimmerman Lake meets the MPCA definition of wetland and is classified as a Class 2D (wetland) water in accordance with Minn. Rules Ch. 7050. Furthermore its designation as a Public Water Wetland ["W" 62-53] by the DNR Protected Water Inventory and the lack of an aquatic recreational resource management history (MPCA (*Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment*, 2007) substantiates the designation as a Class 2D water. The Class 2D designation means that the wetland resource is protected for the "maintenance of a healthy wetland aquatic community and for wetland based aquatic recreation." Numeric nutrient standards developed for shallow lakes (i.e. 60 µg/L TP) do not apply to Class 2D wetlands.

The watershed draining to Zimmerman Lake is 531 acres and is a heavily developed mix of commercial, transportation, and residential uses. It drains northward through Ramsey County Ditch 4, eventually draining to Little Johanna Lake, which is on the EPA's 303(d) list of impaired waters.

Zimmerman Lake provides an amenity to the golf course located to its east and the Mn/DOT office building to its west.

[1] The lake areas were determined by digitizing lake boundaries using 2006 1-foot resolution air photos. No bathymetric data were available for this lake. The maximum depth was estimated using depth data collected during sediment sampling.

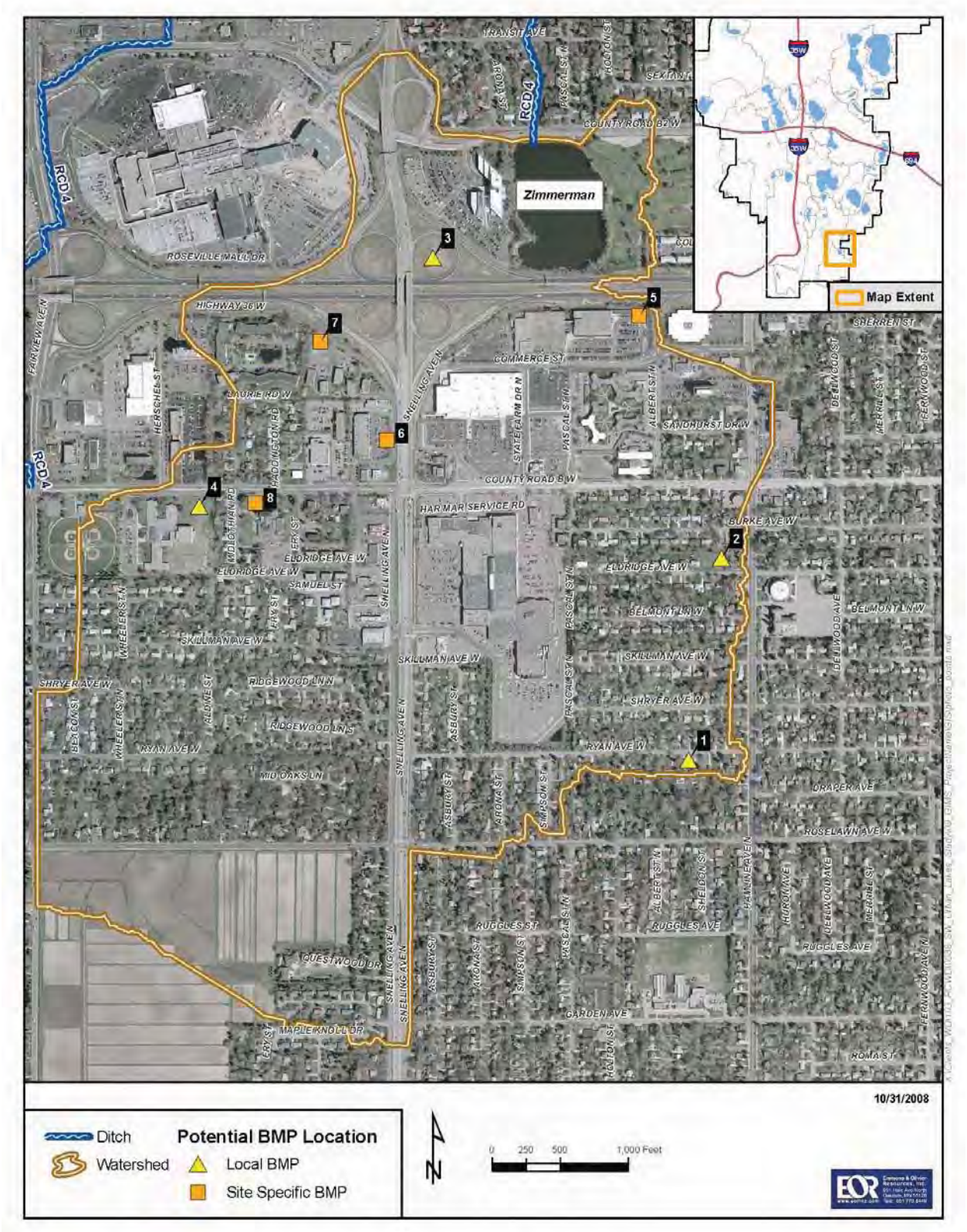


Figure 1. Zimmerman Lake and Potential BMP Locations

Water Quality Summary

There are no nutrient or biological data for Zimmerman Lake. A watershed model (P8) was used to estimate the watershed phosphorus load to the lake, and an in-lake model (Bathtub) was used to predict the response of the lake to phosphorus loading. There are no in-lake monitoring data to calibrate the lake model. Water quality modeling indicates that watershed inputs account for approximately 96% of the nutrient load, with internal loading accounting for 4% (Figure 2). Without any in-lake nutrient data for the lake for model calibration, the modeling results should be considered preliminary. Water clarity data inferred from satellite imagery suggest that the water clarity depth of Zimmerman Lake is less than 1.5 feet.

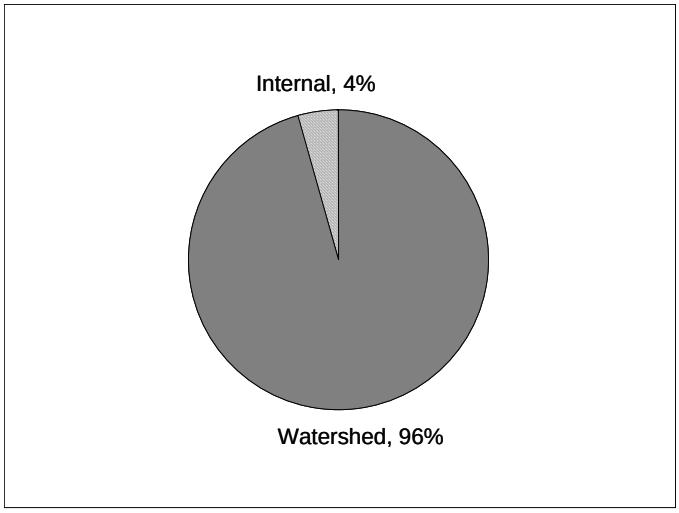


Figure 2. Zimmerman Lake Phosphorus Load Distribution

Public Input

No attendees spoke on issues related to Zimmerman Lake at the public input meeting on June 5, 2008.

Water Quality Issues

- Without further data or public input, water quality issues were not able to be defined.

Recommended Management Approach

Watershed Management Recommendations

Management of land in the watershed is a critical element in addressing downstream impairments. Because the Zimmerman Lake watershed is fully developed, opportunities for retrofitting BMPs into the watershed as it re-develops or as routine maintenance occurs should be sought. To that end, a preliminary field reconnaissance was conducted to identify likely regional, local and site-specific retrofit opportunities. Potential BMP locations identified during this field investigation are identified on Figure 1 and detailed in the *field reconnaissance supplement* at the end of this report. In summary, eight BMP retrofit opportunities were identified in this preliminary field reconnaissance. The following are specific actions that could be pursued to reduce external loading.

- Consideration of local partnerships for further assessment of the four potential local BMP locations identified in the *field reconnaissance supplement*.
- Notice/letter to potential site-specific BMP landowners educating them of potential grant funding through the District's Urban Stormwater Remediation Cost-Share Program.
- Ensure that strict application of RCWD and other local stormwater regulations are followed throughout the watershed draining to the lake.

There are several options known to successfully reduce nutrient runoff that can be suggested even before data are available that will allow more targeted management. These general practices include:

- Stormwater management retrofits for better nutrient, volume, rate, and erosion control
- Nutrient and stormwater volume absorbing raingardens
- Increased frequency of street-sweeping and targeted prioritization to direct runoff areas
- Buffer zones of native vegetation along the lake-shore (good for both runoff problems and fish survival)
- Public education programs to encourage voluntary land-owner changes in landscaping, lawn fertilization, and runoff management
- Active inspection programs for and routine maintenance of previously installed stormwater BMPs
- Compliance monitoring and inspection of active construction sites for adequate erosion and sediment control

Internal Lake Management Recommendations

With no biological or water quality data for Zimmerman Lake, specific in-lake management recommendations can not be made at this time. However, a number of shallow lake management principles will likely apply to Zimmerman Lake:

- If curly-leaf pondweed is present in high densities, it likely contributes to internal loading, and curly-leaf pondweed removal activities should be considered. Curly-leaf pondweed releases a pulse of phosphorus into the water column in June when the plants senesce.
- Submerged and emergent aquatic macrophytes in the lake normally stabilize the sediments and provide refugia for zooplankton. If the macrophyte communities are determined to be sparse, shoreline and littoral zone restoration practices should be undertaken.
- A fisheries survey will indicate the balance of benthivores, planktivores, and piscivores in the lake. Benthivores disturb the bottom sediments thereby releasing phosphorus into the water column, and planktivores can overgraze zooplankton, which normally graze on phytoplankton and keep chlorophyll concentrations in balance. If there is an overabundance of benthivorous fish (such as carp or bullhead) or an overabundance of planktivores, a fisheries management plan should be developed that will aim to restore the balance of these types of fish in the lake. If cooperation is possible, work with DNR to promote a fisheries management strategy that places importance on water quality, while maintaining a viable fishery.

Recommended Data Collection

The following in-lake data collection will help tailor the management recommendations for Zimmerman Lake. There are no in-lake water quality data for the lake; if the implementation of management practices for the lake were to move forward, in-lake data and bathymetric data would be needed and should be considered a high priority.

- Bathymetric data collection
- TP and chlorophyll data: Grab water quality samples should be collected if there is cause to believe that the water body is enriched with nutrients (as evidenced by mid-summer algae blooms) AND the waterbody is contributing flow to adjacent lakes.
- Macrophyte and/or aquatic invertebrate data should be collected in cooperation with the MPCA to determine if the waterbody is meeting the "healthy aquatic community standards."

Zimmerman Lake Field Reconnaissance Supplement

Local Management BMPs

Zimmerman #1
Location: South side of Ryan Avenue W and west of Hamline Avenue N
Description: Example of large open areas in front yards
Potential Improvements: Install raingardens along road corridors; many opportunities in this area will exist when streets are reconstructed. (Note: there are also large boulevard trees limiting some areas.)

Zimmerman #2
Location: North of Eldridge Avenue W and west of Hamline Avenue N
Description: Large open lot
Potential Improvements: Room for good-sized infiltration or water quality feature (might not be able to get enough drainage area to the location to necessitate using the entire lot).

Zimmerman #3
Location: North of County Road B2 W and east of Snelling Avenue
Description: Southeast exit ramp loop
Potential Improvements: It appears that the loop areas adjacent to Snelling Ave. could be better used for treatment. These areas should be assessed for opportunities during road improvement projects.

Zimmerman #4
Location: South of County Road B and west of Midlothian Road
Description: Large open area at school
Potential Improvements: Incorporate feature for school and or adjacent roads. Note there are lots of opportunities on the school site to provide treatment (as needed). It appears that a raingarden was recently incorporated for a small paving project on site.

Site Specific Management BMPs

Zimmerman #5
Location: North of Commerce Street and west of Albert Street (or commerce Street to EB Hwy 36)
Description: Swale and dry pond picking up large parking area
Potential Improvements: Improve feature to include infiltration and/or water quality improvement.

Zimmerman #6
Location: West of Snelling Avenue and South of Hwy 36
Description: Swale picking up parking via curb cuts. No storage currently provided and curb cuts not draining properly.
Potential Improvements: Enhance area to provide depressional storage / create raingardens or bio-filtration areas.

Zimmerman #7
Location: West of Snelling Avenue and south of Hwy 36
Description: Green space area in apartment complex
Potential Improvements: Green space areas in apartment ground could be better used to provide treatment.

Zimmerman #8

Location: South of County Road B and east of Midlothian Road

Description: Swale flowing to storm sewer at St. Michael Church

Potential Improvements: Convert to raingarden/ biofiltration area.

