Shoreview, Minnesota

Second Generation

Surface Water Management Plan

March 2005

Multidisciplined. Single Source.
Trusted solutions for more than 75 years.

S h o r e v i e w • M i n n e s o t a

Second Generation

Surface Water Management Plan

EXECUTIVE SUMMARY

The City of Shoreview (City) has completed this second generation Surface Water Management Plan (SWMP or Plan) to establish a more useful and up-to-date guide for future surface water management activities throughout the City. This second generation Plan builds on the City's 1990 SWMP and addresses several key issues related to storm water management that the City is likely to encounter in the coming years. This executive summary provides a brief description of the purpose and basis for this updated Plan, followed by a presentation of the nine overriding goals that were used to guide development of the Plan. This executive summary closes by highlighting the key issues the City intends to address as part of this Plan.

A. Purpose of the Plan

The vision statement for the *Year 2000 Comprehensive Plan* promoted the idea of community stewardship, or "*managing the City's wealth, including community, environment and economy, to promote a better quality of life for present and future residents*." With this guidance from the Comprehensive Plan, the following Surface Water Management Plan purpose statement was developed:

The Surface Water Management Plan seeks to:

- *Provide for the use, management, improvement and protection of the City's surface water resources based on the best available information;*
- *Contribute to the quality of life by preserving the high environmental quality of the community;*
- *Protect public investments and private property related to or affected by surface water;*
- *Recognize the larger context of surface water management issues;*
- *Balance environmental protection with community and economic needs and capabilities; and*
- *Meet regulatory requirements.*

B. Regulatory Basis for the Plan

There are two primary programs that establish the regulatory need to update the City's initial Surface Water Management Plan (SEH, 1990). First, Minnesota Statutes, Sections 103B.201 to 103B.255 and Minnesota Rule, Chapter 8410 comprise the State's Metropolitan Surface Water Management Program (MSWMP). These Statutes and Rules require the preparation of watershed plans by watershed management organizations (WMOs) and the preparation of local water management plans that are consistent with the respective WMO plans. Second, the City's recently updated *Year 2000 Comprehensive Plan* (URS, 2000), calls for the SWMP to be updated following completion of the Grass Lake Watershed Management Organization plan.

The purpose of the MSWMP is that through policies and thoughtful program implementation, goals for proper water and wetland resource management can be realized and water quality can be protected. Through proper planning and implementation, informed decisions can be made which allow for the protection and/or enhancement of water quality, prevention of ground water degradation, and reduction of local flooding.

Shoreview is located within three major watershed units including the Rice Creek Watershed District (RCWD), the Grass Lake Watershed Management Organization (GLWMO), and the Vadnais Lake Area Watershed Management Organization (VLAWMO) as shown in Figure 2. Both GLWMO and RCWD have jurisdictional authority within the City and, therefore, RCWD and GLWMO must review and approve the City's Plan to evaluate consistency with the respective WMO Plan. RCWD updated their Water Resource Management Plan in 2000 (EOR, 2000), and GLWMO published their completed Watershed Management Plan in September 2001 (Barr, 2001). While VLAWMO did not have jurisdictional authority at the time of this Plan update by the City, they were included in the planning and review process from the onset of the project.

A third regulatory program, very much related to the goals, policies and standards of this Plan, is the National Pollutant Discharge Elimination System (NPDES) Phase II Storm Water Permit Program (Phase II Program). While this program is not directly a driving force for updating the City's Plan, similarities between the MSWMP and NPDES Phase II programs are such that the City intends to realize efficiencies in managing the two separate programs as a single program.

The NPDES Phase II Storm Water Permit Program is a federal regulatory program that requires owners of Municipally Separate Storm Sewer Systems (MS4s) to prepare and implement a Storm Water Pollution Prevention Program (SWPPP) and apply for the permit with the administrative agency. The Minnesota Pollution Control Agency (MPCA) administers the Phase II MS4 program in the state. The City submitted their permit application and SWPPP on March 10, 2003, to comply with the initial submittal deadline. This SWMP incorporates the best management practices (BMPs) that were identified in the City's SWPPP along with several specific projects that were not specified as part of the Phase II program. The City also completed a Phase II storm water permit application and SWPPP for their public works facility which is defined as a Municipally-owned Industrial Facility under the NPDES regulations.

Throughout the process of selection and development of some 38 BMPs, the City considered the significant sources of pollution, the potentially polluting activities being conducted in the watershed and the sensitivity of the receiving waters. The City has also considered the physical and organizational characteristics of the watersheds within the City. The ultimate goal of the City's Phase II SWPPP is to control or reduce the discharge of pollutants in storm water runoff.

C. Plan Overview

The Plan contains an introduction (Section I), a brief background and history and description of the existing physical environment (Section II); specific goals and policies (Section III) developed by the City; specific information regarding key water bodies within the City (Section IV) and an implementation plan summary to guide future projects and management activities for the protection and future enhancement of the City's water and wetland resources (Section V).

Using the nine goals summarized in Table 1, the Plan is intended to guide surface water and water resource management activities over at least the next ten years. Though long term in focus, the Plan has numerous future decision points related to recommended capital improvements and ongoing inspection, maintenance and monitoring activities. The Plan was developed recognizing the need for proper land utilization and growth and, at the same time, emphasizing the need to prioritize management actions and decisions based on the assigned category of a receiving water body (i.e., lake or wetland).

Table 1. Shoreview Storm Water Management Plan Goals

Goal Number	Goal
1	Water Quality
2	Water Quantity (Flooding)
3	Wetlands
4	Erosion Control
5	Groundwater
6	Recreation, Habitat and Shoreline Management
7	Public Participation, Information and Education
8	Maintenance and Inspection
9	Regulatory Responsibility

One of the larger efforts undertaken as a part of this Plan update is the City-wide hydrologic model Update. This effort will improve on the accuracy of results and produce a data format that would be acceptable to the Federal Emergency Management Agency (FEMA) as the City moves toward an update to the City's Flood Insurance Rate Map (FIRM). Figure 12 (foldout map) illustrates the drainage network that forms the basis for the City-wide hydrologic model. The overall goals of this modeling effort were to better predict and understand the urban hydrology within the City such that potential future flooding issues resulting from development or redevelopment could be addressed and to update the FIRM. The desired outcome of the FIRM update is to reduce the number of properties within the City that are required to obtain flood insurance where little flood risk is present.

In addition to the updated SWMP, the City also completed an update to the 1990 Wetland Inventory. The *2003 Wetland Inventory* is provided under separate cover and is summarized in Section IV

This updated SWMP addresses each of the required elements in Minnesota Statutes and Rules and is consistent with the Metropolitan Council's guidelines for Water Management Plans. The Plan is also consistent with the RCWD and GLWMO Plans. The criteria set forth in this Plan, as a minimum, establish the degree of performance necessary to achieve improvement in water quality and water quantity management. These criteria are not intended to dictate or preempt the design process, but rather provide guidelines to proper development and redevelopment.

D. Implementation Plan

The Implementation Plan is made of nine action-implementation Plans created for each of the nine Plan goals. The overall Plan summarizes capital improvement projects, studies and ongoing maintenance, inspection, monitoring and other management activities recommended for at least the years 2003 through 2008 related to the City's NPDES SWPPP as well as activities that are intended to continue on a much longer-term basis. Estimated costs of recommended actions are not provided recognizing that planning-level cost estimates often set unrealistic expectations of the actual costs of projects and/or activities.

The implementation plan is based on goal and policy-driven action-implementation plans. The process of developing the action and implementation plans is based on four steps:

- Development of goal statements consistent with Minnesota Rules Chapter 8410, the WMOs and Metropolitan Council;
- Identification of issues or problems related to achieving the goals;
- Identification of solutions corresponding to each of the issues; and
- Development of specific action steps, including identification of resources, measurement and anticipated schedules.

1. Implementation Priorities

The City's water bodies and wetlands are truly exceptional resources for City residents. They offer a range of recreational opportunities and are generally in very good shape from a water quality perspective. The City's challenge in the years ahead will be to successfully implement this SWMP and the requirements of the NPDES Phase II program to maintain, and where feasible, improve these existing resources. Water Quantity, or flooding, issues are another key area for the City to focus efforts on in the coming years. While no significant issues exist, there are several areas throughout the City where localized flooding can be addressed by infrastructure improvements associated with street reconstruction and/or development projects.

The financial goal for this Plan is to fit within the existing funding sources to pay for water resources management activities. For the activities called out in this Plan, planning-level estimates of capital expenditures have not been made. The primary funding source for Plan activities is the City's Surface Water Management Fund. The Fund is anticipated to be

supplemented by special assessments, grant and other available funding on a project specific basis. In consideration of recent municipal budget situations, a renewed focus will be placed on securing grants, enlisting regional watershed funding, seeking local partnerships with adjacent communities and investigating other innovative financing mechanisms.

Except for the activities that are taken from the City NPDES SWPPP, 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 goal of this plan; to accommodate in-fill development and redevelopment in the community while protecting and improving Shoreview's water resources. Infrastructure replacements and/or additions will be reviewed, approved and administered in accordance with Shoreview's Capital Improvement Program.

2. Amendments to the Plan

The NPDES SWPPP activities will be reviewed and evaluated annually in a public meeting and the permit program itself will be updated regularly in accordance with the NPDES program requirements. For this SWMP to remain dynamic, an avenue must be available to implement new information, ideas, methods, standards, management practices, and any other changes which may affect the intent and/or results of the Plan. Amendment proposals can be requested any time by any person or persons either residing or having business within the City.

Proposed amendments are reviewed by staff, and if determined to be reasonable and necessary amendment the need for a public hearing shall be considered at a regular or special Council meeting. Council and the WMOs have an opportunity to determine whether or not to approve of the proposed amendments.

3. Annual Report to Council

An annual report will be completed by City staff summarizing water resource management activities that have been completed over each calendar year. To the extent practicable, and to avoid duplication of efforts, the annual report will be coordinated with preparation of the Phase II NPDES program annual report that must be submitted to MPCA by March 10th of each year. The NPDES annual report includes a public notice, meeting and comment process prior to finalizing the annual report. The City will use this annual reporting process to evaluate the storm water program overall.

The Plan will remain in effect through approximately 2014 and should then be reviewed for consistency with current water resources management methods. Staff's intent is to revisit the goals, policies, tools and progress of the Plan on a three to five year basis. Water quality trends will be reviewed, the effectiveness of regulatory programs will be evaluated, and the success of public improvement projects will be assessed. Based on these subsequent reviews, the SWMP will be updated to produce a truly dynamic plan. NPDES permits issued by MPCA to cities are effective for a maximum term of five years, with an initial revision to the permit expected in 2005. Therefore, the City will also be revising their NPDES SWPPP in 2005 and on a five year basis after that as part of the NPDES program requirements.

This page left intentional blank

ACKNOWLEDGEMENTS

City Council

City Commissions
- Planning Commission
- Environmental Quality Commission

City Staff

Terry Schwerm	City Manager
Mark Maloney	Public Works Director/City Engineer
Jerry Auge	Assistant City Engineer
Kathleen Nordine	City Planner

SEH Staff

Ron Leaf	Project Manager
Beth Peterson	Project Engineer
Susan Severa	Project Engineer / Modeler
Brad Digre	GIS – Hydrologic Modeling
Steve Hack	GIS – Mapping
Mark Lobermeier	Advisor - 1990 Plan Project Manager

Reviewing Agencies
- Rice Creek Watershed District
- Vadnais Lake Area Watershed Management Organization
- Grass Lake Watershed Management Organization
- Metropolitan Council
- Ramsey County
- Minnesota Pollution Control Agency

SEH No. A-SHORE0201.00

This page left intentional blank

Executive Summary
Acknowledgements
Table of Contents
List of Tables
List of Figures
List of Appendices

TABLE OF CONTENTS

I. Introduction 1

A. Purpose of the Plan 1
B. Regulatory Basis for the Plan 2
1. Metropolitan Surface Water Management Program 2
2. Watershed Management Organizations 3
3. NPDES Phase II Storm Water Permit Program 3
C. Plan Overview 4

II. Background, History and Physical Environment 7

A. Soils and Geology 8
B. Precipitation 9
C. Land Use 10
D. Public Utilities 11
E. Water-based Recreation Areas 12
F. Unique Features and Scenic Areas 12
G. Pollutant Sources 13

III. Goals and Policies 15

A. Goal 1. Water Quality 16
1. Water Quality Assessment 18
2. NPDES Phase II SWPPP 20
3. Implementation Plan 20
B. Goal 2. Water Quantity 22
1. Hydrologic Modeling Update 23
2. Flood Mapping Update 25
3. Implementation Plan 26
C. Goal 3. Wetlands 26
1. Comprehensive Wetland Management Plan 28
2. Implementation Plan 28

D. Goal 4. Erosion Control 29
1. Rice Creek, Grass Lake Programs 30
2. NPDES Phase II SWPPP 30
3. Implementation Plan 31
E. Goal 5. Groundwater 31
1. Implementation Plan 32
F. Goal 6. Recreation, Habitat and Shoreline Management 33
1. Water Bodies 34
2. Implementation Plan 34
G. Goal 7. Public Participation, Information and Education 35
1. WMO and WD Programs 36
2. City Programs 36
3. Implementation Plan 37
H. Goal 8. Maintenance and Inspection 37
1. Storm Water Management Program 39
2. NPDES Phase II SWPPP 39
3. Implementation Plan 40
I. Goal 9. Regulatory Responsibility 40
1. NPDES Phase II SWPPP 41
2. Funding/Financing Considerations 42
3. Implementation Plan 44