APPENDIX H
Previous Study Summary – Lake Josephine

APPENDIX G

PREVIOUS STUDY SUMMARY – LAKE JOSEPHINE

Lake Josephine Assessment Report

The MPCA along with MDNR, Ramsey County Public Works, RCWD and Josephine Lake Association issued a Lake Assessment Report for Josephine Lake in 1998. Pertinent portions from that report are as follows:

> (page iii)
>
> A good historical data base is available for assessing trends in water quality of Lake Josephine. These data include 22 years of Secchi data and several years of water chemistry data. Based on an analysis of 22 years of CLMP, MPCA, DNR, Met. Council, Ramsey County, and two environmental consulting firm's Secchi transparency data, Lake Josephine exhibited a significant improvement in transparency over time ($R_K = 0.52$; $p=0.0008$). Summer mean Secchi transparency measures ranged from 2.3 to 4.3 feet from 1975-1979. In contrast, from 1981-1989 summermeanSecchi ranged from 3.0 to 10.2 feet and from 1990-1998 summer-mean Secchi ranged from 5.2 to 12.1 feet. Summer-mean total phosphorus and chlorophyll-a concentrations exhibited a decline over this time period as well.
>
> (page 3)
>
> Lake Josephine's watershed is relatively small at about 734 acres, excluding the lake. The vast majority (96%) of the watershed is in urban/residential lake use. This percentage, although not typical for lakes in the North Central Hardwood Forest ecoregion, is rather typical for lakes in the Twin Cities metro area. Little Lake Josephine is about 12 acres in size, much of which is covered by cattails and emergent vegetation; however, the open water portion has maximum depth of 25 feet. Originally, about 260 acres drained through Little Lake Josephine prior to entering Lake Josephine. In 1980, a project conducted by the RCWD, in consultation with E.A. Hickok Engineering, resulted in an additional 220 acres of direct drainage from Lake Josephine watershed to Little Lake Josephine. As a result, about 480 acres (65%) drained through Little Lake Josephine prior to entering Lake Josephine. This would result in dramatic improvements in the quality of Lake Josephine (emphasis added).

It is noted that only half of Lake Josephine is within the boundaries of the City of Arden Hills while the remainder is within the City of Roseville. Also, the RCWD storm sewer diversion project took place in Roseville. This importance of this discussion is three-fold. First, a value judgement was made by all agencies involved in the 1980 project that resulted in diverting storm water from one public water into another for treatment. Second, Little Lake Josephine has operated much like a NURP storm water detention pond and thus has improved Lake Josephine's water quality. Third and most important, some of the proposed eleven ponds may involve existing wetlands similar, but much smaller in surface area and depth than Little Lake Josephine, and their use may come into play with implementation of the City's LSWMP.

APPENDIX I
Grant Opportunities

APPENDIX H

GRANT OPPORTUNITIES

Grants

State grants are available for surface water management and non-point source pollution. Examples of some available grants include:

Environmental Protection Agency (EPA): Section 319 Grants
The MPCA applies annually to the United States EPA for Clean Water Act Section 319(h) grant funds. A significant portion of these funds are competitively awarded to local government units and other groups to work on projects that address nonpoint-source water pollution. Fund availability varies. Some programs include:

- 319 Developmental, Education and Research matching grants to support education, training and research projects that are implementation oriented.
- 319 Implementation (non-TMDL) matching grants to support BMP implementation and technical assistance.
- 319 TMDL Implementation matching grants to support the implementation of TMDL's.

MPCA Clean Water Partnership Grants
These are funds appropriated by the Minnesota State Legislature. Funds are awarded to local government units or other groups for work on projects that address non-point source water pollution. Fund availability varies.

MPCA Clean Water Legacy
These are funds established through the Minnesota Clean Water Legacy Act of 2006. Appropriations fund a variety of projects including:

- Surface Water Assessments
- TMDL Development
- TMDL Implementation
- Local Wastewater and Stormwater Projects

MPCA Low Interest Loans
Typically used for wastewater treatment and collection systems, MPCA's State Revolving Loan Fund dollars can be used in watershed or non-point source control.

APPENDIX J
2006-2011 SWPPPs

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

MS4 Annual Report for 2012

Municipal Separate Storm Sewer Systems (MS4s)

Reporting period January 1, 2012 to December 31, 2012
Due June 30, 2013

Doc Type: Permitting Annual Report

Instructions: By completing this mandatory MS4 Annual Report form, you are providing the Minnesota Pollution Control Agency (MPCA) with a summary of your status of compliance with permit conditions, including an assessment of the appropriateness of your identified best management practices (BMPs) and progress towards achieving your identified measurable goals for each of the minimum control measures as required by the MS4 Permit. If a permittee determines that program status or compliance with the permit can not be adequately reflected within the structure of this form additional explanation and/or information may be referenced in an attachment. This form has significant limitations and provides only a snap shot of MS4 compliance with the conditions in the permit. After reviewing the information, MPCA staff may need to contact the permittee to clarify or seek additional information.

Submittal: This MS4 Annual Report must be submitted electronically to the MPCA using the submit button at the end of the form, from the person that is duly authorized to certify this form. All questions with an asterisk (*) are required fields (these fields also have a red border), and must be completed before the form will send. A confirmation e-mail will be sent in response to electronic submissions.

If you have further questions, please contact one of these MPCA staff members (toll-free 800-657-3864):

- Scott Fox 651-757-2368 scott.fox@state.mn.us
- Claudia Hochstein 651-757-2881 claudia.hochstein@state.mn.us
- Cole Landgraf 651-757-2880 cole.landgraf@state.mn.us
- Dan Miller 651-757-2246 daniel.miller@state.mn.us
- Rachel Stangl 651-757-2879 rachel.stangl@state.mn.us

General Contact Information (*Required fields)

*Name of MS4: City of Arden Hills *Contact name: John Anderson

*Mailing address: 1245 West Highway 96

*City: Arden Hills *State: MN *Zip code: 55112

*Phone (including area code): 651-792-7846 *E-mail: janderson@cityofardenhills.org

Minimum Control Measure 1: Public Education and Outreach [V.G.1] (*Required fields)

A. The permit requires each permittee to implement a public education program to distribute educational materials to the community or conduct equivalent outreach activities about the impacts of stormwater discharges on water bodies and steps that the public can take to reduce pollutants in stormwater runoff. [Part V.G.1.a]

Note: Please indicate which of the following distribution methods you used. Indicate the number distributed in the spaces provided (enter "0" if the method was not used or "NA" if the data does not exist):

Media type	Number of media	Number of times published	Circulation/ Audience
Example: Brochures:	*3 different brochures*	*published 5 times*	*about 10,000*
Brochures:	3 different brochers	once, available at City Hall	about 100
Newsletter:	Arden Hills Notes	articles in 4 editions	2700 housholds
Posters:			
Newspaper articles:			
Utility bill inserts:			
Radio ads:			
Television ads:			
Cable Access Channel:	1	streaming banner	city wide
Other: RCWD calender			
Other:			
Other:			

B. *Do you use a website as a tool to distribute stormwater educational materials? ☒ Yes ☐ No

What is the URL: http://www.cityofardenhills.org/index.aspx?NID=219

C. If you answered yes in question B. above, do you track hits to the website? ☒ Yes ☐ No

How many hits were to the stormwater webpage: 339+

D. *Did you hold stormwater related events, presentations to schools or other such activities? ☒ Yes ☐ No

If yes, please describe:

Rain garden Planting at Valentine Park, Rain Garden / BMP presentation for 2013 PMP. Compost / Rainbarrel sale in conjunction with the City of Roseville

E. *Have specific messages been developed and distributed during this reporting year for Minimum Control Measure (MCM):

MCM 1: ☐ Yes ☒ No MCM 4: ☐ Yes ☒ No

MCM 2: ☐ Yes ☒ No MCM 5: ☐ Yes ☒ No

MCM 3: ☐ Yes ☒ No MCM 6: ☐ Yes ☒ No

F. *Have you developed partnerships with other MS4s, watershed districts, local or state governments, educational institutions, etc., to assist you in fulfilling the requirements for MCM 1? ☒ Yes ☐ No

G. List those entities with which you have partnered to meet the requirements of this MCM and describe the nature of the agreement(s): *(Attach a separate sheet if necessary.)*

Rice Creek Watershed District, Informal agreement for educational materials. Ramsey County conservation District is contracted to provide construction erosion control inspections, as part of this work they are involved in education of contractors they come in contact with in order to comply with the city's stormwater ordinances.

H. *Have you developed methods to assess the effectiveness of your public education/outreach program? ☐ Yes ☒ No

If yes, please describe:

Minimum Control Measure 2: Public Participation/Involvement [V.G.2] (*Required fields)

A. *Did you hold a public meeting to present accomplishments and to discuss your Stormwater Pollution Prevention Program (SWPPP)? [Part V.G.1.e] ☒ Yes ☐ No

If no, explain:

B. What was the date of the public meeting (mm/dd/yyyy): 05/28/2013

C. How many citizens attended specifically for stormwater (excluding board/council members and staff/hired consultants)? 0

D. Was the public meeting a stand-alone meeting for stormwater or was it combined with some other function (City Council meeting, other public event, etc.)? ☐ Stand-alone ☒ Combined

E. *Each permittee must solicit and consider input from the public prior to submittal of the annual report. Did you receive written and/or oral input on your SWPPP? [Part V.G.2.b.1-3] ☒ Yes ☐ No

F. *Have you revised your SWPPP in response to written or oral comments received from the public since the last annual reporting cycle? [Part V.G.2.c] ☐ Yes ☒ No

If yes, describe: *(Attach a separate sheet if necessary.)*

Minimum Control Measure 3: Illicit Discharge Detection and Elimination [V.G.3] (*Required fields)

The permit requires permittees to develop, implement, and enforce a program to detect and eliminate illicit discharges as defined in 40 CFR 122.26(b)(2). You must also select and implement a program of appropriate BMPs and measurable goals for this minimum control measure.

A. *Did you update your storm sewer system map? ☒ Yes ☐ No

If yes, please explain which components (ponds, pipes, outfalls, waterbodies, etc.) were updated/added:

waterbodies and outfalls

Note: *The storm sewer system map was to be completed by June 30, 2008. [Part V.G.3.a]*

B. *Have you modified the format in which the map is available? ☒ Yes ☐ No

C. If yes, indicate the new format:

☐ Hardcopy only ☒ GIS system ☐ CAD ☐ Other system: _____

D. *Did you inspect for illicit discharges during the reporting year? ☒ Yes ☐ No

E. If you answered yes in question D above, did you identify any illicit discharges? ☐ Yes ☒ No

F. If you answered yes in question E above, how many illicit discharges were detected during the reporting period: _____

G. If you answered yes in question F above, did the illicit discharge result in an enforcement action? ☐ Yes ☐ No

If yes, what type of enforcement action(s) was taken (check all that apply):

☐ Verbal warning ☐ Notice of violation ☐ Fines ☐ Criminal action

☐ Civil penalties ☐ Other (describe): _____

Minimum Control Measure 4: Construction Site Stormwater Runoff [V.G.4] (*Required fields)

The permit requires that each permittee **develop, implement, and enforce a program** to reduce pollutants in any stormwater runoff to your small MS4 from construction activities within your jurisdiction that result in a land disturbance of equal to or greater than one acre, including the disturbance of less than one acre of total land area that is part of a larger common plan of development or sale if the larger common plan will ultimately disturb one or more acres. [Part V.G.4.]

A. The permit requires an erosion and sediment control ordinance or regulatory mechanism that must include sanctions to ensure compliance and contains enforcement mechanisms [Part V.G.4.a]. Indicate which of the following enforcement mechanisms are contained in your ordinance or regulatory mechanism and the number of actions taken for each mechanism used during the reporting period (enter "0" if the method was not used or "NA" if the data does not exist). **Check all that apply.**

Enforcement mechanism	Number of actions
☐ Verbal warnings	#
☒ Notice of violation	# 105
☐ Administrative orders	#
☐ Stop-work orders	#
☐ Fines	#
☐ Forfeit of security of bond money	#
☐ Withholding of certificate of occupancy	#
☐ Criminal actions	#
☐ Civil penalties	#
☐ Other:	#

B. *Have you developed written procedures for site inspections? ☒ Yes ☐ No

C. *Have you developed written procedures for site enforcement? ☒ Yes ☐ No

D. *Identify the number of active construction sites greater than an acre in your jurisdiction during the reporting period year: 6

E. *On average, how frequently are construction sites inspected (e.g., weekly, monthly, etc.)? every two weeks

F. *How many inspectors, at any time, did you have available to verify erosion and sediment control compliance at construction sites during the reporting period: 1

Minimum Control Measure 5: Post-construction Stormwater Management in New Development and Redevelopment [V.G.5] (*Required fields)

The permit requires each permittee to develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects within your jurisdiction that disturb an area greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale that discharge into your small MS4. Your program must ensure that controls are in place that would prevent or reduce water quality impacts. You must also select and implement a program of appropriate BMPs and measurable goals for this minimum control measure.

Note: The MS4 permit requirements associated with this minimum control measure were required to be fully developed and implemented by June 30, 2008.

A. *Have you established design standards for stormwater treatment BMPs installed as a result of post-construction requirements? ☒ Yes ☐ No

B. *Have you developed procedures for site plan review which incorporate consideration of water quality impacts? ☒ Yes ☐ No

C. *How many projects have you reviewed during the reporting period to ensure adequate long-term operation and maintenance of permanent stormwater treatment BMPs installed as a result of post-construction requirements? [Part V.G.5.b.and Part V.G.5.c]. 6

D. *Do plan reviewers use a checklist when reviewing plans? ☒ Yes ☐ No

E. *How are you funding the long-term operation and maintenance of your stormwater management system? (Check all that apply)

☐ Grants ☒ Stormwater utility fee ☐ Taxes ☐ Other: _____

Minimum Control Measure 6: Pollution Prevention/Good Housekeeping for Municipal Operations [V.G.6] (*Required fields)

The permit requires each MS4 to develop and implement an operation and maintenance program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations. Your program must include employee training to prevent and reduce stormwater pollution from activities, such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and stormwater system maintenance.

A. *Indicate the total number of structural pollution control devices (for example-grit chambers, sumps, floatable skimmers, etc.) within your MS4, the total number that were inspected during the reporting period, and calculate the percent inspected. Enter "0" if your MS4 does not contain structural pollution control devices or none were inspected. Enter "NA" if the data does not exist:

	*Total number	*Number inspected	*Percentage
*Structural pollution control devices:	9	9	100

B. *Did you repair, replace, or maintain any structural pollution control devices? ☒ Yes ☐ No

C. *For each BMP below, indicate the total number within your MS4, how many of each BMP type were inspected and the percent inspected during the reporting period. Enter "0" if your MS4 does not contain BMPs or none were inspected. Enter "NA" if the data does not exist:

Structure/Facility type	*Total number	*Number inspected	*Percentage
*Outfalls to receiving waters:	232	204	85
*Sediment basins/ponds:	50	35	70
***Total**	282	239	85

D. Of the BMPs inspected in C. above, did you include any privately owned BMPs in that number? ☐ Yes ☒ No

E. If yes in D. above, how many: _____

Section 7: Impaired Waters Review (*Required fields)

The permit requires any MS4 that discharges to a Water of the State, which appears on the current U. S. Environmental Protection Agency (EPA) approved list of impaired waters under Section 303(d) of the Clean Water Act, review whether changes to the SWPPP may be warranted to reduce the impact of your discharge [Part IV.D].

A. *Does your MS4 discharge to any waters listed as impaired on the state 303 (d) list? ☒ Yes ☐ No

B. *Have you modified your SWPPP in response to an approved Total Maximum Daily Load (TMDL)? ☐ Yes ☒ No

If yes, indicate for which TMDL: _____

Section 8: Additional SWPPP Issues (*Required fields)

A. *Did you make a change to any BMPs or measurable goals in your SWPPP since your last report? [Part VI.D.3.] ☐ Yes ☒ No

B. If *yes*, briefly list the BMPs or any measurable goals using their unique SWPPP identification numbers that were modified in your SWPPP, and why they were modified: *(Attach a separate sheet if necessary.)*

C. *Did you rely on any other entities (MS4s, consultants, or contractors) to implement any portion of your SWPPP? [Part VI.D.4.] ☒ Yes ☐ No

If *yes,* please identify them and list activities they assisted with:

Rice Creek Watershed District for educational opportunities
Ramsey Conservation District - Erosion control inspections and enforcement

Owner or Operator Certification (*Required fields)

The person with overall administrative responsibility for SWPPP implementation and Permit compliance must certify this MS4 Annual Report. This person must be duly authorized and should be either a principal executive (i.e., Director of Public Works, City Administrator) or ranking elected official (i.e., Mayor, Township Supervisor).

☒ *Yes - *I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete (Minn. R. 7001.0070). I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment (Minn. R. 7001.0540).*

*Name of certifying official: John Anderson

*Title: Assistant City Engineer *Date: 06/26/2013 *(mm/dd/yyyy)*

Submit

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

MS4 Annual Report for 2013

Municipal Separate Storm Sewer Systems (MS4s)

Reporting period January 1, 2013 to December 31, 2013
Due June 30, 2014

Doc Type: Permitting Annual Report

Instructions: By completing this mandatory MS4 Annual Report form, you are providing the Minnesota Pollution Control Agency (MPCA) with a summary of your status of compliance with permit conditions, including an assessment of the appropriateness of your identified best management practices (BMPs) and progress towards achieving your identified measurable goals for each of the minimum control measures as required by the MS4 Permit (permit). If a permittee determines that program status or compliance with the permit can not be adequately reflected within the structure of this form additional explanation and/or information may be referenced in an attachment. This form has limitations and provides only a snap shot of your compliance with the conditions in the permit. After reviewing the information, MPCA staff may need to contact the permittee to clarify or seek additional information.

Submittal: This MS4 Annual Report must be submitted electronically to the MPCA using the submit button at the end of the form, from the person that is duly authorized to certify this form. All questions with an asterisk (*) are required fields (these fields also have a red border), and must be completed before the form will send. A manual confirmation e-mail will be sent in response to electronic submissions. If you do not receive an e-mail confirmation within two business days, please contact the program staff below. (If the submit button does work for you, you can save a copy of the form to a location on your computer where you will easily be able to retrieve it. You will then have to attach the form separately to an e-mail once you are within your Internet mail.)

If you have further questions, please contact one of these MPCA staff members (toll-free 800-657-3864):

- Scott Fox 651-757-2368 scott.fox@state.mn.us
- Claudia Hochstein 651-757-2881 claudia.hochstein@state.mn.us
- Cole Landgraf 651-757-2880 cole.landgraf@state.mn.us
- Dan Miller 651-757-2246 daniel.miller@state.mn.us
- Rachel Stangl 651-757-2879 rachel.stangl@state.mn.us

General Contact Information (*Required fields)

*Name of MS4: City of Arden Hills *Contact name: John Anderson

*Mailing address: 1245 West Highway 96

*City: Arden hills *State: MN *Zip code: 55112

*Phone (including area code): 651-792-7846 *E-mail: janderson@cityofardenhills.org

Minimum Control Measure 1: Public Education and Outreach [V.G.1] (*Required fields)

A. The permit requires each permittee to implement a public education program to distribute educational materials to the community or conduct equivalent outreach activities about the impacts of stormwater discharges on water bodies and steps that the public can take to reduce pollutants in stormwater runoff. [Part V.G.1.a]

Note: Indicate which of the following distribution methods you used. Indicate the number distributed in the spaces provided (enter "0" if the method was not used or "NA" if the data does not exist):

Media type	Number of media	Number of times published	Circulation/ Audience
Example: Brochures:	*3 different brochures*	*published 5 times*	*about 10,000*
Brochures:			
Newsletter:	Arden Hills Notes	3 publ. relevant to stormwater	citywide, 2,700
Posters:			
Newspaper articles:			
Utility bill inserts:			
Radio ads:			
Television ads:			
Cable Access Channel:	1	various items throughout the yr	citywide, 2,600
Other:			
Other:			
Other:			

B. *Do you use a website as a tool to distribute stormwater educational materials? ☒ Yes ☐ No

What is the URL: www.cityofardenhills.org

C. If you answered yes in question B. above, do you track hits to the site? ☒ Yes ☐ No

How many hits were to the stormwater page?: 46

D. *Did you hold stormwater related events, presentations to schools or other such activities? ☒ Yes ☐ No

If yes, describe:

Rain Barrel sale

E. *Have specific messages been developed and distributed during this reporting year for Minimum Control Measure (MCM):

MCM 1: ☐ Yes ☒ No MCM 4: ☐ Yes ☒ No

MCM 2: ☐ Yes ☒ No MCM 5: ☐ Yes ☒ No

MCM 3: ☐ Yes ☒ No MCM 6: ☐ Yes ☒ No

F. *Have you developed partnerships with other MS4s, watershed districts, local or state governments, educational institutions, etc., to assist you in fulfilling the requirements for MCM 1? ☒ Yes ☐ No

G. List those entities with which you have partnered to meet the requirements of this MCM and describe the nature of the agreement(s). Attach a separate sheet if necessary:

Rice Creek Watershed District - Share education materials and website links
Ramsey Conservation District - education associated with Inspections

H. *Have you developed methods to assess the effectiveness of your public education/outreach program? ☐ Yes ☒ No

If yes, describe:

Minimum Control Measure 2: Public Participation/Involvement [V.G.2] (*Required fields)

A. The permit requires you to hold at least one public meeting per year addressing the Stormwater Pollution Prevention Program. You must hold the public meeting prior to submittal to the Commissioner of the annual report. [Part V.G.1.e.]

B. *Did you hold a public meeting to present accomplishments and to discuss your Stormwater Pollution Prevention Program (SWPPP)? ☒ Yes ☐ No

If no, explain:

C. *What was the date of the public meeting: 04/28/2014

D. *How many citizens attended specifically for stormwater (excluding board/council members and staff/hired consultants)? 0

E. *Was the public meeting a stand-alone meeting for stormwater or was it combined with some other function (City Council meeting, other public event, etc.)? ☐ Stand-alone ☒ Combined

F. *Each permittee must solicit and consider input from the public prior to submittal of the annual report. Did you receive written and/or oral input on your SWPPP? [Part V.G.2.b.1-3] ☐ Yes ☒ No

G. *Have you revised your SWPPP in response to written or oral comments received from the public since the last annual reporting cycle? [Part V.G.2.c] ☐ Yes ☒ No

If *yes*, describe. Attach a separate sheet if necessary:

Minimum Control Measure 3: Illicit Discharge Detection and Elimination [V.G.3] (*Required fields)

The permit requires permittees to develop, implement, and enforce a program to detect and eliminate illicit discharges as defined in 40 CFR 122.26(b)(2). You must also select and implement a program of appropriate BMPs and measurable goals for this minimum control measure.

A. *Did you update your storm sewer system map? ☒ Yes ☐ No

If yes, please explain which components (ponds, pipes, outfalls, waterbodies, etc.) were updated/added:

ponds, pipes, outfalls and waterbodies went through a major update in 2013. We used a GPS to collect accurate location and have mapped all data collected to date.

Note: *The storm sewer system map was to be completed by June 30, 2008. [Part V.G.3.a]*

B. *Have you modified the format in which the map is available? ☒ Yes ☐ No

C. If yes, indicate the new format: ☐ Hardcopy only ☒ GIS system ☐ CAD

☐ Other system: _____

D. *Did you inspect for illicit discharges during the reporting year? ☒ Yes ☐ No

E. If you answered yes in question D. above, did you identify any illicit discharges? ☐ Yes ☒ No

F. If you answered yes in question E. above, how many illicit discharges were detected during the reporting period? _____

G. If you answered yes in question E. above, did the illicit discharge result in an enforcement action? ☐ Yes ☐ No

If yes, what type of enforcement action(s) was taken (check all that apply):

☐ Verbal warning ☐ Notice of violation ☐ Fines ☐ Criminal action ☐ Civil penalties

☐ Other (describe): _____

Minimum Control Measure 4: Construction Site Stormwater Runoff [V.G.4] (*Required fields)

The permit requires that each permittee develop, implement, and enforce a program to reduce pollutants in any stormwater runoff to your small MS4 from construction activities within your jurisdiction that result in a land disturbance of equal to or greater than one acre, including the disturbance of less than one acre of total land area that is part of a larger common plan of development or sale if the larger common plan will ultimately disturb one or more acres. [Part V.G.4.]

A. The permit requires an erosion and sediment control ordinance or regulatory mechanism that must include sanctions to ensure compliance and contains enforcement mechanisms [Part V.G.4.a]. Indicate which of the following enforcement mechanisms are contained in your ordinance or regulatory mechanism and the number of actions taken for each mechanism used during the reporting period (enter "0" if the method was not used or "NA" if the data does not exist). **Check all that apply.**

Enforcement mechanism	Number of actions
☐ Verbal warnings	# 60
☐ Notice of violation	# 41
☐ Administrative orders	#
☐ Stop-work orders	#
☐ Fines	#
☐ Forfeit of security of bond money	#
☐ Withholding of certificate of occupancy	#
☐ Criminal actions	#
☐ Civil penalties	#
☐ Other:	#

B. *Have you developed written procedures for site inspections? ☒ Yes ☐ No

C. *Have you developed written procedures for site enforcement? ☒ Yes ☐ No

D. *Identify the number of active construction sites greater than an acre in your jurisdiction during the 2013 calendar year: 15

E. *On average, how frequently are construction sites inspected (e.g., weekly, monthly, etc.)? every 2 weeks

F. *How many inspectors, at any time, did you have available to verify erosion and sediment control compliance at construction sites during the reporting period? 1

Minimum Control Measure 5: Post-construction Stormwater Management in New Development and Redevelopment [V.G.5] (*Required fields)

The permit requires each permittee to develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects within your jurisdiction that disturb an area greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale that discharge into your small MS4. Your program must ensure that controls are in place that would prevent or reduce water quality impacts. You must also select and implement a program of appropriate BMPs and measurable goals for this minimum control measure.