IV. Water Bodies 45

A. Overview 45
B. Category I Water Bodies 47
1. Lake Owasso 47
2. Lake Wabasso 48
3. Snail Lake 49
4. Turtle Lake 50
C. Category II Water Bodies 50
1. Emily Lake 51
2. Shoreview Lake 51
3. Island Lake 52
D. Category III Water Bodies 52
1. Grass Lake 52
2. Lake Judy 53
3. Martha Lake 53
E. Category IV and V Water Bodies 54
F. Wetlands 54

XII. Implementation Plan 57

A. Overview 57
B. Implementation Priorities and Costs 57

C. Amendments to the Plan 59
1. Amendment Procedures 59
2. Request for Amendments 59
3. Staff Review 59
4. Council Consideration 59
5. Public Hearing and Council Approval 59
6. WMO and WD Approval 59
7. Council Adoption 60
D. Annual Report to Council 60

LIST OF APPENDICES

A. Acronyms, Glossary

B. Literature Review and References, Water Management Agency/Organization Contacts

C. Development Guidelines

D. Hydrologic System Data Summary Tables
Recommended Minimum Building Elevation Data (1929 Datum)
Peak Rates and Elevations for 2, 10 and 100-Year Events (1988 Datum)

E. Water Quality Assessment Data Tables

F. Figures

G. NPDES Phase II Program Summary
Link to MS4 Permit SWPPP (City web page)
Link to Industrial Permit SWPPP (City web page)
Link to NPDES Construction Permit (MPCA web page)

LIST OF TABLES

Table 1 Shoreview Storm Water Management Plan Goals ES-1, 4
Table 2 Rainfall in Minneapolis-St. Paul Metropolitan Area (inches)..... 9
Table 3 Summary of Water-Based Recreational Facilities at Protected Waters 12
Table 4 Rare Species and Natural Communities 13
Table 5 Plan Goals and Goal Statements 16
Table 6 Water Quality Policies 17
Table 7 Water Quality Implementation Plan 20
Table 8 Water Quantity (Flooding) Policies 23
Table 9 Water Quantity Implementation Plan 26
Table 10 Wetlands Policies 27
Table 11 Wetland Implementation Plan 29
Table 12 Erosion Control Policies 30
Table 13 Erosion Control Implementation Plan 31
Table 14 Groundwater Policies 32
Table 15 Groundwater Implementation Plan 33
Table 16 Recreation, Habitat and Shoreline Management Policies 34
Table 17 Recreation, Shoreline and Habitat Implementation Plan 35
Table 18 Public Participation, Information and Education Policies..... 36
Table 19 Public Participation, Information and Education Implementation Plan 37
Table 20 Maintenance and Inspection Policies 38
Table 21 Maintenance and Inspection Implementation Plan..... 40
Table 22 Regulatory Responsibility Policies 41
Table 23 Advantages and Disadvantages of Various Funding Alternatives 43
Table 24 Regulatory Responsibility Implementation Plan 44
Table 25 Water Body Classification and Management Lead for Shoreview Lakes and Water Bodies 46
Table 26 TMDL Listed Waters in Shoreview 46
Table 27 Summary of Wetland Types and Cumulative Surface Area in Shoreview.... 54

LIST OF FIGURES *(See Appendix F)*

Figure 1 City Location Map
Figure 2 Watershed Boundaries
Figure 3 Soil Hydrologic Group
Figure 4 Soil Erosion Potential
Figure 5 Existing Land Use
Figure 6 Proposed Land Use
Figure 7 ISTS Sites
Figure 8 Protected Waters
Figure 9 National Wetland Inventory
Figure 10 Wetland Classification
Figure 11 Water Body Classification
Figure 12 Watershed and Drainage Area Boundaries (11 x 17)
Figure 12A Watershed and Drainage Area Boundaries with Storm Sewer (Fold out)
Figure 13 Letters of Map Change to the City's FIRM

S h o r e v i e w • M i n n e s o t a

Second Generation

Surface Water Management Plan

I. INTRODUCTION

The City of Shoreview is located in the northern suburbs of the of the Twin Cities metropolitan area in north central Ramsey County as shown in Figure 1. The City is bordered by Mounds View and Arden Hills to the west; Blaine, Circle Pines and Lino Lakes to the north; North Oaks, Vadnais Heights, and Little Canada to the east; and Roseville to the south.

The City of Shoreview (City) has completed this second generation Surface Water Management Plan (SWMP or Plan) to establish a more useful and up-to-date guide for future surface water management activities throughout the City. This second generation Plan builds on the City's 1990 SWMP and addresses several key issues related to storm water management that the City is likely to encounter in the coming years. This introductory section begins with a brief description of the purpose and basis for this updated Plan, followed by an outline of the major sections and the nine overriding goals that were used to guide development of the Plan.

A. Purpose of the Plan

The purpose statement helps to determine the overall vision for the SWMP. The vision statement for the *Year 2000 Comprehensive Plan* promoted the idea of community stewardship, or "*managing the City's wealth, including community, environment and economy, to promote a better quality of life for present and future residents*." With this guidance from the Comprehensive Plan, the following purpose statement was developed:

The Surface Water Management Plan seeks to:

- *Provide for the use, management, improvement and protection of the City's surface water resources based on the best available information;*
- *Contribute to the quality of life by preserving the high environmental quality of the community;*
- *Protect public investments and private property related to or affected by surface water;*

- *Recognize the larger context of surface water management issues;*
- *Balance environmental protection with community and economic needs and capabilities; and*
- *Meet regulatory requirements.*

B. Regulatory Basis for the Plan

There are two primary programs that establish the regulatory need to update the City's initial Surface Water Management Plan (SEH, 1990). First, Minnesota Statutes, Sections 103B.201 to 103B.255 and Minnesota Rule, Chapter 8410 (http://www.revisor.leg.state.mn.us) comprise the State's Metropolitan Surface Water Management Program (MSWMP). These Statutes and Rules require the preparation of watershed plans by watershed management organizations (WMOs) and the preparation of local water management plans that are consistent with the respective WMO plans. Second, the City's recently updated *Year 2000 Comprehensive Plan* (URS-BRW, 2000), calls for the SWMP to be updated following completion of the Grass Lake Watershed Management Organization plan.

A third regulatory program, very much related to the goals, policies and standards of this Plan, is the National Pollutant Discharge Elimination System (NPDES) Phase II Storm Water Permit Program that is administered in the State by the Minnesota Pollution Control Agency (MPCA) (http://www.pca.state.mn.us). While this program is not directly a driving force for updating the City's Plan, similarities between the MSWMP and NPDES Phase II programs are such that the City intends to realize efficiencies in managing the two separate programs as a single program. Additional information on the purposes and background for each of the three programs follows.

1. Metropolitan Surface Water Management Program (MSWMP)

The purpose of the MSWMP is that through policies and thoughtful program implementation, goals for proper water and wetland resource management can be realized and water quality can be protected. Such a program requires cooperation with neighboring communities, the County, state agencies and WMOs. Through proper planning and implementation, informed decisions can be made which allow for the protection and/or enhancement of water quality, prevention of ground water degradation, and reduction of local flooding.

The purposes of the water management programs required by Minnesota Statutes §103B.205 to 103B.255 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;
- 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.

2. Watershed Management Organizations

Under the MSWMP (http://www.bwsr.state.mn.us), the City is required to submit their updated SWMP to WMOs having jurisdiction within the City. Shoreview is located within three major watershed units including the Rice Creek Watershed District (RCWD) http://www.ricecreekwd.com, the Grass Lake Watershed Management Organization (GLWMO) http://www.glwmo.org, and the Vadnais Lake Area Watershed Management Organization (VLAWMO) http://www.vlawmo.org as shown approximately in Figure 2. Figure 2 illustrates the watershed boundaries from a hydrologic perspective. In practice, the watershed districts and WMOs may have slightly different administrative boundaries than the hydrologic boundaries shown in Figure 2.

Both GLWMO and RCWD have jurisdictional authority within the City and, therefore, RCWD and GLWMO must review the City's Plan to evaluate consistency with the respective WMO Plan. RCWD updated their Water Resource Management Plan in 2000, and GLWMO published their completed Watershed Management Plan in September 2001 (Barr, 2001). While VLAWMO did not have jurisdictional authority at the time of this Plan update by the City, they were included in the planning and review process from the onset of the project.

This updated SWMP addresses each of the required elements in Minnesota Statutes and Rules and is consistent with the Metropolitan Council's guidelines for Water Management Plans. The Plan is also consistent with the RCWD and GLWMO Plans. The criteria set forth in this Plan, as a minimum, establish the degree of performance necessary to achieve improvement in water quality and water quantity management. These criteria are not intended to dictate or preempt the design process, but rather provide guidelines to proper development and redevelopment.

This Plan represents a unique combination of resource management, regulatory controls and public works management. As discussed above, State Statutes and Rules require that a plan be prepared for each watershed in the seven county metropolitan area. Local (i.e., City) plans must also be prepared and approved by the applicable watersheds and the Metropolitan Council. Once approved, the Plan becomes part of the City's overall Comprehensive Plan.

3. NPDES Phase II Storm Water Permit Program

The NPDES Phase II Storm Water Permit Program is a federal regulatory program that requires owners of Municipally Separate Storm Sewer Systems (MS4s) to prepare and implement a Storm Water Pollution Prevention Program (SWPPP) and apply for the permit with the administrative agency. The Minnesota Pollution Control Agency (MPCA) administers the Phase II MS4 program in the state (http://www.pca.state.mn.us). The City submitted their permit application and SWPPP on March 10, 2003, to comply with the initial submittal deadline. This SWMP

incorporates the best management practices (BMPs) that were identified in the City's SWPPP along with several specific projects that were not specified as part of the Phase II program.

One step in meeting the Phase II requirements included a self assessment process that the City completed to prepare their Notice of Intent (NOI or permit application) for coverage under the NPDES MS4 Phase II Permit. In this process, the City considered the receiving waters within the City, the City's existing storm water management plan and a range of BMPs that could be followed to achieve the goals of this Plan and the MS4 requirements. The self assessment resulted in an understanding of the City's current storm water programs and future priorities.

Throughout the process of selection and development of some 38 BMPs, the City considered the significant sources of pollution, the potentially polluting activities being conducted in the watershed and the sensitivity of the receiving waters. The City has also considered the physical and organizational characteristics of the watersheds within the City. The ultimate goal of the City's Phase II SWPPP is to control or reduce the discharge of pollutants in storm water runoff.

C. Plan Overview

One of the first steps taken to develop this Plan was to gather and compile the best available information and data from a number of sources. Sources of these data include the City's *1990 Surface Water Management Plan*, the *2000 Comprehensive Plan*, the WMO plans, MPCA NPDES Program and other relevant data were then reviewed and evaluated as part if the update process. Following this introductory section, the Plan presents a summary of the information reviewed and evaluated. The subsequent sections provide a brief background and history and describe the existing physical environment (Section II); identify specific goals and policies (Section III); present specific information regarding key water bodies within the City (Section IV) and establish an implementation plan to guide future projects and management activities for the protection and future enhancement of the City's water and wetland resources (Section V).

Using the nine goals summarized in Table 1, the Plan is intended to guide surface water and water resource management activities over at least the next ten years. Though long term in focus,

Table 1. Shoreview Storm Water Management Plan Goals

Goal Number	Goal
1	Water Quality
2	Water Quantity (Flooding)
3	Wetlands
4	Erosion Control
5	Groundwater
6	Recreation, Habitat and Shoreline Management
7	Public Participation, Information and Education
8	Maintenance and Inspection
9	Regulatory Responsibility

the Plan has numerous future decision points related to recommended capital improvements and ongoing inspection, maintenance and monitoring activities. Where applicable, staff and financial resources of the City, WMOs and adjacent communities are called on to maximize the effectiveness of the results. The Plan was developed recognizing the need for proper land utilization and growth and, at the same time, emphasizing the need to prioritize management actions and decisions based on the assigned category of a receiving water (i.e., lake or wetland).

In addition to the updated SWMP, the City also completed an update to the 1990 Wetland Inventory. The *2003 Wetland Inventory* is provided under separate cover and is summarized in Section IV

This page left intentional blank

S h o r e v i e w • M i n n e s o t a

Second Generation

Surface Water Management Plan

II. BACKGROUND, HISTORY AND PHYSICAL ENVIRONMENT

As the name implies, the City has a variety of lakes, wetlands and waterways that provide aesthetic, environmental and recreational value to the community. The City has an area of 8,100 acres (12.7 square miles) of land of which approximately 2,400 acres are a combination of surface water and Type 3 to 7 wetland features. Portions of three major watersheds exist with in the City (See Figure 2). The Grass Lake Watershed encompasses approximately 3,100 acres, the Rice Creek watershed encompasses approximately 4,650 acres and the Vadnais Lake Watershed encompasses approximately 350 acres. Of the seven major lakes in Shoreview, most have public boat access facilities and the water quality supports full body contact recreational uses. The City is well known for preserving the natural environment through proactive planning, long-range fiscal planning for infrastructure, and the first-class parks and trails.

The City of Shoreview is part of the Twin Cities metropolitan area which was originally inhabited by the Dakota and Ojibwe Indians. Remnants of the Dakota and Ojibwe civilizations have been found along Rice Creek in neighboring northern suburban communities and in Shoreview near Snail Lake. In 1837, the Ojibwe Indians ceded this area to the United States government. Shoreview was originally part of Mounds View Township, named for a range of hills running through its center.

Residential development throughout the City occurred primarily between the 1960s and 1990s. Edgetown Acres, north of County Road I and adjacent to the Twin Cities Army Ammunition Plant (TCAAP), was developed in response to expectations that the Korean War would generate jobs on the TCAAP property. Development of the remaining areas followed as agricultural land changed to residential land uses. The age of housing in the City ranges from the original farmsteads dating back to the 1850's to the early 2000s, the peak in housing development occurred in the 1970s and 1980s. The City was one of the state's ten fastest growing suburbs in the mid-1980s.

The City is now almost fully developed and will rely on infill and redevelopment to meet the changing needs of residents. Overall, the low-density residential development pattern will remain

with some areas transitioning to higher density residential uses, employment centers, and shopping areas.

A. Soils and Geology

The City's geology influences all other natural resources from waters to woodlands. The last glacial activity and subsequent erosion primarily shaped Shoreview's soils and topography. The entire area north of Highway 96 and a large portion of the area south of Highway 96 lies within the southern part of the Anoka sand plain. This area is illustrated in Figure 3 by primarily Hydrologic Group A and B soils. The Anoka sand plain is a broad expanse of sands deposited by glacial melt waters.

The topography of this area is generally flat although steep slopes may occur adjacent to drainages and depressions. Soils generally consist of deep sandy soils and the infiltration rate and permeability of these soils is rapid, resulting in relatively low runoff volumes. The water table in these soils is generally below 6 feet. However, this region includes areas of organic or poorly drained sandy soils where a shallow water table may occur at 0 to 2 feet below ground surface.

Hilly deposits of glacial till dominate the southern part of Shoreview west of Snail and Grass Lakes. The tills are a mixture of two separate glacial advances into the area. The reddish till material was carried from the northeast by the Superior lobe. This glacier scoured the Lake Superior basin and brought iron-rich reddish soil into the area. A second glacial advance, known as the Grantsburg sub lobe, brought gray calcareous soils from the Canadian prairie and North Dakota plains. This second glacier overrode and intermixed with the earlier deposits from the Superior lobe.

Topography in this area is moderately rolling with occasional steep slopes and depressions. Soils generally consist of brownish or grayish loamy till, reddish sandy or silty loam, or a mixture of both. These soils are typically moderately- to well-drained with a water table below 6 feet in depth. Small lakes, depressions, and drainage ways are scattered throughout the area. Wetlands in this portion of the City are generally the result of a perched water table.

Infiltration capacities of soils can affect the amount of direct runoff resulting from a rainfall event. Generally, the higher the infiltration rate is for a given soil, the lower the runoff potential. Conversely, soils with low infiltration rates produce relatively high runoff volumes and high peak discharge rates.

Four general hydrologic groups for soils based on texture and slope have been established by the Natural Resource Conservation Service (NRCS). The groups as shown in Figure 2 are:

- Group A – Low runoff potential, high infiltration rate
- Group B – Moderate infiltration rate
- Group C – Slow infiltration rate
- Group D – High runoff potential, very slow infiltration rate

The soil hydrologic grouping symbols (A-D) were evaluated along with existing and future land use data from the *Year 2000 Comprehensive Plan* to estimate runoff characteristics that will occur over a given area for a particular rainfall amount.

Soil characteristics are essential for completing hydrologic analyses and are also important when developing erosion control plans. Special attention to erosion control measures and establishment of interim cover during construction must be considered in areas of steep slopes, in areas with highly erodible soils and in areas with prolonged land disturbance. The erosion control handbook published by the Board of Water and Soils Resources (BWSR) includes recommended practices and the Ramsey Soil and Water Conservation District has published a "Soil Erosion and Sediment Control Handbook" (1989) that outline recommended Best Management Practices (BMPs) that should be used for erosion protection. Figure 4 illustrates the general erosion potential throughout the City based on the predominate slope of the land.

B. Precipitation

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 29 inches. The average annual snowfall is approximately 50 inches, equivalent to roughly 5 inches of water. Rainfall data for a variety of return frequencies and storm duration for the Minneapolis-St. Paul metropolitan area is shown in Table 2.

Table 2. Rainfall in Minneapolis-St. Paul Metropolitan Area (inches)

Return Frequency	24-Hour	12-Hour	6-Hour	3-Hour	2-Hour	1-Hour	30-Minute	15-Minute
1-Year	**2.3**	2.0	1.7	1.5	1.4	1.2	0.9	0.6
2-Year	**2.8**	2.4	2.1	1.7	1.7	1.4	1.1	0.7
5-Year	**3.6**	3.1	2.7	2.3	2.2	1.8	1.4	1.0
10-Year	**4.2**	3.7	3.1	2.6	2.5	2.1	1.7	1.3
25-Year	**4.6**	4.2	3.5	3.0	2.8	2.3	1.9	1.4
50-Year	**5.3**	4.6	4.0	3.4	3.1	2.7	2.1	1.5
100-Year	**5.9**	5.0	4.4	3.8	3.5	2.9	2.4	1.7

Several rainfall parameters are considered in using the NRCS hydrologic design methodology. Storm duration, rainfall depths, time distribution (how the total rainfall depth is distributed over the duration of the rainfall event), and recurrence interval (how probable it is that the rainfall event will recur in a given year) are important factors.

The 24-hour, NRCS Type II rainfall distribution with average soil moisture conditions (AMC-2) will be used for overall subwatershed planning within the City of Shoreview. The first generation

1990 Plan used a Type I storm distribution in development of the City-wide hydrologic model. At that time the Minnesota Hydrology Guide recommended a Type I distribution as the standard for all land use areas. The Guide has since been revised and now recommends a Type II distribution for hydrologic analyses of urban areas. See Appendix A for more detail on Type I, II and C storm distributions. For the purposes of this Plan, the Flood Evaluation Storm (FES) is used to evaluate flooding under a worst-case rainfall scenario. Of the two following storm events, the FES for a selected water body will be the storm that results in the highest elevation reached in the water body:

- NRCS 100-year, 24-hour, Type II rainfall distribution with wet soil moisture conditions (AMC-3) which is heavy rainfall, or light rainfall and low temperatures have occurred within the last five days.
- NRCS 100-year, 10-day runoff, Type "C" distribution (National Engineering Handbook, Section 4).

The return period is related to the probability of a given event being equaled or exceeded. The probability that the "100-year event" will be exceeded in a given year is 1 percent. Conventional wisdom holds that if a 100-year event occurs in one year, then it cannot occur for another 100 years. This belief is false because it implies that rainfall occurs deterministically rather than randomly. Because rainfall occurs randomly, there is a finite possibility that the 100-year event could occur in two consecutive years or more frequently than one occurrence in any given year. More information on the NRCS design method or rainfall events is available at http://www.nrcs.usda.gov.

C. Land Use

The City of Shoreview is considered a fully-developed community with 96 percent of its land area developed as of 2000. The predominant land uses include single-family residential, parks, open space and natural areas. With only four percent of the land area remaining vacant, the City's challenge is to provide areas for commercial and industrial redevelopment and other residential opportunities while preserving natural areas. Figure 5 illustrates the existing land use throughout the City, based on the City's current zoning.

The City and its residents place the highest value on preserving the natural environment and ensuring that new development fits the character of existing neighborhoods. The proposed land use plan shown in Figure 6 identifies the intended future land uses throughout the City. This plan takes into consideration the City's existing land use pattern, projected growth and land use policies. For more information on land use within the City of Shoreview refer to the City's *Year 2000 Comprehensive Plan*.

Future land use projections help to identify areas that may be available for water resource enhancements and also to help prioritize improvements. Significant changes in land use can increase runoff rates and volumes due to the additional impervious surface. As areas develop or redevelop at a higher density, storm water runoff generally increases. Roofs, driveway, parking lots, and other impervious surfaces increase the volume of runoff and decrease the volume retained in the soil by infiltration. A key challenge of this Plan will be to establish reasonable and

effective standards that meet stated water quantity and quality goals when development or redevelopment results in an increase in impervious surface.

The City of Shoreview has created numerous park areas throughout the City. In addition, many outlots or natural areas are incorporated into developments. While many of these outlots are marginal lands for development, most contain wetlands or are used for storm water detention. These areas also provide important wildlife habitat as well as aesthetic benefits for the City.

D. Public Utilities

Public utilities within the City include sanitary sewer, water supply system and storm sewer. The City's municipal sanitary sewer is a conveyance system only; the City does not own or operate any sewage treatment facilities. The municipal sanitary sewer system is a gravity-based system consisting of pipes ranging from 8 to 36 inches in diameter. Generally, the pipes consist of clay, cast iron or concrete with PVC used in more recent years. The municipal system collects sewage from individual properties within the City limits and routes it to the regional sewage interceptor system that delivers sewage to regional treatment facilities.

The City currently has three properties categorized by Metropolitan Council Environment Services (MCES) as Industrial Strength/Rate Customers. Forty-five properties (43 residential and 2 non-residential) in the City use private individual sewage treatment systems (ISTS) as illustrated in Figure 7. The City's Development Ordinance regulates ISTS sites and is consistent with recently revised Minnesota Pollution Control Agency Rule 7080 which includes ISTS inspection and maintenance requirements.

The City has no access to suitable surface water sources for water supply and relies solely on groundwater. The Prairie du Chien-Jordan aquifer, located approximately 400 feet below the ground surface, serves as the City's municipal water source. The City appropriates water from this aquifer under a permit from the Minnesota Department of Natural Resources (DNR). This permit allows the City to appropriate 1.4 billion gallons of water a year. All of the City's water supply wells are within a half-mile radius of City Hall.

The City has two elevated storage tanks, one underground storage reservoir and does not have a water treatment plant. However, the City has a centralized pumping system with chlorination and fluoridation for most of their wells.

A significant portion of the City's drainage system is storm sewer. Construction of new storm sewer and improvement of existing storm sewer throughout the City is controlled by new development and street maintenance or reconstruction activities. The storm water conveyance system is discussed in more detail in Section V of this Plan. As part of this project, the City's storm sewer system database has been updated and corrected. The update results in both GIS-based and AutoCAD versions of the storm sewer system. Ultimately, these files will form the foundation for complying with the inspection, maintenance and reporting requirements for the National Pollutant Discharge Elimination System (NPDES) Phase II storm water permit program discussed in Section XI of this Plan.

E. Water-Based Recreation Areas

As mentioned previously, the City has a variety of lakes, wetlands and waterways that provide aesthetic, environmental and recreational value to the community. Based on the Department of Natural Resources Protected Waters and Wetlands Inventory, there are 19 protected waters located fully or partially with the City of Shoreview. These water bodies, as shown in Figure 8, are identified as protected waters (i.e., lakes or wetlands). Several parks located on or near these protected waters provide boat ramps, fishing access and/or swimming beaches, along with trails and picnic areas. Table 3 summarizes the water-based recreational facilities at these parks.

Table 3. Summary of Water-Based Recreational Facilities at Protected Waters

Water Body	Park or Area	Boat Ramp	Fishing Access	Swimming Beach	Trails or Picnic Areas
Island Lake	Island Lake County Park	●	●	●	●
Lake Owasso	Lake Owasso County Park	●	●	●	
Snail Lake	Marsh County Park				
	Snail Lake Regional Park	●	●	●	●
Turtle Lake	Turtle Lake County Park	●	●	●	●
Lake Judy	Lake Judy Park				●

The City's updated *2003 Wetland Inventory* (SEH, 2003) categorizes and inventories wetlands throughout the City. A majority of wetlands within the City were field inspected to classify each according to a new classification system for City wetlands. The new system is based on and is consistent with the Grass Lake WMO classification system. The *2003 Wetland Inventory* also identifies wetlands throughout the City according to the National Wetlands Inventory (NWI) system for which the extent of wetlands in Shoreview is illustrated in Figure 9.

F. Unique Features and Scenic Areas

The Minnesota DNR maintains a database of unique and sensitive plant and animal species. Given the lakes, wetlands and open space in the City and surrounding area, it is no surprise that Shoreview is home to a variety of wildlife including a number of rare species and natural communities. These species add to the City's biological wealth and diversity. A summary of the rare species and natural communities found within the City is provided in Table 4.

Table 4. Rare Species and Natural Communities

Common Species Name		Status*	Approximate Location
Plants	Autumn Fimbristylis	Special Concern	Snail Lake Regional Park
	Club-Spur Orchid	Special Concern	
	Grass-Like Arrowhead	None	
	Tooth Cup	Threatened	
Animals	Blanding's Turtle	Threatened	Numerous
	Upland Sandpiper	None	Northwest near Rice Creek
	Red-Shouldered Hawk	Special Concern	Snail Lake Regional Park
	River Otter	None	Rice Creek
Natural Communities	Cattail Marsh	Not Applicable	Grass Lake
	Hardwood Swamp	Not Applicable	
	Inland Sand Lake Beach	Not Applicable	Snail Lake

Source: Minnesota Department of Natural Resources, Minnesota Natural Heritage Database
* All statuses shown refer to the state listing. There are currently no federally-listed species in Shoreview.

G. Pollutant Sources

Information on pollutant sources is available from the MPCA (651.296.6300). This detailed information has not been included here as it is subject to frequent change and may be obtained by calling the MPCA or by visiting the MPCA's website (www.pca.state.mn.us) which has information on various pollutant sources and related and related regulatory programs. The MPCA will identify leaking underground storage tank (LUST) sites, and maintain a list of registered above and underground storage tanks (ASTs and USTs) within the City. The MPCA also has information on permitted wastewater discharges and hazardous waste sites.

Some additional pollutant source information may also available from Ramsey County (http://www.co.ramsey.mn.us). The County maintains maps and a database that display MPCA-reported LUSTs, MPCA-reported spills, MPCA-registered ASTs and USTs. This information may be accessed by the public upon reasonable request to the County at 651.773.4466.