Note: The MS4 permit requirements associated with this minimum control measure were required to be fully developed and implemented by June 30, 2008.

A. *Have you established design standards for stormwater treatment BMPs installed as a result of post-construction requirements? ☒ Yes ☐ No

B. *Have you developed procedures for site plan review which incorporate consideration of water quality impacts? ☒ Yes ☐ No

C. *How many projects have you reviewed during the reporting period to ensure adequate long-term operation and maintenance of permanent stormwater treatment BMPs installed as a result of post-construction requirements? [Part V.G.5.b.and Part V.G.5.c]. 8

D. *Do plan reviewers use a checklist when reviewing plans? ☒ Yes ☐ No

E. *How are you funding the long-term operation and maintenance of your stormwater management system? (Check all that apply)

☒ Grants ☒ Stormwater utility fee ☒ Taxes

☐ Other: _____

Minimum Control Measure 6: Pollution Prevention/Good Housekeeping for Municipal Operations [V.G.6] (*Required fields)

The permit requires each permittee to develop and implement an operation and maintenance program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations. Your program must include employee training to prevent and reduce stormwater pollution from activities, such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and stormwater system maintenance.

A. *The permit requires each permittee to inspect annually all structural pollution control devices, such as trap manholes, grit chambers, sumps, floatable skimmers and traps, separators, and other small settling or filtering devices [Part V.G.6.b.2)]

B. *Did you inspect all structural pollution control devices during the reporting period? ☒ Yes ☐ No

C. *Have you developed an alternate inspection frequency for any structural pollution control devices? [V.G.6.b.7)] ☐ Yes ☒ No

**Indicate the total number of structural pollution control devices for which you have developed and alternative inspection frequency:* n/a

D. *Indicate the total number of structural pollution control devices (for example-grit chambers, sumps, floatable skimmers, etc.) within your MS4, the total number that were inspected during the reporting period, and calculate the percent inspected. Enter "0" if your MS4 does not contain structural pollution control devices or none were inspected. Enter "NA" if the data does not exist:

	*Total number	*Number inspected	*Percentage
*Structural pollution control devices:	88	88	100

E. *Did you repair, replace, or maintain any structural pollution control devices? ☒ Yes ☐ No

F. *For each BMP below, indicate the total number within your MS4, how many of each BMP type were inspected and the percent inspected during the reporting period. Enter "0" if your MS4 does not contain BMPs or none were inspected. Enter "NA" if the data does not exist:

Structure/Facility type	*Total number	*Number inspected	*Percentage
*Outfalls to receiving waters:	256	54	21%
*Sediment basins/ponds:	50	1	2%
***Total**	306	55	18%

G. Of the BMPs inspected in F.. above, did you include any privately owned BMPs in that number? ☐ Yes ■ No

H. If yes in G.. above, how many: _____

Section 7: Impaired Waters Review (*Required fields)

The permit requires any permittee whose MS4 discharges to a Water of the State, which appears on the current U. S. Environmental Protection Agency (EPA) approved list of impaired waters under Section 303(d) of the Clean Water Act, review whether changes to the SWPPP may be warranted to reduce the impact of your discharge [Part IV.D].

A. *Does your MS4 discharge to any waters listed as impaired on the state 303 (d) list? ☒ Yes ☐ No

B. *Have you modified your SWPPP in response to an approved Total Maximum Daily Load (TMDL)? ☐ Yes ☒ No

If yes, indicate for which TMDL: _____

Section 8: Additional SWPPP Issues (*Required fields)

A. *Did you make a change to any BMPs or measurable goals in your SWPPP since your last report? [Part VI.D.3.] ☒ Yes ☐ No

B. If *yes*, briefly list the BMPs or any measurable goals using their unique SWPPP identification numbers that were modified in your SWPPP, and why they were modified: *(Attach a separate sheet if necessary)*

2013 Reauthorization application contains revisions to the SWPPP, Attached

C. *Did you rely on any other entities (MS4 permittees, consultants, or contractors) to implement any portion of your SWPPP? [Part VI.D.4.] ☒ Yes ☐ No

If *yes,* please identify them and list activities they assisted with:

Ramsey County Conservation District - Construction inspection
Rice Creek Watershed District - Education

Owner or Operator Certification (*Required fields)

The person with overall administrative responsibility for SWPPP implementation and permit compliance must certify this MS4 Annual Report. This person must be duly authorized and should be either a principal executive (i.e., Director of Public Works, City Administrator) or ranking elected official (i.e., Mayor, Township Supervisor).

☒ *Yes - *I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete (Minn. R. 7001.0070). I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment (Minn. R. 7001.0540).*

*Name of certifying official: John Anderson

*Title: Assistant City Engineer *Date: 06/13/2014 *(mm/dd/yyyy)*

Submit

Minnesota Pollution Control Agency

You are currently logged in as:

Arden Hills City MS4

If this is correct, click the 'Next' button. If this information is incorrect, contact Cole Landgraf (651-757-2880, cole.landgraf@state.mn.us) or Rachel Stangl (651-757-2879, rachel.stangl@state.mn.us).

Before you begin...

The MS4 Annual Report for 2014 will automatically save your answers when you hit the ‘Next’ button at the bottom of each page.

If you wish to leave the MS4 Annual Report for 2014 and complete the document at another time, you may do so by hitting ‘Next’ at the bottom of your current page to save your progress before exiting the document. Return to the survey by following the previously used web link, and again login using your email and assigned password credentials. Once you successfully log in, your previous answers will appear.

You may print a copy of the MS4 Annual Report for 2014 for your records at any time by pressing the ‘Print’ button at the bottom of the page.

Additionally, it is possible to save a PDF copy of the MS4 Annual Report for 2014 if you are working on a computer with OneNote (a program often included in Microsoft Office packages). Detailed saving instructions are available at stormwater.pca.state.mn.us/index.php/Guidance_for_saving_MS4_annual_reports.

MS4 Annual Report for 2014

Reporting period: January 1, 2014 to December 31, 2014

Due: June 30, 2015

Instructions: Complete this annual report to provide a summary of your activities under the 2013 MS4 Permit (Permit) between January 1, 2014 and December 31, 2014. You may provide additional explanation and/or information in an email with the subject *YourMS4NameHere_2014AR* to ms4permitprogram.pca@state.mn.us. MPCA staff may also contact you for additional information.

Questions: Contact Cole Landgraf at 651-757-2880 or cole.landgraf@state.mn.us or Rachel Stangl at 651-757-2879 or rachel.stangl@state.mn.us.

MS4 General Contact Information

Last name	Anderson
First name	John
Title	Assistant City Engineer
Mailing address	1245 West Highway 96
City	Arden Hills
State	MN
Zip code	55112
Phone	651-792-7846
Email	janderson@cityofardenhills.org

MCM 1: Public Education and Outreach

The following questions refer to Part III.D.1. of the Permit.

Q2 Did you select a stormwater-related issue of high priority to be emphasized during this Permit term? [Part III.D.1.a.(1)]

- (●) Yes
- ( ) No

Q3 What is your stormwater-related issue(s)? Check all that apply.

- [ ] TMDL(s)
- [ ] Local businesses
- [ ] Residential BMPs
- [ ] Pet waste
- [x] Yard waste
- [ ] Deicing materials
- [x] Household chemicals
- [ ] Construction activities
- [ ] Post-construction activities
- [ ] Other

Q4 Did you begin to educate the public on illicit discharge recognition and reporting? [Part III.D.1.a.(2)]

- (●) Yes
- ( ) No

Q5 How did you distribute educational materials or equivalent outreach? Check all that apply and provide circulation/audience associated with each item. [Part III.D.1.a.]

- [ ] Brochure
- [x] Newsletter
- [ ] Utility bill insert
- [ ] Newspaper ad
- [ ] Radio ad
- [ ] Television ad
- [ ] Cable access channel
- [ ] Stormwater-related event
- [ ] School presentation or project
- [x] Website
- [ ] Other (1)
- [ ] Other (2)

☐ Other (3)

Q6 Intended audience? Check all that apply.

	Residents	Local Businesses	Developers	Students	Employees	Other
Newsletter	☑	☐	☐	☐	☐	☐
Website	☑	☑	☑	☐	☐	☐

Q7 Enter the total circulation/audience (if unknown, use best estimate):

Newsletter	2800
Website	6000

Provide a brief description of each activity related to public education and outreach (e.g. rain garden workshop, school presentation, public works open house) held and the date each activity was held from January 1, 2014 to December 31, 2014. [Part III.D.1.c.(4)]

Q8 Date of activity	Q9 Description of activity
Date (mm/dd/yyyy) 2/15/2014	newsletter - tips for greener 2014
Date (mm/dd/yyyy) 3/14/2014	newsletter - rain barrel sale
Date (mm/dd/yyyy) 4/15/2014	newsletter -annual clean up day notice
Date (mm/dd/yyyy) 5/15/2014	newsletter - yard waste
Date (mm/dd/yyyy) 6/15/2015	newsletter - karth lake water quality efforts, recycling automotive fluids
Date (mm/dd/yyyy) 9/15/2015	newsletter - recycling and disposal of household products
Date (mm/dd/yyyy)	
Date (mm/dd/yyyy)	

Q10 Between January 1, 2014 and December 31, 2014, did you modify your BMPs, measurable goals, or future plans for your public education and outreach program? [Part IV.B.]

- ○ Yes
- ◉ No

MCM 2: Public Participation/Involvement

The following questions refer to Part III.D.2.a. of the Permit.

Q11 You must provide a minimum of one opportunity each year for the public to provide input on the adequacy of your Stormwater Pollution Prevention Program (SWPPP). Did you provide this opportunity between January 1, 2014 and December 31, 2014? [Part III.D.2.a.(1)]

- ◉ Yes
- ○ No

Q12 What was the opportunity that you provided? Check all that apply.

- ☑ Public meeting
- ☐ Public event
- ☐ Other

Q13 Did you hold a stand-alone meeting or combine it with another event?

- ☐ Stand-alone
- ☑ Combined

Enter the date of the public meeting (mm/dd/yyyy): 3/9/2015

Enter the number of citizens that attended and were informed about your SWPPP: 0

Q16 Between January 1, 2014 and December 31, 2014, did you receive any input regarding your SWPPP?

- ○ Yes
- ◉ No

Q18 Between January 1, 2014 and December 31, 2014, did you modify your BMPs, measurable goals, or future plans for your public participation/involvement program? [Part IV.B.]

- ○ Yes
- ◉ No

MCM 3: Illicit Discharge Detection and Elimination

The following questions refer to Part III.D.3. of the Permit.

Q19 Between January 1, 2014 and December 31, 2014, did you update your regulatory mechanism(s) which prohibits non-stormwater discharges to your MS4?

- ○ Yes
- ◉ No

Q20 Between January 1, 2014 and December 31, 2014, what was the status of this regulatory mechanism(s)?

Current regulatory mechanism sufficient ▼

Optional, describe status:

current ordinance on IDDE was reviewed in 2014 and found to be adequate to meet goals of the permit

Q21 Did you identify any illicit discharges between January 1, 2014 and December 31, 2014? [Part III.D.3.h.(4)]

- ○ Yes
- ◉ No

Q30 Do you have written Enforcement Response Procedures (ERPs) to compel compliance with your illicit discharge regulatory mechanism(s)? [Part III.B.]

- ◉ Yes
- ○ No

Q32 Did you train all field staff in illicit discharge recognition (including conditions which could cause illicit discharges) and reporting illicit discharges for further investigations? [Part III.D.3.e.]

- ◉ Yes
- ○ No

Q33 How did you train your field staff? Check all that apply.

- [ ] Email
- [ ] PowerPoint
- [x] Presentation
- [ ] Video
- [ ] Field Training
- [ ] Other

The following questions refer to Part III.C.1. of the Permit.

Q34 Did you update your storm sewer system map between January 1, 2014 and December 31, 2014? [Part III.C.1.]

- (•) Yes
- ( ) No

Q35 Does your storm sewer map include all pipes 12 inches or greater in diameter and the direction of stormwater flow in those pipes? [Part III.C.1.a.]

- (•) Yes
- ( ) No

Q36 Does your storm sewer map include outfalls, including a unique identification (ID) number and an associated geographic coordinate? [Part III.C.1.b.]

- (•) Yes
- ( ) No

Q37 Does your storm sewer map include all structural stormwater BMPs that are part of your MS4? [Part III.C.1.c.]

- (•) Yes
- ( ) No

Q38 Does your storm sewer map include all receiving waters? [Part III.C.1.d.]

- (•) Yes
- ( ) No

Q39 In what format is your storm sewer map available?

- ○ Hardcopy only
- ◉ GIS
- ○ CAD
- ○ Other

Q40 Between January 1, 2014 and December 31, 2014, did you modify your BMPs, measurable goals, or future plans for your illicit discharge detection and elimination (IDDE) program? [Part IV.B.]

- ○ Yes
- ◉ No

MCM 4: Construction Site Stormwater Runoff Control

The following questions refer to Part III.D.4. of the Permit.

Q41 Between January 1, 2014 and December 31, 2014, did you update your regulatory mechanism to be at least as stringent as the Agency's general permit to Discharge Stormwater Associated with Construction Activity (CSW Permit) No. MN R100001 (http://www.pca.state.mn.us/index.php/view-document.html?gid=18984) for erosion and sediment controls and waste controls? [Part III.D.4.a.]

- ○ Yes
- ◉ No

Q42 Between January 1, 2014 and December 31, 2014, what was the status of this regulatory mechanism?

Research ▼

Optional, describe status:

completed ordinance revision in May of 2015

Q43 Have you developed written procedures for site plan reviews as required by the Permit? [Part III.D.4.b.]

- ◉ Yes
- ○ No

Q44 Have you documented each site plan review as required by the Permit? [Part III.D.4.f.]

- (●) Yes
- ( ) No

Q45 Enter the number of site plan reviews conducted for sites an acre or greater between January 1, 2014 and December 31, 2014:

5

Q46 What types of enforcement actions do you have available to compel compliance with your regulatory mechanism? Check all that apply and enter the number of each used from January 1, 2014 to December 31, 2014.

- [x] Verbal warnings
- [x] Notice of violation
- [ ] Administrative orders
- [x] Stop-work orders
- [ ] Fines
- [ ] Forfeit of security of bond money
- [x] Withholding of certificate of occupancy
- [ ] Criminal actions
- [ ] Civil penalties
- [ ] Other

Enter the number of verbal warnings issued:	60
Enter the number of notice of violations issued:	30
Enter the number of stop-work orders issued:	0
Enter the number of withholdings of certificate of occupancy issued:	0

Q47 Do you have written Enforcement Response Procedures (ERPs) to compel compliance with your construction site stormwater runoff control regulatory mechanism(s)? [Part III.B.]

- (●) Yes
- ( ) No

Q49 Enter the number of active construction sites an acre or greater that were in your jurisdiction between January 1, 2014 and December 31, 2014:

6

Q50 Do you have written procedures for identifying priority sites? [Part III.D.4.d.(1)]

- ○ Yes
- ◉ No

Q52 Do you have a checklist or other written means to document site inspections when determining compliance? [Part III.D.4.d.(4)]

- ◉ Yes
- ○ No

Q53 Enter the number of site inspections conducted for sites an acre or greater between January 1, 2014 and December 31, 2014:

1

Q54 Enter the frequency at which site inspections are conducted (e.g. daily, weekly, monthly): [Part III.D.4.d.(2)]

every two weeks

Q55 Enter the number of trained inspectors that were available for construction site inspections between January 1, 2014 and December 31, 2014:

1

Q56 Provide the contact information for the inspector(s) and/or organization that conducts construction stormwater inspections for your MS4. List your primary construction stormwater contact first if you have multiple inspectors.

(1) Inspector name	Samantha Kreibich
Organization	Ramsey Conservation District
Phone (Office)	651-266-7274
Phone (Work Cell)	612-210-6975
Email	samantha.krebich@co.ramsey.mn.us

Preferred contact method	email
(2) Inspector name	
Organization	
Phone (Office)	
Phone (Work Cell)	
Email	
Preferred contact method	
(3) Inspector name	
Organization	
Phone (Office)	
Phone (Work Cell)	
Email	
Preferred contact method	

Q57 What training did inspectors receive? Check all that apply.

- [x] University of Minnesota Erosion and Stormwater Management Certification Program
- [ ] Qualified Compliance Inspector of Stormwater (QCIS)
- [ ] Minnesota Laborers Training Center Stormwater Pollution Prevention Plan Installer or Supervisor
- [ ] Minnesota Utility Contractors Association Erosion Control Training
- [ ] Certified Professional in Erosion and Sediment Control (CPESC)
- [ ] Certified Professional in Stormwater Quality (CPSWQ)
- [ ] Certified Erosion, Sediment and Storm Water Inspector (CESSWI)
- [ ] Other

Q58 Between January 1, 2014 and December 31, 2014, did you modify your BMPs, measurable goals, or future plans for your construction site stormwater runoff control program? [Part IV.B.]

- ( ) Yes
- (•) No

MCM 5: Post-Construction Stormwater Management

The following questions refer to Part III.D.5. of the Permit.

Q59 Between January 1, 2014 and December 31, 2014, did you update your regulatory mechanism(s) to incorporate all requirements as specified in Part III.D.5.a. of the Permit?

- (●) Yes
- ( ) No

Q61 What approach are you using, or planning to use, to meet the performance standard for Volume, Total Suspended Solids (TSS), and Total Phosphorus (TP) as required by the Permit? [Part III.D.5.a.(2)] Check all that apply.

Refer to the link http://www.pca.state.mn.us/index.php/view-document.html?gid=17815 for guidance on stormwater management approaches.

- [ ] Retain a runoff volume equal to one inch times the area of the proposed increase of impervious surfaces on-site
- [ ] Retain the post-construction runoff volume on site for the 95th percentile storm
- [ ] Match the pre-development runoff conditions
- [ ] Adopt the Minimal Impact Design Standards (MIDS)
- [ ] An approach has not been selected
- [x] Other method (Must be technically defensible--e.g. based on modeling, research and acceptable engineering practices)

Other, describe:

require performance standards adopted by Rice Creek Watershed district are met by site design.

Q62 Do you have written Enforcement Response Procedures (ERPs) to compel compliance with your post-construction stormwater management regulatory mechanism(s)? [Part III.B.]

- (●) Yes
- ( ) No

Q64 Between January 1, 2014 and December 31, 2014, did you modify your BMPs, measurable goals, or future plans for your post-construction stormwater management program? [Part IV.B.]

- (●) Yes
- ( ) No

Describe those modifications:

city ordinance was updated to include a requirement that post construction treatment systems meet design criteria setforth by Rice Watershed District. This ordinance was adopted in May of 2015

MCM 6: Pollution Prevention/Good Housekeeping for Municipal Operations

The following questions refer to Part III.D.6. of the Permit.

Q65 Enter the total number of structural stormwater BMPs, outfalls (excluding underground outfalls), and ponds within your MS4 (exclude privately owned).

Structural stormwater BMPs	92
Outfalls	256
Ponds	69

Q66 Enter the number of structural stormwater BMPs, outfalls (excluding underground outfalls), and ponds that were inspected from January 1, 2014 to December 31, 2014 within your MS4 (exclude privately owned). [Part III.D.6.e.]

Structural stormwater BMPs	92
Outfalls	0
Ponds	0

Q67 Have you developed an alternative inspection frequency for any structural stormwater BMPs, as allowed in Part III.D.6.e.(1) of the Permit?

- ○ Yes
- ◉ No

Q68 Based on inspection findings, did you conduct any maintenance on any structural stormwater BMPs? [Part III.D.6.e.(1)]

- ◉ Yes
- ○ No

Q69 Briefly describe the maintenance that was conducted:

Rain Garden maintenance of 52 sites including remove sediment, weeding, add plantings, place mulch. Pump all 9 grit chambers to remove collected sediment

Q70 Do you own or operate any stockpiles, and/or storage and material handling areas? [Part III.D.6.e.(3)]

- ○ Yes
- ◉ No

Q74 Between January 1, 2014 and December 31, 2014, did you modify your BMPs, measurable goals, or future plans for your pollution prevention/good housekeeping for municipal operations program? [Part IV.B.]

- ○ Yes
- ◉ No

Partnerships

Q83 Did you rely on any other regulated MS4s to satisfy one or more Permit requirements?

- ◉ Yes
- ○ No

Q84 Describe the agreements you have with other regulated MS4s and which Permit requirements the other regulated MS4s help satisfy: [Part IV.B.6.]

we contract with Ramsey Conservation District to inspect construction sites for compliance with our Construction stormwater permit program. We partner with Rice Creek Watershed District to provide us educational materials.

Additional Information

If you would like to provide any additional files to accompany your annual report, use the space below to upload those files. For each space, you may attach one file.

Q85 Click the "up arrow" icon below to upload a file. When it has uploaded successfully, a unique ID will appear in the box. Only files 6 MB or less will upload.

Q86 Click the "up arrow" icon below to upload a file. When it has uploaded successfully, a unique ID will appear in the box. Only files 6 MB or less will upload.

Q87 Click the "up arrow" icon below to upload a file. When it has uploaded successfully, a unique ID will appear in the box. Only files 6 MB or less will upload.

Q88 Optional, describe the file(s) uploaded:

Owner or Operator Certification

The person with overall administrative responsibility for SWPPP implementation and Permit compliance must certify this MS4 Annual Report. This person must be duly authorized and should be either a principal executive (i.e., Director of Public Works, City Administrator) or ranking elected official (i.e., Mayor, Township Supervisor).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete (Minn. R. 7001.0070). I am aware that there are

significant penalties for submitting false information, including the possibility of fine and imprisonment (Minn. R. 7001.0540).

- [x] Yes

By typing my name in the following box, I certify the above statements to be true and correct, to the best of my knowledge, and that information can be used for the purpose of processing my MS4 Annual Report.

Name:	John Anderson
Title:	Assistant City Engineer
Date: (mm/dd/yyyy)	06/25/2015

Before you submit...

Print or save a copy of your completed MS4 Annual Report for 2014 for your records. The MPCA will not be able to provide you with a copy.

You may print a copy of the MS4 Annual Report for 2014 for your records by pressing the 'Print' button at the bottom of the page.

Additionally, it is possible to save a PDF copy of the MS4 Annual Report for 2014 if you are working on a computer with OneNote (a program often included in Microsoft Office packages). Detailed saving instructions are available at stormwater.pca.state.mn.us/index.php/Guidance_for_saving_MS4_annual_reports.

If you have any questions, contact MPCA staff Cole Landgraf (cole.landgraf@state.mn.us, 651-757-2880) or Rachel Stangl (rachel.stangl@state.mn.us, 651-757-2879).

Minnesota Pollution Control Agency

You are currently logged in as:

Arden Hills City MS4

If this is correct, click the 'Next' button. If this information is incorrect, contact Cole Landgraf (651-757-2880, cole.landgraf@state.mn.us) or Rachel Stangl (651-757-2879, rachel.stangl@state.mn.us).

Before you begin...

A fillable Microsoft Word document with all of the questions is available at https://www.pca.state.mn.us/sites/default/files/wq-strm4-06a.doc (for personal use only, not for submittal).

The MS4 Annual Report for 2015 will automatically save your answers when you hit the 'Next' button at the bottom of each page.

If you wish to leave the MS4 Annual Report for 2015 and complete the document at another time, you may do so by hitting 'Next' at the bottom of your current page to save your progress before exiting the document. Return to the survey by following the previously used web link, and again login using your email and assigned password credentials. Once you successfully log in, your previous answers will appear.

The MPCA will email a PDF of your MS4 Annual Report for 2015 information to you in a confirmation email within three business days after you submit this form.

You may print a copy of the MS4 Annual Report for 2015 for your records at any time by pressing the 'Print' button at the bottom of the page.

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MS4 Annual Report for 2015

Reporting period: January 1, 2015 to December 31, 2015

Due: June 30, 2016

Instructions: Complete this annual report to provide a summary of your activities under the 2013 MS4 Permit (Permit) between January 1, 2015 and December 31, 2015. MPCA staff may contact you for additional information.

Fillable document available at https://www.pca.state.mn.us/sites/default/files/wq-strm4-06a.doc (for personal use only, not for submittal).

Questions: Contact Cole Landgraf at 651-757-2880 or cole.landgraf@state.mn.us or Rachel Stangl at 651-757-2879 or rachel.stangl@state.mn.us.

MS4 General Contact Information

Full name	John M Anderson
Title	Acting Public Works Director / City Engineer
Mailing address	1245 W Hwy 96
City	Arden Hills
State	MN
Zip code	55112
Phone	651-792-7846
Email	janderson@cityofardenhills.org

Preparer Contact Information (if different from the MS4 General Contact)

Full name	
Title	
Organization	
Mailing address	
City	
State	
Zip code	
Phone	
Email	

MCM 1: Public Education and Outreach

The following questions refer to Part III.D.1. of the Permit.