This page left intentional blank

S h o r e v i e w • M i n n e s o t a

Second Generation

Surface Water Management Plan

III. GOALS AND POLICIES

Minnesota Rules, Part 8410.0170, subpart 5 (italics below), relating to Surface Water Management, requires local governments to establish goals and policies for the effective management of water resources. The nine goals established in this Plan support the City's Purpose Statement described in the Introduction by translating each goal into specific policies and action-implementation plans.

> *M.R. 8410.0170, Subpart 5. Establishment of policies and goals (Local Plans). Each local (SWMP) plan must state specific goals and corresponding policies related to the purpose of these plans, be consistent with the policies and goals of the organization plans within the city or township, and address the relation of the local plan to the regional, state, and federal goals and programs outlined in Part 8410.0070.*

A ***goal*** is a desired end toward which surface water management efforts are directed. This section identifies goals for water resources planning and management functions throughout the City. The goals of this plan were established in accordance with the purposes of the water management programs required by Sections 103B.201 to 103B.251 and in conformance with the goals of the WMOs having jurisdiction in Shoreview including the Rice Creek Watershed District and the Grass Lake Watershed Management Organization. Table 5 summarizes the City's nine goals and corresponding goal statements. Each goal has several corresponding ***policies*** that form the governing principals that will be followed to achieve the goals. Each of the nine goals and the corresponding policies is presented in more detail in the following pages.

Plan ***standards*** (or storm water Development Guidelines) are an extension of the goals and policies that provide detailed guidance on storm water management practices. They provide specific, detailed guidance regarding water quantity and quality management practices. Plan standards are included in Appendix C of this Plan.

Action-Implementation Plans have been developed for each of the nine goals and each water body category in Shoreview. The Action Plans identify real or potential problems related to achieving the stated goals and recommended approaches and/or solutions for addressing the problems. For each of the water bodies and goals, a related ***Plan*** has been established.

The Action-Implementation Plans may include specific activity steps, reference to the applicable NPDES Permit Best Management Practice (BMP), available resources, and the means of measuring the completion of the activity step and a target date for completion. The combination of these implementation plans will formulate the overall strategy for implementing the City's second generation Surface Water Management Plan. Many of the action-implementation activities correspond directly to actions committed to in the City's NPDES Permit submittal known as the Storm Water Pollution Prevention Program (SWPPP).

Table 5. Plan Goals and Goal Statements

Goal Number	Goal	Goal Statement
1	Water Quality	Maintain or improve water quality to meet established standards consistent with the intended use and classification, with special focus on Category I water bodies.
2	Water Quantity (Flooding)	Control flooding and protect property while minimizing public expenditures necessary to control volumes and rates of runoff
3	Wetlands	Preserve and improve wetlands acreage, functions and values and achieve no net loss of wetlands in conformance with the Minnesota Wetland Conservation Act and associated rules
4	Erosion Control	Minimize soil erosion and sedimentation
5	Groundwater	Protect the quality and quantity of groundwater resources and promote groundwater recharge
6	Recreation, Habitat and Shoreline Management	Recreation, habitat and shoreline management. Protect and enhance fisheries and wildlife habitat, surface water recreation and shorelands
7	Public Participation, Information and Education	Public participation, information and education. Provide information and educational resources to improve knowledge and promote an active public role in management of water resources
8	Maintenance and Inspection	Preserve function and performance of public infrastructure through continued implementation of a maintenance and inspection program
9	Regulatory Responsibility	Maintain primary responsibility for managing water resources at the local level but continue coordination and cooperation with other agencies and organizations

A. Goal 1. Water Quality

The City has completed an assessment of the water quality treatment capacity within each watershed, subwatershed and drainage area throughout the City. Using the results of this analysis (discussed later in this water quality goal section) along with the water quality policies presented in Table 6 and the water body prioritization system presented in Section IV, the City is

better equipped to approach future storm water management decisions in a systematic and prioritized manner.

Water quality is often directly related to the level of available nutrients in a water body. While nutrients comprise only one category of substances that can affect water quality, nutrients, principally phosphorous, must be controlled to achieve the water quality goals of this Plan. Phosphorous is most often the limiting factor for plant growth and increases in available phosphorous allow plant species to dominate the lakeshore, open water, or marsh. There are several key activities that can be followed to minimize the delivery of phosphorus into the City's priority water bodies.

Housekeeping practices such as removing leaves from streets and storm drains and limiting the use of phosphorus fertilizers are examples of simple ways individuals (residents) and the City can make improvements in water quality. According to the Minneapolis Chain of Lakes Clean Water Partnership, many people do not realize that organic materials, like leaves and grass clippings, fertilizer, pesticides and pet waste can disrupt the sometimes fragile ecosystem of a lake. Once in the lakes, these organic materials decay, releasing phosphorus. The excess phosphorus increases algae growth, inhibiting the growth of other aquatic plants. When algae die and decay, they exert a biological oxygen demand on the lake, depleting available oxygen for fish and other aquatic species. Limiting nutrient is the key to maintaining and improving water quality in City water bodies.

The City has developed the water quality policies listed in Table 6 to support the water quality goals of this Plan.

Table 6. Water Quality Policies

Goal Statement:	**Protect, maintain or improve water quality to meet established standards consistent with the intended use and classification, with special focus on Category I water bodies.**
Policy No.	**Goal 1: Water Quality - Policies**
1.1	Water bodies within the City will be classified by their use, function and water quality in accordance with the classification defined below. Development projects discharging to water bodies will be required to follow the pre-treatment development standards provided in Appendix C of this Plan. **Category I** Water bodies in this category are typically used for swimming and other direct contact recreational activities. These waters have the highest/best quality and are usually the most popular water bodies with the public **Category II** Water bodies in this category are typically used for indirect contact recreational activities such as boating and fishing that involve incidental contact with lake water. These water bodies have poorer water quality than Category I water bodies but are still popular with the public. **Category III** Water bodies in this category serve functions for wildlife habitat, aesthetic enjoyment and may also provide opportunities for warm-water fishing provided winterkill does not occur. These waters have poorer quality than Category I and II waters and typically are not viewed as swimmable.

	Category IV (Nutrient Traps) Water bodies in this category are intended to reduce downstream loading of phosphorus and other nutrients that contribute to water pollution. Because of their physical features (e.g., surface area, depth, vegetation), these ponds/basins have phosphorus removal efficiencies of at least 50 percent. **Category V (Sediment Traps)** Similar to Category IV water bodies but are too small to effectively remove a significant fraction of nutrients. Because of their physical features (e.g., surface area, depth, vegetation), these ponds/basins will generally have phosphorus removal efficiencies of less than 50 percent.
1.2	Water bodies will be managed to meet RCWD and GLWMO plans and standards to maintain water quality. Category I-III water bodies will be managed for non-degradation of water quality, habitat, diversity and aesthetics. Category IV-V water bodies will be managed according to their function (nutrient or sediment removal).
1.3	Water quality monitoring of water bodies shall be completed in accordance and in cooperation with watershed and regulatory requirements and, if applicable, Metropolitan Council's water quality monitoring program.
1.4	For new storm water discharge points or outfalls, pretreatment (at least grit removal) of storm water is required prior to its discharge to wetlands and Category I-III water bodies. For existing discharge points or outfalls, the City will endeavor to eliminate all direct storm sewer discharges into Category I-III water bodies.
1.5	The City will encourage the improvement and/or expansion of existing detention areas rather than creation of new areas where feasible.
1.6	The City recognizes that relationship between non-invasive, native aquatic vegetation and water quality and will not support or participate in the removal of such vegetation from any water body. Any application of chemicals must receive proper review and permits.
1.7	Regional detention areas (instead of small individual on-site ponds) shall be utilized whenever possible to remove sediment and nutrients from runoff.
1.8	Water quality infrastructure construction or improvement projects should provide for long-term access and maintenance.
1.9	The City shall continue their program of inventory, inspection and maintenance of all individual sewage treatment systems consistent with the Shoreview Municipal Code, Minnesota Rules 7080 and Metropolitan Council policies. As required by the Municipal Code, properties currently served by individual sewage treatment systems should connect to the municipal sanitary sewer system.
1.10	The City shall implement a program that addresses the minimum control measures outlined in the Phase II NPDES rules for municipal storm sewer systems.
1.11	The City will encourage environmentally-friendly lawn care and house-keeping practices, and the use of native plantings or natural landscapes rather than turfed lawns where appropriate.
1.12	The City shall reduce or minimize impervious surface coverage where practical or feasible.

1. Water Quality Assessment

A water quality assessment of all subwatersheds throughout the City was completed to evaluate the approximate level of treatment capacity provided in existing ponding areas and water bodies. Results of the assessment are presented in summary tables provided in Appendix E. The Rice Creek Watershed District standard of dead storage volume equal to the volume of runoff generated from a 2.5-inch rainfall over the contributing impervious drainage area was used as the treatment criterion for this evaluation.

Using a dead storage volume of 2.5 inches of runoff is comparable to providing treatment that would remove approximately 65 percent total phosphorus (TP) and 90 percent total suspended solids (TSS). This assumption relates to results reported in the Nationwide Urban Runoff Program (NURP) study completed by the EPA, and assumes a particle size distribution consistent with that reported in the NURP study. Instead of requiring that developers model pollutant removal efficiencies with available computer programs (e.g., the P8 Urban Catchment Model) the 2.5 inch standard is typically a more conservative, yet simplified, approach to sizing treatment capacity in storm ponds.

Two different methodologies were used to calculate dead storage (or treatment) volume provided in each subwatershed depending on the information available. Method 1 used knowledge of the actual dead storage provided in the subwatershed, based on actual pond grading plans or lake information. For lake information, the dead storage volume was calculated by multiplying the surface area of the lake by the mean depth, provided the mean depth information was available.

For basins with an unknown mean depth (or that was not available at the time of this analysis), and estimation approach (Method 2) was used. Method 2 uses the surface area at the Normal Water Level (NWL) and assumptions of depths of 2 feet, 4 feet and 6 feet. The volume of dead storage was calculated for the 2-foot depth by assuming two-thirds of the NWL area multiplied by the estimated depth which corresponds approximately to a basin with 3:1 (H:V) side slopes. A multiplier of one-half was used for the 4 and 6-foot depths in order to achieve a more conservative approximation of the available dead storage, with the assumption that many basins would have a slope flatter than 3:1.

Results of the water quality assessment presented in Appendix E show that, based on the estimated described above, roughly half of the City's individual drainage areas (see Figure 12) have adequate dead storage volume to meet the Rice Creek Watershed District water quality goal (2.5 inches of dead storage for each acre of impervious contributing area). In all cases, this tool will be used primarily by City staff to guide decisions for treatment requirements in the various drainage areas. Data presented in the table should not be used to justify the elimination of a treatment system for a development or redevelopment project. Instead, all developments will need to comply with the treatment standards described in this Plan and the respected watershed for which the project is located.

The watersheds were ranked from low to high priority for water quality treatment based on the water body classification of the receiving water along with its use, and if they are on the TMDL List of Impaired Waters. Section IV of this Plan discusses the water bodies, their classifications, any significant water quality trends, if known, and more detail on the results of the water quality treatment assessment. In general, the quality of Shoreview's water bodies is promising as most of the subwatersheds currently have adequate treatment capacity. From the results of the assessment, the highest priority watersheds are Turtle Lake, Snail Lake and Island Lake. One of the higher priority activities is to address the direct storm sewer system discharges identified in the Direct Discharge Report information that is provided in Appendix E.

One method the City may use to approach future water quality management decisions is to consider three key factors:

- The priority (or category) of the receiving water;
- The degree of anticipated land use change in terms of impervious surface cover; and
- The existing treatment capacity available (excess or deficit).

This and/or other prioritization methods can be used along with the actions the City has already committed to as part of the MS4 NPDES SWPPP (submitted to the MPCA in March 2003) to guide future water quality-related projects and decisions.

2. NPDES Phase II SWPPP

The overriding goal of the NPDES Phase II storm water permit program in urban areas is to protect and improve water quality. The regulatory program in Minnesota covers three aspects of storm water runoff: Industrial Sites, Municipal Separate Storm Sewer Systems (MS4), and construction sites. The City's MS4 SWPPP for the years 2003 to 2008 has been established and is presented in more detail in Appendix G. SWPPP activities have been incorporated into relevant sections and implementation plans within this SWMP.

3. Implementation Plan

Table 7 outlines activity steps that are intended to guide the City in achieving the water quality goals of this Plan. Table 7 also shows the corresponding BMP Identification number as listed in the MS4 SWPPP, a list of possible resources available, the measurement system and a project target date for each of the planned activities.