Q2 Did you select a stormwater-related issue of high priority to be emphasized during this

Permit term? [Part III.D.1.a.(1)]

- (•) Yes
- ( ) No

Q3 What is your stormwater-related issue(s)? Check all that apply.

- [ ] TMDL(s)
- [ ] Local businesses
- [x] Residential BMPs
- [ ] Pet waste
- [ ] Yard waste
- [ ] Deicing materials
- [ ] Household chemicals
- [ ] Construction activities
- [ ] Post-construction activities
- [ ] Other

Q4 Have you distributed educational materials or equivalent outreach to the public focused on illicit discharge recognition and reporting? [Part III.D.1.a.(2)]

- (•) Yes
- ( ) No

Q5 Do you have an implementation plan as required by the Permit? [Part III.D.1.b.]

- (•) Yes
- ( ) No

Q6 How did you distribute educational materials or equivalent outreach? Check all that apply and provide circulation/audience associated with each item. [Part III.D.1.a.]

- [ ] Brochure
- [x] Newsletter
- [ ] Utility bill insert
- [ ] Newspaper ad
- [ ] Radio ad
- [ ] Television ad
- [ ] Cable access channel
- [x] Stormwater-related event
- [ ] School presentation or project
- [x] Website
- [ ] Other (1)
- [ ] Other (2)
- [ ] Other (3)

Q7 Intended audience? Check all that apply.

	Residents	Local Businesses	Developers	Students	Employees	Other
Newsletter	[x]	[ ]	[ ]	[ ]	[ ]	[ ]
Stormwater-related event	[x]	[ ]	[ ]	[ ]	[ ]	[ ]
Website	[x]	[x]	[ ]	[ ]	[ ]	[ ]

Q8 Enter the total circulation/audience (if unknown, use best estimate):

Newsletter	2500
Stormwater-related event	200
Website	250

Provide a brief description of each activity related to public education and outreach (e.g. rain garden workshop, school presentation, public works open house) held and the date each activity was held from January 1, 2015 to December 31, 2015. [Part III.D.1.c.(4)]

Q9 Date of activity		Q10 Description of activity
Date (mm/dd/yyyy)	01/12/15	PMP public hearing, ask fro rain garden voulteers
Date (mm/dd/yyyy)	3/1/15	Karth Lake Clean up - Arden Notes story
Date (mm/dd/yyyy)	4/1/15	Spring Clean up day ad - Arden Notes
Date (mm/dd/yyyy)	4/8/15	PMP open house, discuss details of rain garden construction with residents
Date (mm/dd/yyyy)	5/1/15	Spring Clean up day ad - Arden Notes
Date (mm/dd/yyyy)	6/1/15	Rice Creek meander project - Arden Notes
Date (mm/dd/yyyy)	10/1/15	Rain Garden story - Arden Notes
Date (mm/dd/yyyy)	11/1/15	leaves and our lakes - Arden Notes

Q11 Between January 1, 2015 and December 31, 2015, did you modify your BMPs, measurable goals, or future plans for your public education and outreach program? [Part IV.B.]

- ○ Yes
- ◉ No

MCM 2: Public Participation/Involvement

The following questions refer to Part III.D.2.a. of the Permit.

Q12 You must provide a minimum of one opportunity each year for the public to provide input on the adequacy of your Stormwater Pollution Prevention Program (SWPPP). Did you provide this opportunity between January 1, 2015 and December 31, 2015? [Part III.D.2.a.(1)]

- ◉ Yes
- ○ No

Q13 What was the opportunity that you provided? Check all that apply.

- ☑ Public meeting

- [ ] Public event
- [ ] Other

Q14 Did you hold a stand-alone meeting or combine it with another event?

- [ ] Stand-alone
- [x] Combined

Enter the date of the public meeting (mm/dd/yyyy): 03/09/15

Enter the number of citizens that attended and were informed about your SWPPP: 0

Q17 Between January 1, 2015 and December 31, 2015, did you receive any input regarding your SWPPP?

- ( ) Yes
- (•) No

Q19 Between January 1, 2015 and December 31, 2015, did you modify your BMPs, measurable goals, or future plans for your public participation/involvement program? [Part IV.B.]

- ( ) Yes
- (•) No

MCM 3: Illicit Discharge Detection and Elimination

The following questions refer to Part III.D.3. of the Permit.

Q20 As of December 31, 2015, have you enacted a regulatory mechanism which prohibits non-stormwater discharges to your MS4?

- (•) Yes
- ( ) No

Q21 Provide either a website address to the above regulatory mechanism or upload a copy. How will you provide this regulatory mechanism?

- [ ] Website address
- [x] Upload

Q23 Click the "up arrow" icon below to upload a file. When it has uploaded successfully, a unique ID will appear in the box. Only files less than 10 MB in size will upload.

ref:0000000199:Q23

Q24 Did you identify any illicit discharges between January 1, 2015 and December 31, 2015? [Part III.D.3.h.(4)]

- ○ Yes
- ◉ No

Q33 Do you have written Enforcement Response Procedures (ERPs) to compel compliance with your illicit discharge regulatory mechanism(s)? [Part III.B.]

- ◉ Yes
- ○ No

Q34 Provide either a website address to the above ERPs or upload a copy. How will you provide these ERPs?

- ☐ Website address
- ☑ Upload

Q36 Click the "up arrow" icon below to upload a file. When it has uploaded successfully, a unique ID will appear in the box. Only files less than 10 MB in size will upload.

ref:0000000199:Q36

Q37 Did you train all field staff in illicit discharge recognition (including conditions which could cause illicit discharges) and reporting illicit discharges for further investigations? [Part III.D.3.e.]

- ◉ Yes
- ○ No

Q38 How did you train your field staff? Check all that apply.

- ☐ Email
- ☐ PowerPoint
- ☑ Presentation
- ☐ Video
- ☐ Field Training
- ☐ Other

The following questions refer to Part III.C.1. of the Permit.

Q39 Did you update your storm sewer system map between January 1, 2015 and December 31, 2015? [Part III.C.1.]

- ◉ Yes
- ○ No

Q40 Does your storm sewer map include all pipes 12 inches or greater in diameter and the direction of stormwater flow in those pipes? [Part III.C.1.a.]

- ◉ Yes
- ○ No

Q41 Does your storm sewer map include outfalls, including a unique identification (ID) number and an associated geographic coordinate? [Part III.C.1.b.]

- ◉ Yes
- ○ No

Q42 Does your storm sewer map include all structural stormwater BMPs that are part of your MS4? [Part III.C.1.c.]

- (•) Yes
- ( ) No

Q43 Does your storm sewer map include all receiving waters? [Part III.C.1.d.]

- (•) Yes
- ( ) No

Q44 In what format is your storm sewer map available?

- ( ) Hardcopy only
- (•) GIS
- ( ) CAD
- ( ) Other

Q45 Between January 1, 2015 and December 31, 2015, did you modify your BMPs, measurable goals, or future plans for your illicit discharge detection and elimination (IDDE) program? [Part IV.B.]

- (•) Yes
- ( ) No

Describe those modifications:

in 2015 we built 24 rain gardens and added 3 grit chambers

MCM 4: Construction Site Stormwater Runoff Control

The following questions refer to Part III.D.4. of the Permit.

Q46 As of December 31, 2015, have you enacted a regulatory mechanism that is at least as stringent as the Agency's general permit to Discharge Stormwater Associated with Construction Activity (CSW Permit) No. MN R100001 (http://www.pca.state.mn.us/index.php/view-document.html?gid=18984) for erosion and sediment controls and waste controls? [Part III.D.4.a.]

- (•) Yes
- ( ) No

Q47 Have you developed written procedures for site plan reviews as required by the Permit? [Part III.D.4.b.]

- (•) Yes
- ( ) No

Q48 Have you documented each site plan review as required by the Permit? [Part III.D.4.f.]

- (•) Yes
- ( ) No

Q49 Enter the number of site plan reviews conducted for sites an acre or greater of soil disturbance between January 1, 2015 and December 31, 2015:

6

Q50 What types of enforcement actions do you have available to compel compliance with your regulatory mechanism? Check all that apply and enter the number of each used from January 1, 2015 to December 31, 2015.

- [x] Verbal warnings
- [ ] Notice of violation
- [ ] Administrative orders
- [x] Stop-work orders
- [ ] Fines
- [ ] Forfeit of security of bond money
- [x] Withholding of certificate of occupancy
- [ ] Criminal actions
- [ ] Civil penalties
- [ ] Other

Enter the number of verbal warnings issued: 230

Enter the number of stop-work orders issued: 0

Enter the number of withholdings of certificate of occupancy issued: 0

Q51 Do you have written Enforcement Response Procedures (ERPs) to compel compliance with your construction site stormwater runoff control regulatory mechanism(s)? [Part III.B.]

- (•) Yes
- ( ) No

Q52 Enter the number of active construction sites an acre or greater that were in your jurisdiction between January 1, 2015 and December 31, 2015:

17

Q53 Do you have written procedures for identifying priority sites? [Part III.D.4.d.(1)]

- (•) Yes
- ( ) No

Q54 How are sites prioritized? Check all that apply.

- [ ] Site topography
- [ ] Soil characteristics
- [ ] Types of receiving water(s)
- [ ] Stage of construction
- [x] Compliance history
- [ ] Weather conditions
- [ ] Other

Q55 Do you have a checklist or other written means to document site inspections when determining compliance? [Part III.D.4.d.(4)]

- (•) Yes

○ No

Q56 Enter the number of site inspections conducted for sites an acre or greater between January 1, 2015 and December 31, 2015:

160

Q57 Enter the frequency at which site inspections are conducted (e.g. daily, weekly, monthly): [Part III.D.4.d.(2)]

every two weeks, more frequently if follow up is needed

Q58 Enter the number of trained inspectors that were available for construction site inspections between January 1, 2015 and December 31, 2015:

1

Q59 Provide the contact information for the inspector(s) and/or organization that conducts construction stormwater inspections for your MS4. List your primary construction stormwater contact first if you have multiple inspectors.

(1) Inspector name	Andrea Prichard
Organization	Ramsey Conservation District
Phone (Office)	651-266-7274
Phone (Work Cell)	
Email	andrea.prichard@co.ramsey.mn.us
Preferred contact method	email
(2) Inspector name	
Organization	
Phone (Office)	
Phone (Work Cell)	
Email	
Preferred contact method	
(3) Inspector name	
Organization	
Phone (Office)	
Phone (Work Cell)	
Email	
Preferred contact method	

Q60 What training did inspectors receive? Check all that apply.

- ☑ University of Minnesota Erosion and Stormwater Management Certification Program
- ☐ Qualified Compliance Inspector of Stormwater (QCIS)

- [ ] Minnesota Laborers Training Center Stormwater Pollution Prevention Plan Installer or Supervisor
- [ ] Minnesota Utility Contractors Association Erosion Control Training
- [ ] Certified Professional in Erosion and Sediment Control (CPESC)
- [ ] Certified Professional in Stormwater Quality (CPSWQ)
- [ ] Certified Erosion, Sediment and Storm Water Inspector (CESSWI)
- [ ] Other

Q61 Between January 1, 2015 and December 31, 2015, did you modify your BMPs, measurable goals, or future plans for your construction site stormwater runoff control program? [Part IV.B.]

- ( ) Yes
- (•) No

MCM 5: Post-Construction Stormwater Management

The following questions refer to Part III.D.5. of the Permit.

Q62 As of December 31, 2015, have you enacted a regulatory mechanism to incorporate all requirements as specified in Part III.D.5.a. of the Permit?

- (•) Yes
- ( ) No

Q63 What approach are you using to meet the performance standard for Volume, Total Suspended Solids (TSS), and Total Phosphorus (TP) as required by the Permit? [Part III.D.5.a.(2)]
Check all that apply.

Refer to the link http://www.pca.state.mn.us/index.php/view-document.html?gid=17815 for guidance on stormwater management approaches.

- [x] Retain a runoff volume equal to one inch times the area of the proposed increase of impervious surfaces on-site
- [ ] Retain the post-construction runoff volume on site for the 95th percentile storm
- [ ] Match the pre-development runoff conditions
- [ ] Adopt the Minimal Impact Design Standards (MIDS)
- [ ] An approach has not been selected
- [ ] Other method (Must be technically defensible--e.g. based on modeling, research and acceptable engineering practices)

Q64 Do you have written Enforcement Response Procedures (ERPs) to compel compliance with your post-construction stormwater management regulatory mechanism(s)? [Part III.B.]

- (•) Yes
- ( ) No

Q65 Between January 1, 2015 and December 31, 2015, did you modify your BMPs, measurable goals, or future plans for your post-construction stormwater management program? [Part IV.B.]

- ( ) Yes
- (•) No

MCM 6: Pollution Prevention/Good Housekeeping for Municipal Operations

The following questions refer to Part III.D.6. of the Permit.

Q66 Enter the total number of structural stormwater BMPs, outfalls (excluding underground outfalls), and ponds within your MS4 (exclude privately owned).

Structural stormwater BMPs	92
Outfalls	256
Ponds	69

Q67 Enter the number of structural stormwater BMPs, outfalls (excluding underground outfalls), and ponds that were inspected from January 1, 2015 to December 31, 2015 within your MS4 (exclude privately owned). [Part III.D.6.e.]

Structural stormwater BMPs	92
Outfalls	100
Ponds	0

Q68 Have you developed an alternative inspection frequency for any structural stormwater BMPs, as allowed in Part III.D.6.e.(1) of the Permit?

- ○ Yes
- ◉ No

Q69 Based on inspection findings, did you conduct any maintenance on any structural stormwater BMPs? [Part III.D.6.e.(1)]

- ◉ Yes
- ○ No

Q70 Briefly describe the maintenance that was conducted:

city wide rain garden weeding, mulching, removal of debris, Storm outfall repairs completed on three outfalls, pumped all grit chambers

Q71 Do you own or operate any stockpiles, and/or storage and material handling areas? [Part III.D.6.e.(3)]

- ○ Yes
- ◉ No

Q75 Between January 1, 2015 and December 31, 2015, did you modify your BMPs, measurable goals, or future plans for your pollution prevention/good housekeeping for municipal operations program? [Part IV.B.]

- ○ Yes
- ◉ No

Partnerships

Q84 Did you rely on any other regulated MS4s to satisfy one or more Permit requirements?

- (•) Yes
- ( ) No

Q85 Describe the agreements you have with other regulated MS4s and which Permit requirements the other regulated MS4s help satisfy: [Part IV.B.6.]

we have a contract with Ramsey Conservation District to inspect construction sites permitted through city issued grading and erosion control permits

Additional Information

If you would like to provide any additional files to accompany your annual report, use the space below to upload those files. For each space, you may attach one file. You may provide additional explanation and/or information in an email with the subject *YourMS4NameHere_2015AR* to ms4permitprogram.pca@state.mn.us.

Q86 Click the "up arrow" icon below to upload a file. When it has uploaded successfully, a unique ID will appear in the box. Only files less than 10 MB in size will upload.

Q87 Click the "up arrow" icon below to upload a file. When it has uploaded successfully, a unique ID will appear in the box. Only files less than 10 MB in size will upload.

Q88 Click the "up arrow" icon below to upload a file. When it has uploaded successfully, a unique ID will appear in the box. Only files less than 10 MB in size will upload.

Q89 Optional, describe the file(s) uploaded:

Owner or Operator Certification

The person with overall administrative responsibility for SWPPP implementation and Permit compliance must certify this MS4 Annual Report. This person must be duly

authorized and should be either a principal executive (i.e., Director of Public Works, City Administrator) or ranking elected official (i.e., Mayor, Township Supervisor).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete (Minn. R. 7001.0070). I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment (Minn. R. 7001.0540).

☑ Yes

By typing my name in the following box, I certify the above statements to be true and correct, to the best of my knowledge, and that information can be used for the purpose of processing my MS4 Annual Report.

Name:	John M Anderson
Title:	Acting Public Works Director and City Engineer
Date: (mm/dd/yyyy)	06/27/16

When you are ready to submit, you must click the 'Submit' button at the bottom of this page.

Provide the email(s) of the individual(s) you would like to receive the MS4 Annual Report for 2015 submittal confirmation email from the MPCA. After you click the Submit button below, please allow up to three business days to receive this email.

Email (1)	janderson@cityofardenhills.org
Email (2)	siverson@cityofardenhills.org
Email (3)	

Print or save a copy of your completed MS4 Annual Report for 2015 for your records. The MPCA will email a PDF of your MS4 Annual Report for 2015 information in a confirmation email within three business days after you submit this form to the email(s) you provided above.

You may print a copy of the MS4 Annual Report for 2015 for your records by pressing the 'Print' button at the bottom of the page.

Additionally, it is possible to save a PDF copy of the MS4 Annual Report for 2015 if you are working on a computer with OneNote (a program often included in Microsoft Office

packages). Detailed saving instructions are available at stormwater.pca.state.mn.us/index.php/Guidance_for_saving_MS4_annual_reports.

If you have any questions, contact MPCA staff Cole Landgraf (cole.landgraf@state.mn.us, 651-757-2880) or Rachel Stangl (rachel.stangl@state.mn.us, 651-757-2879).

Minnesota Pollution Control Agency

MS4 Annual Report for 2016

Reporting period: January 1, 2016 to December 31, 2016

Due: June 30, 2017

Instructions: Complete this annual report to provide a summary of your activities under the 2013 MS4 Permit (Permit) between January 1, 2016 and December 31, 2016. MPCA staff may also contact you for additional information.

Questions: Contact Cole Landgraf (cole.landgraf@state.mn.us, 651-757-2880) or Megan Handt (megan.handt@state.mn.us, 651-757-2843)

MS4 General Contact Information

Full Name:	Sue Polka
Title:	City Engineer
Mailing Address:	1245 Highway 96
City:	Arden Hills
State:	MN
Zip Code:	55112
Phone:	651-792-7846
Email:	spolka@cityofardenhills.org

Preparer Contact Information (*if different from the MS4 General Contact*)

Full Name:	Kelsey Gelhar
Title:	Graduate Engineer
Organization:	City of Arden Hills
Mailing Address:	1245 Highway 96
City:	Arden Hills
State:	MN
Zip Code:	55112
Phone:	6127094897
Email:	kgelhar@cityofardenhills.org

Minnesota Pollution Control Agency

MCM 1: Public Education and Outreach

The following questions refer to Part III.D.1. of the Permit.

Q2 Did you select a stormwater-related issue of high priority to be emphasized during this Permit term? [Part III.D.1.a.(1)]

Yes

Q3 If '*Yes*' in **Q2**, what is your stormwater-related issue(s)? Check all that apply.

	Total Maximum Daily Loads (TMDLs)
	Local businesses
X	Residential best management practices (BMPs)
	Pet waste
	Yard waste
	Deicing materials
	Household chemicals
X	Construction activities
	Post-construction activities
	Other

If '*Other*,' describe:

Q4 Have you distributed educational materials or equivalent outreach to the public focused on illicit discharge recognition and reporting? [Part III.D.1.a.(2)]

Yes

Q5 Do you have an implementation plan as required by the Permit? [Part III.D.1.b.]

Yes

Q6 How did you distribute educational materials or equivalent outreach? [Part III.D.1.a.] *Check all that apply in the table below.*

Q7 For the items checked in **Q6** below, who is the intended audience? *Check all that apply in the table below.*

Q8 For the items checked in **Q6** below, *enter the total circulation/audience in the table below* (if unknown, use best estimate).

Q6		Q7 Intended audience? Check all that apply:						Q8
How did you distribute educational materials or equivalent outreach? Check all that apply:		Residents	Local businesses	Developers	Students	Employees	Other	Total circulation/audience: (if unknown, best est.)
	Brochure							
X	**Newsletter**	X						2500
	Utility bill insert							
	Newspaper ad							
	Radio ad							
	Television ad							
	Cable access channel							
X	**Stormwater-related event**	X						200
	School project or presentation							
X	**Website**	X	X					250
	Other (1) Describe:							
	Other (2) Describe:							
	Other (3) Describe:							

For **Q9** and **Q10** below, provide a brief description of each activity related to public education and outreach (e.g. rain garden workshop, school presentation, public works open house) held and the date each activity was held from January 1, 2016 to December 31, 2016. [Part III.D.1.c.(4)]

Q9 Date of Activity	Q10 Description of Activity
3/1/2016	Arden Notes Story - Rain Barrels
4/1/2016	Arden Notes Story - Spring Clean Up Day
5/1/2016	Arden Notes Story - Composting
6/1/2016	Arden Notes Story - Recycling Bulky Items
7/1/2016	Arden Notes Story - Recycling
8/1/2016	Arden Notes Story - Lawn Tips (RCWD)
11/1/2016	Arden Notes Story - Environment
12/1/2016	Arden Notes Story - "Green" Holiday Season

Q11 Between January 1, 2016 and December 31, 2016, did you modify your BMPs, measurable goals, or future plans for your public education and outreach program? [Part IV.B.]

No

If '*Yes*,' describe those modifications:

Minnesota Pollution Control Agency

MCM 2: Public Participation/Involvement

The following questions refer to Part III.D.2.a. of the Permit.

Q12 You must provide a minimum of one opportunity each year for the public to provide input on the adequacy of your Stormwater Pollution Prevention Program (SWPPP). Did you provide this opportunity between January 1, 2016 and December 31, 2016? [Part III.D.2.a.(1)]

Yes

Q13 If '*Yes* ' in **Q12**, what was the opportunity that you provided? Check all that apply.

X	Public meeting
	Public event
	Other

Q14 If '*Public meeting* ' in **Q13**, did you hold a stand-alone meeting or combine it with another event?

Combined

Enter the date of the public meeting: 5/31/2016

Enter the number of citizens that attended and were informed about your SWPPP: 0

Q15 If '*Public Event*' in **Q13**,

Describe:

Q15 Enter the date of the public event:

Enter the number of citizens that attended and were informed about your SWPPP: 0

Q16 If '*Other*' in **Q13**,

Describe:

Enter the date of the 'other' event:

Enter the number of citizens that attended and were informed about your SWPPP: 0

Q17 Between January 1, 2016 and December 31, 2016, did you receive any input regarding your SWPPP?

No

If '*Yes* ,' enter the total number of individuals or organizations that provided comments on your SWPPP:

Q18 If '*Yes*' in **Q17**, did you modify your SWPPP as a result of written input received? [Part III.D.2.b.(2)]

If *'Yes* ,' describe those modifications:

Q19 Between January 1, 2016 and December 31, 2016, did you modify your BMPs, measurable goals, or future plans for your public education and outreach program? [Part IV.B.]

If '*Yes* ,' describe those modifications:

No

Minnesota Pollution Control Agency

MCM 3: Illicit Discharge Detection and Elimination

The following questions refer to Part III.D.3. of the Permit.

Q20 Do you have a regulatory mechanism which prohibits non-stormwater discharges to your MS4?

Yes

Q21 Did you identify any illicit discharges between January 1, 2016 and December 31, 2016? [Part III.D.3.h.(4)]

No

Q22 If '*Yes* ' in **Q21**, enter the number of illicit discharges detected:

Q23 If '*Yes* ' in **Q21**, how did you discover these illicit discharges? Check all that apply.

	Public complaint
	Staff

Q24 If '*Public complaint* ' in **Q23**, enter the number discovered by the public:

Q25 If '*Staff* ' in **Q23**, enter the number discovered by staff:

Q26 If '*Yes*' in **Q21**, did any of the discovered illicit discharges result in an enforcement action (this includes verbal warnings)?

Q27 If '*Yes*' in **Q26**, what type of enforcement action(s) was taken and how many of each action were issued between January 1, 2016 and December 31, 2016? Check all that apply.

		Number issued:
	Verbal warning	
	Notice of violation	
	Fine	
	Criminal action	
	Civil penalty	
	Other	

If '*Other*,' describe:

Q28 If '*Yes*' in **Q26**, did the enforcement action(s) taken sufficiently address the illicit discharge(s)?

Q29 If '*No*' in **Q28**, why was the enforcement not sufficient to address the illicit discharge(s)?

Q30 Do you have written Enforcement Response Procedures (ERPs) to compel compliance with your illicit discharge regulatory mechanism(s)? [Part III.B.]

Yes

Q31 Between January 1, 2016 and December 31, 2016, did you train all field staff in illicit discharge recognition (including conditions which could cause illicit discharges) and reporting illicit discharges for further investigations? [Part III.D.3.e.]

Yes

Q32 If '*Yes*' in **Q31**, how did you train your field staff? Check all that apply.

	Email
	Powerpoint
X	Presentation
	Video
	Field Training
	Other

If '*Other*,' describe:

The following questions refer to Part III.C.1. of the Permit.

Q33 Did you update your storm sewer system map between January 1, 2016 and December 31, 2016? [Part III.C.1.]

Yes

Q34 Does your storm sewer map include all pipes 12 inches or greater in diameter and the direction of stormwater flow in those pipes? [Part III.C.1.a.]

Yes

Q35 Does your storm sewer map include outfalls, including a unique identification (ID) number and an associated geographic coordinate? [Part III.C.1.b.]

Yes

Q36 Does your storm sewer map include all structural stormwater BMPs that are part of your MS4? [Part III.C.1.c.]

Yes

Q37 Does your storm sewer map include all receiving waters? [Part III.C.1.d.]

Yes

Q38 In what format is your storm sewer map available?