Table 7. Water Quality Implementation Plan

Activity Steps	BMP Unique ID No.	Resources	Measurement	Target Date
1. Regulatory Program to Prohibit Non-Storm Water Discharges into the MS4	3-02-R	• City Staff • Technical Assistance • MPCA Guidance	• Review current City ordinances. • If changes are needed, complete background and draft ordinance structure. • Begin formal ordinance development process. • Complete process.	2006 2006 2006 2008
2. Illicit discharge and detection program	3-04-R	• City Staff • Utility as-builts • Development reviews	• Compile list on illicit connections and inspection activities. • Establish priority system to evaluate possible illicit connections.	2004 2005
3. ISTS inspection and certification program	3-06	• City Staff • Ramsey County	• Track the number of ISTS sites inspected. • Track failed systems.	Annual Annual

Table 7. Water Quality Implementation Plan (Continued)

Activity Steps	BMP Unique ID No.	Resources	Measurement	Target Date
4. Used Oil/Household Hazardous Waste Program	3-07	• City Staff • Ramsey County	• Request facility user information from the County. • Request material disposed of information from the County.	Annual Annual
5. Phosphorus Fertilizer Ordinance	3-08	• City Staff • Technical assistance	• Implement ordinance	Annual
6. Post-Construction Runoff Control Ordinance	5-02-R	• City Staff • Surface Water Management Plan – Goals and Policies	• Review current ordinance • If needed, complete update and revisions needed to meet NPDES requirements and City goals and policies	2006 2008
7. Reduction of directly connected impervious surfaces	5-05-R	• City Staff • Area developers • WMOs	• Track the BMPs installed and/or sites that reduce directly connect impervious	Annual
8. Road Salt Alternatives	6-08	• City staff • Mn/DOT • Water quality studies	• Explore alternatives and make changes as need to salt use program	2005
9. Explore opportunities to implement BMPs to improve water quality in Category I, II and III water bodies	NA	• Surface Water Management Plan • Area developers • Water quality assessment – Appendix E	• BMPs installed or implemented	Annual
10. Encourage development to include alternative storm water practices and promote infiltration	NA	• Surface Water Management Plan • WMOs • Suitable soils	• Review development plans and make recommendations • Implement project	Annual
11. Track completion of TMDL List of Impaired Waters by MPCA	NA	• MPCA Final TMDL List • TMDL studies as completed	• Implement projects as directed by the TMDL studies for Island Lake, Lake Owasso, Snail Lake, and Turtle Lake	Future
12. Explore opportunities to eliminate direct storm sewer discharges to high-priority water bodies	NA	• Development reviews • City staff • Street recon program • WMOs	• Installed treatment systems	Annual

B. Goal 2. Water Quantity (Flooding)

Traditional storm water management deals with just one component of the hydrologic cycle; surface runoff. Large amounts of energy are directed towards alleviating significant negative impacts of surface runoff and flooding on the cultural, water, and natural resources. The primary management strategy is shifting from detention in both existing natural (i.e., wetlands) and constructed basins, towards a combination of traditional approaches and low impact development (LID) techniques. LID and Integrated Management Practices (IMPs) generally emphasize reduction of runoff volume and on-site runoff control via infiltration or small volume storage to mimic predevelopment hydrology for smaller and more frequent rainfall events. This trend provides opportunities to help remedy the negative impact of storm runoff on lake water quality and reduce the volume of runoff that may otherwise contribute to flooding.

The LID approach typically does not replace traditional storm water management needs, but instead provides alternatives to reduce the extent of a conventional system, enhance overall performance and reduce maintenance needs for these systems. The discussion of LID practices could just as easily be presented in the water quality goal section of this Plan. However, one of the key features of LID practices is the emphasis on reduction of runoff volumes by reducing the impervious area or directly connected impervious areas. In addition, BMPs that provide on-site runoff control via infiltration, bioretention or small volume storage to mimic predevelopment hydrology for more frequent rainfall events reduce the overall runoff volume from a given area. The LID approach to water quantity management relates directly to water quality, wetland management, erosion control, and land development strategies. By doing a better job at managing the quantity of runoff at or very close to the source, the other goals of this Plan are more easily and efficiently achieved. In Shoreview, where infill and redevelopment will be a large part of the development activity in the future, LID practices and approaches may be a feasible option where land is not available for a conventional storm water pond.

With increased value placed on wetlands, the number and extent of wetlands that can be used for detention will continue to decline. The approach to water quantity management relates directly to water quality, wetland management, erosion control, and land development strategies. By doing a better job at managing the quantity of runoff, the other goals of this Plan are more easily and efficiently achieved.

In Shoreview the issues of flooding has two primary priorities: eliminating or reducing the extent and duration of flooding in existing and proposed developments; and eliminating the need for properties located with the existing flood hazard boundaries defined in the current Flood Insurance Rate Map (FIRM). The policies presented in Table 8 outline the City's approach towards meeting the water quantity goal.

Table 8. Water Quantity (Flooding) Policies

Goal Statement: **Control flooding and protect property while minimizing public expenditures necessary to control volumes and rates of runoff.**	
Policy No.	**Goal 2: Water Quantity (Flooding) - Policies**
2.1	The level of protection adjacent to floodways, streams and channels and around all wetlands, ponds, detention basins and lakes shall be based on the critical-duration 100-year flood, consistent with the standards of this plan.
2.2	Non-trunk storm water systems should be planned to provide discharge capacity for the critical-duration runoff event that is not less than a 10-year frequency event, consistent with the standards of this plan.
2.3	Proposed development, redevelopment and infrastructure projects shall not overburden the existing downstream storm water drainage system. It is the responsibility of the design engineer to evaluate a project's impact on the downstream system.
2.4	Easements over floodplains, detention areas, wetlands, ditches and all other parts of the storm water system should be obtained as areas develop or redevelop.
2.5	Minimum principal structure elevations shall be at least two feet above the critical 100-year flood elevation; higher elevations may be required for structures adjacent to ponding areas with larger tributary watersheds and/or adjacent to landlocked basins. Minimum building elevations shall be at least one foot above the critical 100-year flood elevation.
2.6	Newly constructed storm water facilities shall meet the standards of this plan. As opportunities allow through development, redevelopment and infrastructure replacement, existing storm water facilities should be upgraded to improve storm water management and water quality and to meet the standards of this plan.
2.7	Infiltration practices shall be promoted within the limitations imposed by construction practices, soil conditions, groundwater supply and recharge, safety, snow removal, maintenance and other issues. See also Policy 1.12.
2.8	The retention capacity of the existing drainage system shall be protected.
2.9	Where possible, regional ponding areas, as opposed to individual on-site ponds, should be used to reduce flooding, to control discharge rates and to provide necessary storage volumes as indicated in this plan, and shall be consistent with the standards of this plan.
2.10	All developments must, to the extent determined by the City, provide land, funding or a combination of both to develop regional ponding sites to achieve the rates and volumes indicated in this plan. Where opportunities exist, the City will encourage regional systems instead of on-site ponding. Permitting requirements of the RCWD will also apply to each development.
2.11	Hydrologic studies shall utilize hydrograph methodology consistent with the standards of this plan.

1. Hydrologic Modeling Update

One of the larger efforts undertaken as a part of this SWMP update was to update the City-wide hydrologic model to improve on the accuracy of results and produce a format that would be acceptable to FEMA as the City moved toward an update to the City's Flood Insurance Rate Map (FIRM). Early in the project staff determined that converting the 1990 TR-20 model to a Hydrologic Engineering Center- Hydrologic Modeling System (HEC-HMS) model was the best

approach. HEC-HMS is accepted by FEMA and uses much of the same input information used in TR-20. The second step in updating the model was to update the input parameters using the most recent and best available data on GIS (Geographic Information Systems. A digital terrain model (DTM), consisting of two-foot contours and GIS was used to establish watershed boundaries and identify detention/storage areas.

The DTM based drainage area delineation process divided the City into relatively small drainage areas and did not take into account storm sewer or other alterations to the drainage that may have occurred since the DTM was created. These issues were resolved by reviewing as-builts of the storm sewer system and field reconnaissance, as needed. These watershed boundaries developed by the DTM were then compared to the boundaries generated for the 1990 SWMP and TR-20 model. The final watershed boundaries used in the updated model were generated by a combination of review of the 1990 boundaries and storm sewer system within the City.

Once the final watershed boundaries were established, this file was merged with the hydrologic soil group and future land use files. Curve numbers were also generated using GIS. A weighted curve number was then calculated for each watershed. The updated curve numbers were compared to the original numbers to ensure they were logical and were revised as reasonable. Figures 12 (11 x 17) and 12A (foldout map with storm sewer lines shown) illustrate the drainage network that forms the basis for the City-wide hydrologic model. For the watersheds that were not altered significantly from the 1990 boundaries, the original time of concentration was used. For altered or new subwatersheds a new time of concentration was determined. All the data was converted from the original TR-20 hydrologic model to a HEC-HMS model.

The goal of this effort was to better predict and understand the urban hydrology within the City such that potential future flooding issues resulting from development or redevelopment could be addressed. A secondary goal was to establish the base model from which revisions to the City's Flood Insurance Rate Maps (FIRM) could be completed. The desired outcome of the FIRM update is to reduce the number of properties within the City that are required to obtain flood insurance where little flood risk is present.

In any hydrologic modeling effort, the basic analytical problems that must be solved to complete these objectives are the prediction of storm water and/or snow melt peak runoff rates, runoff volumes and flood hydrographs within the drainage system. Ultimately, a peak elevation is determined for water bodies in each major drainage system under several storm scenarios of Flood Evaluation Storms (FES). This update employs Natural Resources Conservation Service (NRCS) methods to analyze the City's hydrologic system. Three storm (or runoff) events were modeled using the HEC-HMS, Version 2.2.1, computer model available from the Hydrologic Engineering Center. The FES is defined as the storm from the following three that produces the highest peak water surface elevations for a given water body:

- 100-year, 24-hour, Type II distribution with antecedent moisture conditions 2 (AMC-2);
- 100-year, 24-hour, Type II distribution, with AMC-3; and
- 100-year, 10-day runoff, "C" distribution (NEH-4).

The peak elevations determined from the hydrologic modeling are be used to set the recommended minimum building elevations. The results of the hydrologic modeling update are presented in tabular format in Appendix D. Because some of the recommended minimum building elevations (MBE) have changed since the original TR-20 modeling was completed as part of the 1990 SWMP, both 1990 and 2004 MBEs are listed in the tables. The City intends that the 2004 MBE be used to evaluate development and redevelopment projects, but recognizes that in some cases more detailed modeling may be available for selected areas of the City. In these cases the City will consider the modeling results on an individual basis if results are significantly different than those presented in Appendix D. The MBE is based first on 2-feet above the 100-year design storm peak elevation. If any of the other modeled storms exceed this elevation, the MBE is set at that level to provide additional protection.

2. Flood Mapping Update

As mentioned above, the City is currently in the process of updating their FIRM which must be reviewed and approved by Federal Emergency Management Agency (FEMA). Results of the hydrologic modeling completed under this SWMP update will be used as the basis for establishing base flood elevations in the FIRM revision process. However, while modeling reported in this Plan was completed in 2003-2004, the FEMA FIRM revision approval process can be expected to take up a year or more. It is possible that some of the high water levels (HWLs) reported in this Plan may need to be revised based on comments from the Federal Emergency Management Agency (FEMA) review process.

As part of the original FIRM, detailed hydrologic or hydraulic analyses were completed on seven flooding sources (five lakes and two lake connection areas) to determine flood elevations. FEMA used approximate methods and did not perform detailed hydrologic or hydraulic analyses to determine flood elevations or accurate flood prone area boundaries for large portions of the City. The resulting FIRM maps developed by FEMA include a total of 30 flood prone areas identified, with only being 5 numbered A zones.

FIRMs are essential for accurate flood insurance rating. Lenders and insurance companies rely on FIRMs to determine which properties require flood insurance and to aid in determining the rate of the insurance. Lenders and insurance companies may require that landowners within flood prone areas designated on the FIRM have flood insurance or the landowner must prove that their property is not a flood hazard. Landowners that purchased property prior to the development of the City's FIRM in 1981 may not have been required to purchase flood insurance. However, flood insurance will likely be required if the property is refinanced or sold. The required analysis may be too costly for each property owner to perform individually in order to attempt to prove their property is not a flood hazard, therefore it is likely that the landowner would have to purchase flood insurance.

Figure 13 illustrates the letters of map change (LOMC) to the City existing FIRM. The figure is intended to show the areas of the City most often subject to differences in the regulatory flood zones and the base flood elevation as determined through hydrologic modeling methods. As shown in Figure 13, most of the LOMC in Shoreview have been completed in the north-central part of the City. The proposed map revision shows that more than 220 properties and/or

structures are removed from the regulatory flood hazard zone. As a result, and upon approval of the map by FEMA, a substantial number of these owners will no longer be required to purchase flood insurance for their property. The City anticipates that the revised FIRM will become effective in about July 2005.

3. Implementation Plan

Table 9 outlines activity steps that are intended to guide the City in achieving the water quantity goals of this Plan. Table 9 also shows a list of possible resources available, the measurement system and a project target date for each of the planned activities.

Table 9. Water Quantity Implementation Plan

Activity Steps	BMP Unique ID No.	Resources	Measurement	Target Date
1. Complete FIRM revision modeling and submit to FEMA	NA	• City staff • Technical Assistance • DNR FHM Grant funds • FEMA mapping partners	• Completed submittal • Completed interim (unofficial) FIRM map • FEMA approved FIRM	June 2004 July 2005
2. Look for opportunities in the Rice Creek watershed to implement area-wide infrastructure improvements (water quality and quantity)	NA	• City staff • Hydrologic modeling • Rice Creek WD	• Completed Projects • Improved efficiency of drainage system	Future
3. Complete a trunk storm sewer drainage study for the Marsden Lake drainage areas north of County Rd I	NA	• City Staff • Technical Assistance • RCWD	• Completed Study • Improvements installed based on study findings	Future
4. Work with GLWMO, VLAWMO, Ramsey Co. and SPWU to better assess the interaction between Grass and Vadnais Lakes	NA	• City staff • WMOs • Ramsey Co. • SP Water Utility	• Completed report or technical memo Note: more project specific detail is available from the County.	Ongoing
5. Assess the capacity of ponding available in the SW corner of drainage area GL-5	NA	• City staff • GLWMO • Hydrologic modeling	• Completed drainage study • Installed/constructed improvements	Future

C. Goal 3. Wetlands

The key to meeting the City's wetland goal is the implementation of the rules and requirements of the Wetland Conservation Act. While more complete than the 1990 version, the City's *2003 Wetland Inventory* is based primarily on the wetlands shown in GIS databases including the National Wetland Inventory (NWI), the 1990 City inventory and the this Surface Water

Management Plan. The 2003 inventory may not include all of the wetlands and aquatic resources within the City. Evaluation of wetland basins included in the inventory consisted of a brief field visit and visual assessment of each accessible wetland. Field delineation, assessment of hydrology, identification of all plant species and characterizations of soils were not performed.