GIS

If '*Other*,' describe:

Q39 Between January 1, 2016 and December 31, 2016, did you modify your BMPs, measurable goals, or future plans for your illicit discharge detection and elimination (IDDE) program? [Part IV.B.]

No

If '*Yes,*' describe those modifications:

Minnesota Pollution Control Agency

MCM 4: Construction Site Stormwater Runoff Control

The following questions refer to Part III.D.4. of the Permit.

Q40 Do you have a regulatory mechanism that is at least as stringent as the Agency's general permit to Discharge Stormwater Associated with Construction Activity (CSW Permit) No. MN R100001 (http://www.pca.state.mn.us/index.php/view-document.html?gid=18984) for erosion and sediment controls and waste controls? [Part III.D.4.a.]

Yes

Q41 Have you developed written procedures for site plan reviews as required by the Permit? [Part III.D.4.b.]

Yes

Q42 Have you documented each site plan review as required by the Permit? [Part III.D.4.f.]

Yes

Q43 Enter the number of site plan reviews conducted for sites an acre or greater between January 1, 2016 and December 31, 2016:

6

Q44 What types of enforcement actions do you have available to compel compliance with your regulatory mechanism? Check all that apply and enter the number of each used from January 1, 2016 to December 31, 2016.

		Number issued:
X	Verbal warning	89
X	Notice of violation	0
	Administrative order	0
X	Stop-work order	0
	Fine	0
	Forfeit of security bond money	0
X	Withholding of certificate of occupancy	0
	Criminal action	0
	Civil penalty	0
	Other	0

If '*Other*,' describe:

Q45 Do you have written Enforcement Response Procedures (ERPs) to compel compliance with your construction site stormwater runoff control regulatory mechanisms? [Part III.B.]

Yes

Q46 Enter the number of active construction sites an acre or greater that were in your jurisdiction between January 1, 2016 and December 31, 2016:

16

Q47 Do you have written procedures for identifying priority sites for inspections? [Part III.D.4.d.(1)]

Yes

Q48 If '*Yes*' *in* ***Q47***, how are sites prioritized for inspections? Check all that apply.

	Site topography
	Soil characteristics
	Types of receiving water(s)
	Stage of construction
X	Compliance history
X	Weather conditions
X	Citizen complaints
	Project size
	Other

If '*Other*,' describe:

Q49 Do you have a checklist or other written means to document site inspections when determining compliance? [Part III.D.4.d.(4)]

Yes

Q50 Enter the number of site inspections conducted for sites an acre or greater between January 1, 2016 and December 31, 2016:

146

Q51 Enter the frequency at which site inspections are conducted (e.g. daily, weekly, monthly): [Part III.D.4.d.(2)]

Every two weeks, more frequently if follow up is needed

Q52 Enter the number of trained inspectors that were available for construction site inspections between January 1, 2016 and December 31, 2016:

1

Q53 Provide the contact information for the inspector(s) and/or organization that conducts construction stormwater inspections for your MS4. List your primary construction stormwater contact first if you have multiple inspectors.

1 Inspector Name	Andrea Prichard
Organization	Ramsey Conservation District
Phone (Office)	651-266-7274
Phone (Work Cell)	
Email	andrea.prichard@co.ramsey.mn.us
Preferred contact method	Email
2 Inspector Name	
Organization	
Phone (Office)	
Phone (Work Cell)	
Email	
Preferred contact method	
3 Inspector Name	
Organization	
Phone (Office)	
Phone (Work Cell)	
Email	
Preferred contact method	

Q54 What training did inspectors receive? Check all that apply.

X	University of Minnesota Erosion and Stormwater Management Certification Program
	Qualified Compliance Inspector of Stormwater (QCIS)
	Minnesota Laborers Training Center Stormwater Pollution Prevention Plan Installer or Supervisor
	Minnesota Utility Contractors Assocation Erosion Control Training
	Certified Professional in Erosion and Sediment Control (CPESC)
	Certified Professional in Stormwater Quality (CPSWQ)
	Certified Erosion Sediment and Storm Water Inspector (CESSWI)
	Other

If '*Other*,' describe:

Q55 Between January 1, 2016 and December 31, 2016, did you modify your BMPs, measurable goals, or future plans for your construction site stormwater runoff control program? [Part IV.B.]

No

If '*Yes*,' describe those modifications:

Minnesota Pollution Control Agency

MCM 5: Post-Construction Stormwater Management

The following questions refer to Part III.D.5. of the Permit.

Q56 Do you have a regulatory mechanism which meets all requirements as specified in Part III.D.5.a of the Permit?

Yes

Q57 What approach are you using to meet the performance standard for Volume, Total Suspended Solids (TSS), and Total Phosphorus (TP) as required by the Permit? [Part III.D.5.a.(2)] Check all that apply.

Refer to the link http://www.pca.state.mn.us/index.php/view-document.html?gid=17815 for guidance on stormwater management approaches.

X	Retain a runoff volume equal to one inch times the area of the proposed increase of impervious surface on-site
	Retain the post-construction runoff volume on site for the 95th percentile storm
	Match the predevelopment runoff conditions
	Adopt the Minimal Impact Design Standards (MIDS)
	An approach has not been selected
	Other method (Must be technically defensible - e.g., based on modeling, research and acceptable engineering practices)

If '*Other*,' describe:

Q58 Do you have written Enforcement Response Procedures (ERPs) to compel compliance with your post-construction stormwater management regulatory mechanism(s)? [Part III.B.]

Yes

Q59 Between January 1, 2016 and December 31, 2016, did you modify your BMPs, measurable goals, or future plans for your post-construction site stormwater management program? [Part IV.B.]

No

If '*Yes*,' describe those modifications:

Minnesota Pollution Control Agency

MCM 6: Pollution Prevention/Good Housekeeping for Municipal Operations

The following questions refer to Part III.D.6. of the Permit.

Q60 Enter the total number of structural stormwater BMPs, outfalls (excluding underground outfalls), and ponds within your MS4 (exclude privately owned).

Structural stormwater BMPs	92
Outfalls	256
Ponds	69

Q61 Enter the number of structural stormwater BMPs, outfalls (excluding underground outfalls), and ponds that were inspected from January 1, 2016 to December 31, 2016 within your MS4 (exclude privately owned). [Part III.D.6.e.]

Structural stormwater BMPs	92
Outfalls	200
Ponds	69

Q62 Have you developed an alternative inspection frequency for any structural stormwater BMPs, as allowed in Part III.D.6.e.(1) of the Permit?

No

Q63 Based on inspection findings, did you conduct any maintenance on any structural stormwater BMPs? [Part III.D.6.e.(1)]

Yes

Q64 If '*Yes* ,' briefly describe the maintenance that was conducted:

City-wide rain garden weeding, mulching, and removal of debris, pumped all grit chambers

Q65 Do you own or operate any stockpiles, and/or storage and material handling areas? [Part III.D.6.e.(3)]

No

Q66 If '*Yes*' in **Q65**, did you inspect all stockpiles and storage and material handling areas quarterly? [Part III.D.6.e.(3)]

Q67 If '*Yes* ' in **Q66**, based on inspection findings, did you conduct maintenance at any of the stockpiles and/or storage and material handling areas?

Q68 If '*Yes*' in **Q67**, briefly describe the maintenance that was conducted:

Q69 Between January 1, 2016 and December 31, 2016, did you modify your BMPs, measurable goals, or future plans for your pollution prevention/good housekeeping for municipal operations program? [Part IV.B.]

If '*Yes* ,' describe those modifications:

No

Minnesota Pollution Control Agency

Discharges to Impaired Waters with a USEPA-Approved TMDL that Includes an applicable WLA

If required, you must complete the **TMDL Annual Report Form**, available at: http://stormwater.pca.state.mn.us/index.php/Upload_page_with_TMDL_forms.
Attach your completed TMDL Annual Report Form to this Annual Report as instructed below. [Part III.E]

Q71 Successfully uploaded file: *TMDL form not required for Arden Hills City MS4.*

Minnesota Pollution Control Agency

Alum or Ferric Chloride Phosphorus Treatment Systems

The following questions refer to Part III.F.3.a. of the Permit. Provide the information below as it pertains to your alum or ferric chloride phosphorus treatment system.

'Alum or Ferric Chloride Phosphorus Treatment Systems' section not required for Arden Hills City MS4.

Q72 Date(s) of operation (mm/dd/yyyy - mm/dd/yyyy)

January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	

	Q73 Chemical(s) used for treatment:	**Q74** Gallons of alum or ferric chloride treatment:	**Q75** Gallons of water treated:	**Q76** Calculated pounds of phosphorus removed:
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				

Q77 Any performance issues and corrective action(s), including the date(s) when corrective action(s) were taken, between January 1, 2016 and December 31, 2016:

Minnesota Pollution Control Agency

Partnerships

Q78 Did you rely on any other regulated MS4s to satisfy one or more Permit requirements?

Yes

Q79 If '*Yes*' in **Q78**, describe the agreements you have with other regulated MS4s and which Permit requirements the other regulated MS4s help satisfy: [Part IV.B.6.]

We have a contract with the Ramsey Conservation District to inspect construction sites permitted through City issued Grading and Erosion Control permits. The City also collaborates with Rice Creek Watershed District on education and outreach for MCM 1 and 2.

Minnesota Pollution Control Agency

Additional Information

If you would like to provide any additional files to accompany your annual report, use the space below to upload those files. For each space, you may attach one file. You may provide additional explanation and/or information in an email with the subject YourMS4NameHere_2016AR to ms4permitprogram.pca@state.mn.us.

Q80 Successfully uploaded file: *No file attached.*

Q81 Successfully uploaded file: *No file attached.*

Q82 Successfully uploaded file: *No file attached.*

Q83 Optional, describe the file(s) uploaded:

Minnesota Pollution Control Agency

Owner of Operator Certification

The person with overall administrative responsibility for SWPPP implementation and Permit compliance must certify this MS4 Annual Report. This person must be duly authorized and should be either a principal executive (i.e., Director of Public Works, City Administrator) or ranking elected official (i.e., Mayor, Township Supervisor).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete (Minn. R. 7001.0070). I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment (Minn. R. 7001.0540).

X Yes

By typing my name in the following box, I certify the above statements to be true and correct, to the best of my knowledge, and that information can be used for the purpose of processing my MS4 Annual Report.

Name:	Susan Polka
Title:	Public Works Director/City Engineer
Date:	6/16/2016

APPENDIX K
Current MPCA MS4 Coverage Letter

Minnesota Pollution Control Agency
520 Lafayette Road North | St. Paul, Minnesota 55155-4194 | 651-296-6300
800-657-3864 | 651-282-5332 TTY | www.pca.state.mn.us | Equal Opportunity Employer

March 17, 2014

John Anderson
City of Arden Hills
1245 W Hwy 96
Arden Hills, MN 55112-5743

RE: Issuance of Coverage under the National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) General Permit MNR040000 for Municipal Separate Storm Sewer Systems for City of Arden Hills MS4

Dear Mr. Anderson:

In accordance with Minn. R. 7001.0140, the Commissioner of the Minnesota Pollution Control Agency (MPCA) has made a final determination to issue coverage under the National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) General Permit MNR040000 for Municipal Separate Storm Sewer Systems (MS4 General Permit) to the City of Arden Hills, effective March 17, 2014. Please find enclosed a copy of the above referenced MS4 General Permit.

The MPCA's final decision to issue permit coverage is based on the following:

- MPCA staff has reviewed your MS4 General Permit application and Stormwater Pollution Prevention Program (SWPPP) Document.
- Public notice and opportunity for comment on your MS4 General Permit application and SWPPP Document has been provided, and no comments were received.

As you know, it is the responsibility of the MS4 owner and/or operator to comply with the requirements of the MS4 General Permit and your SWPPP Document. This issuance of coverage does not preclude the MPCA from following up with an inspection or audit to verify compliance with the MS4 General Permit and SWPPP Document. Also, be aware that as a condition of recordkeeping, Part IV.C.3. of the MS4 General Permit requires that the permittee retain their SWPPP Document and all records pertinent to it for at least three (3) years beyond the term of the MS4 General Permit.

In addition, for an MS4 that was covered under the previous MS4 General Permit (issuance date June 1, 2006), coverage under that permit is terminated on the coverage date as specified above. An MS4 covered under the new MS4 General Permit is required to report on activities that were required or committed to under the previous permit.

Finally, the MPCA thanks you for your cooperation in the permitting process. Please retain this letter as documentation of your MS4 General Permit coverage under the NPDES/SDS Permit MNR040000.

Please contact MS4 team member Claudia Hochstein at 651-757-2881 with any questions.

Sincerely,

Duane Duncanson

This document has been electronically signed.

Duane Duncanson
Supervisor, Municipal Compliance Unit I
St. Paul Office
Municipal Division

cc: City of Arden Hills MS4 File