One significant aspect of the wetland inventory update is the creation of a new wetland classification system which, for the most part, is taken from the Grass Lake WMO Plan. The new system and corresponding wetland areas are shown in Figure 10.

Both Rice Creek Watershed District (RCWD) and Grass Lake Watershed Management Organization (GLWMO) currently have jurisdiction over wetlands within the City. However, the City acts as the Local Government Unit (LGU) on behalf of GLWMO. For wetlands which are in the Vadnais Lake Area Watershed Management Organization (VLAWMO), the City will also act as the LGU to manage these wetlands.

Table 10. Wetlands Policies

Goal Statement:	**Preserve and improve wetlands acreage, functions and values and achieve no net loss of wetlands in conformance with the Minnesota Wetland Conservation Act and associated rules.**
Policy No.	**Goal 3: Wetlands - Policies**
3.1	Wetlands within the City shall be classified based on susceptibility to degradation by urban storm water inputs in accordance with the following classification system: **Protect** - High quality natural basins, unique habitats, rare/threatened/ endangered species, high quality adjacent uplands. **High Management** - Moderate to high quality basins, some receive direct storm water, high quality adjacent uplands. **Low Management** - Highly impacted to moderate quality natural basins, most receive direct storm water, low diversity or monotypes. **Utilize** - Created basins, highly impacted natural basins, isolated monotypes.
3.2	Within GLWMO, the City shall administer wetland protect and mitigation in accordance with the Minnesota Wetland Conservation Act and associated rules. In the RCWD, the watershed district is responsible local government unit under the Minnesota Wetland Conservation Act.
3.3	Wetlands shall be protected from impacts in the following order: avoid, minimize, mitigate. Mitigation of unavoidable wetland impacts must be accomplished through restoration (first priority), enhancement (second priority) or wetland creation (third priority).
3.4	Prior to development activities or public projects, a wetland delineation must be completed including a field delineation and report detailing the methodology and findings of the delineation.
3.5	Where feasible, the duration and magnitude of water level fluctuation in Type A-C wetlands from storm water runoff shall be minimized to prevent adverse habitat changes.
3.6	Natural buffer zones are encouraged around ponds and wetlands City-wide and shall be provided on City-owned ponds and wetlands where feasible. Buffer areas should not be mowed or fertilized, except that harvesting of vegetation may be performed to reduce nutrient inputs or pest species. Allowances may be made for multiple use detention areas.

The policies listed in Table 10 will be used as the basis to achieve the City's wetland goals. The policies and strategies will apply to new development and redevelopment projects proposed within the City. Any wetland habitat on property to be developed will be subject to these management policies, as well as the rules and requirements of the Wetland Conservation Act and other City regulations.

1. Comprehensive Wetland Management Plan

The City of Shoreview currently does not have a Comprehensive Wetland Protection and Management Plan. The City intends to consider preparation of a plan that can serve as an alternative to the Rules adopted under Minnesota Statutes, section 103G.2242. In order to complete the process, the Plan must be approved by the BWSR and adopted by the City as an ordinance. The Plan must require equal or greater standards and procedures then the Wetland Conservation Act.

Typically these Plans will include a wetland inventory, a functions and values assessment, sequencing standards, replacement standards, a description of the size and location of replacement wetlands, allowance of exemptions based on ordinance standards and definitions of high priority wetland areas. Benefits of completing this plan include a current functions and values assessment for management and wetland ordinance development, greater flexibility in sequencing and replacement standards for wetlands, and development and management of higher quality wetlands within the City.

The City will also address wetland buffers as part of the wetland management plan planning process. Resources including the study by the Metropolitan Council and Builders Association of the Twin Cities related to buffers will be evaluated when available (anticipated in about 2005-2006).

2. Implementation Plan

Table 11 outlines activity steps that are intended to guide the City in achieving the wetland goals of this Plan. Table 11 also shows the corresponding BMPs from the NPDES SWPPP, a list of possible resources available, the measurement system and a project target date for each of the planned activities.

Table 11 – Wetland Implementation Plan

Activity Steps	BMP Unique ID No.	Resources	Measurement	Target Date
1. Preparation of a Comprehensive Wetland Management Plan	NA	• City Staff • City Wetland Inventory • WCA • MPCA	• Completed Plan • Wetland function and values for wetlands within the City • Protection and management standards • Sequencing and replacement standards	2005-2006
2. Continue citizen participation programs to encourage stewardship of wetland resources	1-01-R 1-02-R	• City staff • Sho-Review newsletter • NPDES Phase II program	• Completed wetland public participation activities	Ongoing
3. Prepare materials for public education about the importance of wetland resources and their protection and management.	1-01-R 1-02-R	• City staff • Sho-Review newsletter • NPDES Phase II program	• Newsletter and/or Sho-Review mailings • Storm water web page postings	Ongoing
4. Develop guidelines for development that summarize policies and requirements for projects that may affect wetlands	NA	• City staff • Technical Assistance	• Completed Guidelines	2007

D. Goal 4. Erosion Control

As discussed previously in Goal 1, water quality problems are frequently linked to high phosphorus concentrations. Phosphorus is often transported to surface water through soil erosion but can also be transported to waters in a variety of other mechanisms. Nevertheless, erosion control is extremely important in the effort to improve water quality. Soil erosion and sediment deposition also can create pond and drainage way performance and maintenance problems.

Ponds, drainage facilities and water bodies can be impacted by erosion and sediment from a variety of sources including construction sites and winter street sanding operations. The coarse sediment accumulates in water bodies where runoff or flow velocities are relatively low. Usually a sand delta appears at a storm sewer outfall that is a visible indication of the effectiveness of erosion and sediment control measures and road maintenance activities of the past winter.

As sediment builds up over time, it reduces the capacity of drainage systems and the pollutant removal capabilities of ponds by reducing dead storage volume (i.e., the volume below the outlet elevation). Sediment from erosion also reduces infiltration rates in basins or BMPs design for groundwater recharge. Extending the life of facilities involves source control and elimination of material that causes the problem. Regulatory aspects will control a major portion of the sediment at the source and an effective street sweeping will also have a positive impact. The policies listed in Table 12 are intended to help the City achieve the erosion control goal of this Plan.

Table 12. Erosion Control Policies

Goal Statement: **Minimize soil erosion and sedimentation.**	
Policy No.	**Goal 4: Erosion Control - Policies**
4.1	Erosion control plans shall be required for all land disturbance activities over one acre in accordance with NPDES construction site permit requirements.
4.2	Best management practices (BMPs) shall be used at all construction sites per the Metropolitan Council "Minnesota Urban Small Sites BMP Manual" (2001) and the Minnesota Pollution Control Agency's "Protecting Water Quality in Urban Areas" (2000).
4.3	Natural vegetation shall be preserved to the greatest practical extent.
4.4	Graded areas shall be protected from runoff to reduce erosion in a manner consistent with the standards of this plan. Streets will be frequently swept where construction activities spill sediments onto public streets.
4.5	Stockpiled soil (and or like-materials) shall be protected to prevent erosion.
4.6	All erosion and sediment control measures specified in the erosion control plan must be installed prior to obtaining a permit.
4.7	Point discharges of storm water open channels or detention basins shall be constructed in a manner that minimizes erosion.
4.8	Effective energy dissipation devices should be provided at all conveyance system discharge points to prevent bank, channel or shoreline erosion. Design of stream bank stabilization and streambed control measures should consider unique or special site conditions, energy dissipation potential, adverse effects, preservation of natural processes and aesthetics in addition to standard engineering and economic criteria.

1. Rice Creek and Grass Lake Programs

The WMOs also have authority over erosion control within the City. Rice Creek Watershed District requires that an erosion control plan must be completed for proposed land disturbing activities as part of their permit process. RCWD's erosion control plan requirement addresses temporary and permanent control measures to reduce erosion and sedimentation. The RCWD program also refers to recommendations of the Best Management Practices identified in the Minnesota Pollution Control Agency's "Protecting Water Quality in Urban Areas."

Grass Lake Watershed Management Organization requires that the member cities require erosion control plans for land disturbing activities within their community, along with adopting erosion control ordinances and inspection of construction projects.

2. NPDES Phase II SWPPP

The City does not have an Erosion and Sediment Control ordinance. However, erosion control is addressed in the City's Municipal Codes under Development Regulations, Municipal Codes 203.035 and 209.040. The City acknowledges the recommendations of the Ramsey County Soil and Water Conservation District and their manual. The City also recognizes the Minnesota Construction Site Erosion and Sediment Control Planning Handbook published by the Minnesota

Board of Water and Soil Resources, and the Protecting Water Quality in Urban Areas handbook published by the Minnesota Pollution Control Agency (2000).

The City's NPDES SWPPP submitted to MPCA in March 2003 includes BMPs to address erosion and sediment control. The City has an existing ordinance (City codes 203.035 and 209.040) that addresses construction site erosion control. The ordinance requires erosion control plans and a grading permit for sites that involve the movement of more than 50 cubic yards of material or disturb an area of more than 2000 square feet. For areas within any bluff or shore impact zone or on any steep slope a permit will be required for sites that involve the movement of more than 10 cubic yards of material or disturb an area of more than 1000 square feet. The City plans to review the ordinance to determine if updates and/or changes are needed.

3. Implementation Plan

Table 13 outlines activity steps that are intended to guide the City in achieving the erosion goals of this Plan. Table 13 also shows the corresponding BMPs from the NPDES SWPPP, a list of possible resources available, the measurement system and a project target date for each of the planned activities.

Table 13 – Erosion Control Implementation Plan

Activity Steps	BMP Unique ID No.	Resources	Measurement	Target Date
1. Construction erosion and sediment control ordinance	4-02-R	• City Staff	• Review ordinance language and requirements. • Complete process and Council approval.	2004 2005
2. Development plan review process	4-04-R	• City Staff	• Site developed	Annual
3. Construction site inspection and street sweeping follow-up	4-05-R	• City Staff • Contractor	• Completed inspections and follow up actions	Annual

E. Goal 5. Groundwater

The City of Shoreview relies solely on groundwater as its water supply source. The Prairie du Chien-Jordan aquifer, located approximately 400 feet below the ground surface of Shoreview, serves as the City's municipal water source. All of the City's water supply wells are within a half-mile radius of City Hall (see Figure 1).

Ramsey County published *The Ramsey County Ground Water Quality Protection Plan: A Guide to Preventing Ground Water Contamination for Local Governments* in 1994. The Ramsey County Plan identifies groundwater contaminated areas and predicts areas that are potentially susceptible to groundwater contamination. The Ramsey County Plan also contains a comprehensive topographic and geological overview describing groundwater aquifers in the County.

The Minnesota Department of Health has recently completed a Source Water Assessment for Shoreview. All five City wells are in the category that is not a source water protection area. The assessment also shows that the wells are not susceptible because they meet well construction standards and do not present a pathway for contamination to readily enter the water supply. The City does not have an existing Wellhead Protection Plan (WHPP) as required by the Minnesota Department of Health. The goal of the WHPP is to protect the public water supply from contaminants. It is a preventative program, keeping harmful contaminants from entering the public water supply system. The City is responsible for formulating and implementing the WHPP in accordance with Minnesota Rules Chapter 4720. Note that Ramsey County has a Ground Water Quality Protection Plan that was adopted in 1994.

Several areas throughout the City have soils that are very conducive to storm water infiltration practices and groundwater recharge (see Figure 3). In addition, the Rice Creek Watershed District has requirements for certain projects to infiltrate a portion of the storm water form a rainfall event. As the City moves towards implementing the various state and local requirements and addressing the Individual Sewage Treatment Systems (ISTS) located throughout the City, evaluation of the soils and surface water features will be an important task. The City has developed the policies in Table 14 to help guide future groundwater related decisions.

Table 14. Groundwater Policies

Goal Statement: **Protect the quality and quantity of groundwater resources and promote groundwater recharge.**	
Policy No.	**Goal 5: Groundwater – Policies**
5.1	When possible, infiltration strategies shall be utilized to allow rainfall to soak into the ground rather than drain away.
5.2	Groundwater recharge areas as identified in the City Wellhead Protection Plan shall be protected from adverse development and from potential contamination.
5.3	Ramsey County is recognized as the lead agency regarding groundwater. The City supports the policies in the Ramsey County Groundwater Plan.
5.4	The City will proactively address failing individual sewage treatment systems (ISTS) or ISTS sites found to be an imminent public health threat, to ensure that systems are brought into conformance with state requirements.
5.5	The City will evaluate the need to eliminate or manage unused/abandoned wells as they may be encountered in conjunction with infrastructure improvement projects.
5.6	The City shall promote proper well abandonment.

1. Implementation Plan

Table 15 outlines activity steps that are intended to guide the City in achieving the groundwater goals of this Plan. Table 15 also shows a list of possible resources available, the measurement system and a project target date for each of the planned activities.

Table 15 – Groundwater Implementation Plan

Activity Steps	BMP Unique ID No.	Resources	Measurement	Target Date
1. Update ISTS system data	3-06	• MPCA Rules 7080 • Ramsey County • GIS database	• Updated GIS database	2005
2. Update Conservation and Emergency Management Plan for the Shoreview Water System, 1996 (PCE, Inc.)	NA	• 1996 PCE Plan • DNR Rules and guidelines	• Updated plan approved	2006
3. Evaluate policies and approaches to encourage or limit the use of infiltration BMPs in sensitive groundwater areas	NA	• City staff • Technical Assistance • Ramsey County	• Established Policies	2006

F. Goal 6. Recreation, Habitat and Shoreline Management

The goal of the Minnesota Department of Natural Resources (DNR) Division of Fish and Wildlife is to protect and enhance the fisheries and wildlife resources and the aquatic biological community for their long-term recreational, ecological, aesthetic, and economic benefits to the state. (Anon., 1993). The DNR is the agency with exclusive responsibility for the management of fisheries in waters of the state. Specifically relating to this SWMP, the concept of ecosystem management requires that not just a species of interest be managed in a given water body, but that all plants, animals, and the physical and chemical constituents of the environment be part of the management program. (Anon., 1993).

The City of Shoreview has developed policies to help support the Recreation, Habitat and Shoreline Management goal to help protect and enhance recreational opportunities for City residents, and to improve the quality of shoreland areas for fish and wildlife habitat. These policies are outlined in Table 16.

Table 16. Recreation, Habitat and Shoreline Management Policies

Goal Statement:	**Protect and enhance fisheries and wildlife habitat, surface water recreation and shorelands.**
Policy No.	**Goal 6: Recreation, Habitat and Shoreline Management - Policies**
6.1	To the greatest possible extent, natural areas shall be preserved, especially adjacent to wetland areas, for the benefit of wildlife.
6.2	Buffer zones of natural vegetation shall be provided around publicly-owned and maintained ponds and wetlands to provide habitat where adequate land is available. Private property owners will be encouraged to create and maintain buffer zones along wetlands and shorelines.
6.3	Wetland mitigation or storm water facility projects shall include provisions to enhance or create habitat.
6.4	The City shall cooperate with the state and the county to enhance water-based recreation by promoting the maintenance and improvement of public boat access to City lakes. The City recognizes the need to balance water recreational activities with water quality and habitat issues.
6.5	The City shall generally support efforts of lead agencies (e.g., DNR, Ramsey County, etc.) to control exotic and invasive species in City lakes.
6.6	Streambank and lakeshore vegetation should be maintained during and after construction projects.
6.7	Disturbed shoreline areas (on streams and lakes) should be identified, ranked and considered for improvements based on the severity of the disturbance and the potential impact on the water body.
6.8	Non-disturbed shoreland areas should be protected, and restoration of disturbed shorelands to their natural state is encouraged.
6.9	Alternative landscape designs are encouraged that increase beneficial habitat and recreation uses and promote infiltration.

1. Water Bodies

Shoreview water bodies are classified according to the use, function and water quality characteristics in accordance with an updated classification system discussed in Section IV of this Plan. Figure 11 illustrates water body classification system in Shoreview and outlines the waters that are included in each category. The basis functions of each category of water body are described in Table 25.

2. Implementation Plan

Table 17 outlines activity steps that are intended to guide the City in achieving the recreation, shoreline and habitat goals of this Plan. Table 17 also shows the corresponding BMPs from the NPDES SWPPP, a list of possible resources available, the measurement system and a project target date for each of the planned activities.

Table 17 – Recreation, Habitat and Shoreline Management Implementation Plan

Activity Steps	BMP Unique ID No.	Resources	Measurement	Target Date
1. Publish information relating to DNR programs for shoreland and habitat management and enhancement	NA	• City staff • DNR • Ramsey County	• Improved shoreland and habitat areas	Annual
2. Evaluate opportunities to improve recreation opportunities related to development and redevelopment projects	NA	• City staff • Developers • DNR information	• Completed projects with recreational features (e.g., wildlife habitat, aesthetics, access to waters)	Ongoing
3. Prepare shoreland improvement plan for streams and lakes. Identify, rank and consider improvements based on the severity of the disturbance and the potential impact on the water body.	NA	• City staff • Technical assistance	• Completed shoreland improvement plan	2007

G. Goal 7. Public Participation, Information and Education

Public participation and involvement is a strategy that recognizes people want to be involved in decisions that affect any facet of their life. The process of involving the public creates and implements opportunities for the public to participate in the processes that lead to decision-making and result in more ownership in the outcome.

The City has developed the public information and participation policies listed in Table 18 to help achieve the goals of this Plan. Public education and participation activities are also requirements of the National Pollutant Discharge Elimination System (NPDES) Permit for which the City is required to comply with. Goal 9 and Appendix G of this Plan provide more detail on the City's NPDES program activities relating public participation and involvement.

Table 18. Public Participation, Information and Education Policies

Goal Statement:	**Provide information and educational resources to improve knowledge and promote an active public role in management of water resources.**
Policy No.	**Goal 7: Public Participation, Information and Education - Policies**
7.1	The City will provide opportunities for public involvement (e.g., neighborhood meetings, public hearings, mailed notices, etc.) for significant water resource decisions or projects.
7.2	The City will coordinate and consult with appropriate city commissions and committees on surface water issues.
7.3	City will communicate with lake associations and other appropriate civic and citizen groups.
7.4	The City shall actively develop and implement a community education program related to water resources. This program will use a variety of media including use of notices, mailings, local cable television, newsletters, articles, Internet web sites, workshops and/or presentations to inform and educate the public.
7.5	The City will cooperate with other agencies and encourage establishment of model interpretative sites for public education.

1. WMO and WD Programs

Rice Creek Watershed District (RCWD) intends to provide the technical data and coordination necessary to implement the district's strategy to expand their public information and education efforts. RCWD will rely on the municipalities including Shoreview to distribute the information.

Grass Lake Watershed Management Organization (GLWMO) does not rely on an advisory committee and relies on inputs from the municipalities and their boards, committees and commissions for comments regarding proposed projects and initiatives. GLWMO relies on the member cities to distribute information to the public regarding the organization, water resources and storm water management. The City of Shoreview administers the GLWMO program and is, therefore, able to participate in and coordinate many of the WMO's educational and public involvement activities quite easily.

2. City Programs

The City has numerous lake associations and committees who focus on the interests and the protection of the lakes and other water resources within the City limits. The City also has a website where information regarding the City's committees and commissions, their mission statements and read past agendas and meeting minutes are available. As part of the NPDES Phase II Storm water Permit the City has also created a storm water management page on their website that includes the contents of this Plan and the related NPDES permit submittals. As part of the NPDES program, the City is required to implement a public education and outreach program, along with a public participation and involvement program and to incorporate public information into each of the other four minimum control measures of the permit.

The City's web site is an alternative medium to provide municipal information to both City residents and those people who live outside Shoreview. An electronic version of the completed and approved water resources management plan will ultimately be accessible on the web. Because the Plan has such a wide audience from engineers and planners, to developers and citizens, to scientists and educators, electronic access to the text and mapping creates a better understanding of the goals, policies and activities of this Plan.

The City will continue to distribute information on pertinent water and wetland management issues via the Shoreview Newsletter and will promote opportunities for residents to participate in water resources management activities. The City will also make an ongoing effort on both a City-wide and watershed level toward educating the public by distributing information to its residents on responsible practices they should employ to protect water resources within the community. The program will educate residents on things such as the benefits of using phosphorus-free fertilizer and the proper use of a wide range of lawn chemicals.

3. Implementation Plan

Table 19 outlines activity steps that are intended to guide the City in achieving the public participation, information and education goals of this Plan. Table 19 also shows the corresponding BMPs from the NPDES SWPPP, a list of possible resources available, the measurement system and a project target date for each of the planned activities.

Table 19 – Public Participation, Information and Education Implementation Plan

Activity Steps	BMP Unique ID No.	Resources	Measurement	Target Date
1. City Storm Water Education Program	1-01-R 1-02-R 1-03 1-04 1-05 2-03	• City Staff • Rice Creek WD • Grass Lake WMO • Ramsey County	• City newsletter • City website • Cable access television • Public Meeting	Annual Annual Annual Annual
2. Storm drain stenciling	2-02	• City Staff • Residents • Area developers	• Completed implementation	Annual
3. Lake and stream cleanup and monitoring	2-04	• City Staff • Volunteers	• Implement improvements	Annual
4. City Cleanup Program	2-05	• City Staff • Residents	•	Annual
5. Complaint Response Program	4-06-R	• City Staff	• Review existing program • Post call line number	2004 2004

H. Goal 8. Maintenance and Inspection

Inspections help to 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 quantity and quality goals. The application of development standards ensures consistency in the work produced and the documentation of the constructed systems. Appropriate land use controls can be used to maximize the preservation of the natural drainage systems and to control increases in runoff rate, volume and pollutant loading. Inspections and long-term maintenance of these systems is the critical final step to ensure the planned long-term benefits.

There are four basic steps to developing an effective storm drainage maintenance program.

- Evaluating problems, needs, and opportunities;
- Defining goals and objectives of inspection and maintenance activities;
- Establishing policies, programs and priorities; and
- Developing criteria and standards for evaluating performance and

One often forgotten aspect of storm water facility maintenance is private ponds. Maintenance agreements with private pond owners can ensure that ponds are kept in good operating condition and that routine maintenance occurs. An example pond maintenance agreement is provided in Appendix C that can be modified to address other BMPs (e.g., infiltration basins, bioretention areas, grit chambers, etc. Recommended maintenance activities and schedules for a wide range of BMPs can be found on many online sources including http://www.stormwatercenter.net. Documentation or review comments and changes and acquisition of proper ponding easements are also important considerations during the development review process.

Each of the four essential elements above is covered by this SWMP. However, to be effective, the need for good management, the need for good data; and the need for sound financing must be addressed. Many well-conceived maintenance plans are never fully implemented because of the lack of funding. A sound and continuous source of revenue is vital to an effective maintenance program. The City has a source of revenue in the Surface Water Management Fund and has developed the policies in Table 20 to support the maintenance goals of this Plan.

Table 20. Maintenance and Inspection Policies

Goal Statement: **Preserve function and performance of public infrastructure through continued implementation of a maintenance and inspection program.**	
Policy No.	**Goal 8: Maintenance and Inspection - Policies**
8.1	The City will continue to implement a maintenance and inspection program for water resource facilities (e.g., ponds, storm sewer systems, outfalls to waters, etc.). The City's maintenance and inspection program shall meet the requirements of the NPDES Phase II MS4 Storm Water Program.
8.2	The City will require maintenance of privately constructed water quality treatment ponds through formal development or maintenance agreements (see Appendix C for example agreement).
8.3	The City shall require adequate maintenance-related access for public and private water resource management facilities.
8.4	Pond and detention facility clean out activities will comply with the requirements of the Minnesota Wetland Conservation Act, the Minnesota Department of the Natural Resources, the Minnesota Pollution Control Agency and the standards of this plan.
8.5	The City will continue its operation and maintenance activities that preserve water quality, including street sweeping, pond and grit chamber maintenance and appropriate application of salt/sand that balances public safety and environmental protection.

1. Storm Water Management Program

The City 1990 SWMP was developed primarily to prevent flooding and improve water quality. While maintenance and inspection goals and policies were not specifically stated, the 1990 Plan included a Maintenance Guide that included the following practices:

- ***Semi-annual inspection of all wetland areas***. Brief walking inspection to record sediment buildup, skimmer and structure conditions, litter, vegetation, and visual water quality.
- ***Street Sweeping***. Semi-annually, following spring snowmelt and in fall.
- ***Catch Basin Cleaning***. Frequency to prevent encroachment of sediment and debris above flow line of pipe.
- ***Inspection of direct storm sewer discharge***. Inspection on bi-annual basis and following large storm events to determine if discharge point is free from sediment and to observe the condition of any treatment facility if applicable.
- ***Removal of sediment***. Based on semi-annual inspections, sediment shall be removed from areas where the sediment impedes the flow path, from areas not designated for sediment removal, or where sediment build up has eliminated necessary storage volume.
- ***Structure and skimmer maintenance***. Based on semi-annual inspections and following heavy rains, maintenance needs should be developed.
- ***Litter control***. Semi-annual wetland inspections and collection. Seasonal public education efforts.
- ***Chemical application to reduce aquatic and roadside vegetation***. Discourage this practice to the greatest extent possible.
- ***Vegetation harvesting***. In areas specially developed and maintained to control and reduce nutrients, vegetation should be harvested in the late summer of each year. Storm water should then be diverted from the treatment area until vegetation can be reestablished.
- ***Storm sewer and culvert flushing***. Monthly visual checks of pipes that have a history of sedimentation problems. Flushing performed on an as needed basis.

2. NPDES Phase II SWPPP

The City is currently following these other activities typically associated with a storm system maintenance and inspection program. The City's NPDES MS4 SWPPP also includes several BMPs that the City will follow to meet the goals of this Plan and the requirements of the NPDES Permit. The key components of the City's inspection and maintenance program include:

- A structural BMP and outfall inspection program;
- Follow-up maintenance activities including removal of accumulated sediments;
- Creation of storm sewer system maintenance database; and
- A prioritized street sanding and sweeping program.

Each of these activities is discussed in more detail in the SWPPP BMP sheets located in Appendix G.

3. Implementation Plan

Table 21 outlines activity steps that are intended to guide the City in achieving the maintenance and inspection goals of this Plan. Table 21 also shows the corresponding BMPs from the NPDES SWPPP, a list of possible resources available, the measurement system and a project target date for each of the planned activities.

Table 21 – Maintenance and Inspection Implementation Plan

Activity Steps	BMP Unique ID No.	Resources	Measurement	Target Date
1. Storm sewer outfall and BMP map	3-03-R	• City Staff • Surface Water Management Plan	• Map	2008
2. BMP Maintenance Agreement Program	5-03-R	• City Staff • Area developers	• Develop maintenance agreement	2004
3. City staff training and inspection program	6-02-R 3-05	• City Staff • WMOs	• Formalize training program • Conduct training sessions • Maintenance staff meetings	2004 Annual Annual
4. Structural BMP and outfall inspection program	6-03-R	• City Staff	• Inspect system outfall and ponds • Inspect other pollution control devices	Annual Annual
5. Storm water system maintenance program	6-04-R	• City Staff • GIS	• Inspect and maintain system • Create GIS database	Annual Annual
6. Development of storm sewer system database	6-05-R	• City Staff • GIS	• Review database options • Implement database	2004 2008
7. Street sweeping program	6-06	• City Staff	• Sweep at least once in the spring and once in the fall • Sweep target/priority areas in the summer and winter as needed	Annual Annual
8. Spill prevention and control training program	6-07	• City Staff	• Develop annual program • Present training session	2004 Annual

I. Goal 9. Regulatory Responsibility

According to the City of Shoreview's 1990 Surface Water Management Plan, the City assumed the role of permitting all land alteration activities and enforcing the standards and policies set forth by that Plan. Rice Creek Watershed District (RCWD) also reviews and comments on any proposed land alteration within the RCWD and have authority over wetlands within their jurisdiction. It is not the City's intent to take over the water-related permitting process from the

RCWD. Rather, the City has a parallel water-related permitting process for developments within the RCWD jurisdiction. Because Grass Lake Watershed Management Organization (GLWMO) does not have permitting authority, the City's has the responsibility for management of storm water, water resources and wetland protection for projects within GLWMO's jurisdictional boundary.

The Minnesota Department of Natural Resources has authority over issues relating to water and wetlands designated as State Protected Wetlands and Waters. The U.S. Army Corps of Engineers has authority relating to all wetlands identified by the U.S. Fish and Wildlife Service's National Wetland Inventory.

Ramsey County and the Minnesota Department of Health have regulatory authority over groundwater issues within the City. Erosion control falls under several jurisdictions including the City, RCWD, the Ramsey Soil and Water Conservatory District and the state Board of Water and Soil Resources. The Minnesota Pollution Control Agency has regulatory authority over individual septic systems within the City limits.

As with any regulatory program, funding and financing issues are a critical consideration. As such this section contains a summary of funding programs that related specifically to water resources and surface water management activities. Consistent with the intent of related regulatory agencies, the City has developed the policies in Table 22 to help ensure that the regulatory responsibility goals of this Plan are met.

Table 22. Regulatory Responsibility Policies

Goal Statement:	**Maintain primary responsibility for managing water resources at the local level but continue coordination and cooperation with other agencies and organizations.**
Policy No.	**Goal 9: Regulatory Responsibility - Policies**
9.1	This plan and all subsequent amendments shall be consistent with all other regulatory agencies.
9.2	The programs and standards of this plan shall be implemented as required by regulatory responsibilities and, as needed, at the direction of the City Council. This plan may be amended as necessary to remain current.
9.3	The City will develop and implement ordinances and programs to remain consistent and compliant with local, regional and national programs related to storm water management.
9.4	RCWD is responsible for maintenance of all Judicial Ditches and Rice Creek within the City.
9.5	The Minnesota Department of Natural Resources and the U.S. Army Corps of Engineers have regulatory authority relating to waters and wetlands identified by their respective inventories.

1. NPDES Phase II SWPPP

The NPDES Phase II Permit Program (http://www.pca.state.mn.us/water/stormwater/index.html) is a federal regulatory program that requires owners of Municipally Separate Storm Sewer Systems (MS4s) to prepare and implement a Storm Water Pollution Prevention Program

(SWPPP) and apply for the permit with the administrative agency. The Minnesota Pollution Control Agency administers the Phase II MS4 program in the state and the City submitted their permit application on March 10, 2003, to comply with the initial submittal deadline. This SWMP incorporates the best management practices (BMPs) that were identified in the City's SWPPP along with several specific projects that were not specified as part of the Phase II program.

One step in meeting the Phase II requirements included a self assessment process that the City completed to prepare their Notice of Intent (NOI or permit application) for coverage under the NPDES MS4 Phase II Permit. In this process, the City considered the receiving waters within the City, the City's existing storm water management plan and a range of BMPs that could be followed to achieve the goals of this Plan and the MS4 requirements. The self assessment resulted in an understanding of the City's current storm water programs and future priorities.

The City currently has erosion control, water quality and water quantity design measures in place under their Municipal Codes. The City requires a Grading Permit, Erosion Control Plans and security deposits from all developers within the Community. The City also inspects all projects being constructed within the City limits. BMPs that form the City's SWPPP are summarized and described in more detail in *Appendix G*. Information and references to permit requirements are provided in the individual BMP summary sheets. The City is required to review, and if needed, create or revise ordinances addressing illicit discharge detection and elimination, construction site storm water runoff control, and post-construction storm water management in new development and redevelopment.

2. Funding/Financial Considerations

Paying for water management projects and administrative activities has become more complex in recent years. In the past, special assessments against benefited properties financed most of the necessary improvements. However, the financial options have broadened considerably. The question is, which method(s) best suit the needs of the City. The major categories of funding sources are: Ad Valorem Taxes; Special Assessments; Development Charges [Building Permits, Land Development Fees and Land Exaction]; and Grants. The City currently has a storm water utility (Surface Water Management Fund) in place. Following is a description and financing principles used with each of these financing mechanisms. Table 23 illustrates the advantages and disadvantages of the different financing methods.

- ***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. A special tax district 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.
- ***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.

- ***Development Charges***. Fees charged to new development that generates runoff can be charged to finance infrastructure needed to serve the development. This is a useful tool in communities that are rapidly developing.

Table 23. Advantages and Disadvantages of Various 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. 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).
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 - irregular schedule. 5. Requires considerable lead time from application to receiving funds.

- ***Grants***. State 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 its availability. Grants are useful but should only be used to supplement a planned local revenue source. Some of the agencies and programs that may have available grant funds include:

  - Environmental Protection Agency
  - U.S. Army Corps of Engineers
  - U. S. Fish and Wildlife Service
  - Pittman-Robertson - Federal Aid in Wildlife Restoration Act
  - Minnesota Department of Natural Resources
  - Metropolitan Council
  - Rice Creek Watershed District
  - Minnesota Pollution Control Agency

3. Implementation Plan

Table 24 outlines activity steps that are intended to guide the City in achieving the regulatory responsibility goals of this Plan. Table 24 also shows the corresponding BMPs from the NPDES SWPPP, a list of possible resources available, the measurement system and a project target date for each of the planned activities.

Table 24 – Regulatory Responsibility Implementation Plan

Activity Steps	BMP Unique ID No.	Resources	Measurement	Target Date
1. Coordinate projects as needed with WMOs		• City Staff • RCWD • VLAWMO • GLWMO	• Completed projects • Water quality or quantity issue resolved	Annual
2. NPDES SWPPP	All	• City Staff • Existing permit SWPPPs for MS4 and Industrial sites • MPCA Forms and guidance	• Complete Annual Report for MS4 and Industrial Site • Adjust SWPPP as needed • Reapply for permit(s) in 2008	Annual March 10 Annual
3. Implement Wetland Conservation Act rules for projects in the GLWMO and VLWMO jurisdiction	NA	• City Staff • WMOs	• Completed permit actions and projects	Ongoing

Shoreview • Minnesota

Second Generation

Surface Water Management Plan

IV. WATER BODIES

A. Overview

Shoreview water bodies are classified according to the use, function and water quality characteristics in accordance with the classification system shown in Table 25. Major lakes in Shoreview are classified as Category I, II or III water bodies. Table 25 also shows the management and leadership role for water bodies in the City. Management of water bodies is grouped into three categories according to the Grass Lake WMP Plan: WMO Managed; City Managed; and Cooperatively Managed. For the three water bodies in Shoreview that are cooperatively managed, GLWMO is primarily responsible for classification of the water body, while the City is responsible for setting goals, monitoring, tracking data, preparing management plans and implementing management activities. For GLWMO managed water bodies, the WMO is responsible for leading all these activities (see GLWMO Plan Tables 5-2 and 5-4 for more information). Figure 11 illustrates the water body classification system in Shoreview and identifies the management lead for each water body.

This section of the Plan is intended to describe the key water bodies within in Shoreview according to their relative priority or category. Each category of water bodies is presented in the following subsections. Water bodies in each category are presented along a summary of the information collect and analyzed for each water to date, an assessment of any problems and recommended implementation priorities.

One of the priority considerations that is not fully addressed in the SWMP is the waters listed on the January 2003 Total Maximum Daily Load (TMDL) List of Impaired Waters. The City understands that the TMDL List (as required under Section 303(d) of the Clean Water Act) was approved by US EPA in January 2003, and that when complete the TMDLs will be used by the MPCA and local entities to further prioritize management actions. The City will consider the listing of the lakes in Table 26 in future management decisions but recognizes that waters listed with mercury as the pollutant must be management more regionally. Island Lake will be considered for nutrient reduction activities as part of this Plan.

Table 25. Water Body Classification and Management Lead for Shoreview Lakes and Water Bodies

Water Body Classification	Lake / Water Body	Management Lead[1]	Description
Category I	Lake Owasso Lake Wabasso Snail Lake Turtle Lake	GLWMO GLWMO GLWMO City	Water bodies in this category are typically used for swimming and other direct contact recreational activities. These water bodies have the highest/best water quality and are usually the most popular water bodies with the public
Category II	Lake Emily Shoreview Lake Island Lake	Cooperatively Cooperatively City	Water bodies in this category are typically used for indirect contact recreational activities such as boating and fishing that involve incidental contact with lake water. These water bodies have poorer water quality than Category I water bodies but are still popular with the public.
Category III	Grass Lake Lake Judy Martha Lake	GLWMO Cooperatively City	Water bodies in this category serve important functions for wildlife habitat and aesthetic enjoyment and may also provide opportunities for warm-water fishing provided winterkill does not occur. These water bodies have poorer water quality than Category I and II water bodies and typically are not viewed as swimmable.
Category IV (Nutrient Traps)	Storm Ponds	City	Water bodies in this category are intended to reduce downstream loading of phosphorus and other nutrients that contribute to water pollution. These ponds are designed to have phosphorus (TP) removal efficiencies of at least 50 %.
Category V (Sediment Traps)	Storm Ponds	City	These water bodies are similar to Category IV water bodies but are too small to effectively remove a significant fraction of nutrients. These basins will generally have TP removal efficiencies of less than 50 %.

1. See GLWMO Plan Table 5-2 and 5-4 for more detail on management roles and responsibilities.

Table 26. TMDL Listed Waters in Shoreview

Receiving Water	Assessment ID or DNR Lake #	Affected Use	Pollutant or Stressor	Target Start/Completion Date
Island Lake- South	62-0075-01	Swimming	2 Excess Nutrients	2010/2014
Island Lake-North	62-0075-02	Swimming	2 Excess Nutrients	2010/2014
Lake Owasso	62-0056-00	Aquatic Life	1 Mercury FCA[1]	2002/2015
Snail Lake	62-0073-00	Aquatic Life	1 Mercury FCA[1]	2002/2015
Turtle Lake	62-0061-00	Aquatic Life	1 Mercury FCA[1]	2002/2015

1. FCA means fish consumption advisory.

B. Category I Water Bodies

Category I water bodies are typically used for swimming and other direct contact recreational activities. These water bodies have the highest/best water quality and are usually the most popular water bodies with the public. Category I water bodies are discussed individually in the following pages and include:

- Lake Owasso
- Lake Wabasso
- Snail Lake
- Turtle Lake

1. Lake Owasso (DNR ID No. 62-56P)

Lake Owasso is located in both Shoreview and Roseville and has a surface area of approximately 410 acres (see Figure 11). The maximum depth of Lake Owasso is about 40 feet with an average depth of 9 feet. Public access is provided on the north shore at Lake Owasso County Park along with a swimming beach, operated by Ramsey County.

Lake Owasso has suffered from both extremes of low and high lake water levels. Ramsey County pumped groundwater into Lake Owasso for many years to augment water levels during extreme low water periods. Pumping was suspended in 1991, when the DNR suspended all metro lake augmentation pumping permits. High water levels have, on occasion, led to subsequent flooding of adjacent properties. To address high water level problems, the outlet for Lake Owasso was modified in 1990 from a six-foot long weir to a 10-foot by 10-foot box culvert, and a 28.5-inch span and a 22-inch space concrete arch pipe. Both are connected to a 44-inch span arch pipe under Owasso Boulevard routed to Lake Wabasso. The outlet was modified to reduce lake drawdown times, reduce outlet plugging and lower peak flood elevations.

Water level data has been collected on Lake Owasso since 1924 by the Minnesota DNR. The MPCA along with their Citizen Lake Monitoring Program have collected water quality data on the lake for many years. As described in the GLWMO Plan (Barr, 2001) Secchi disk readings and chlorophyll *a* concentrations would classify Lake Owasso as mesotrophic while total phosphorus concentrations indicate that Lake Owasso is classified as a eutrophic lake. Since 1999, the average Secchi disk readings have gone down after an improvement trend since 1977.

Numerous studies have been completed on the management of Lake Owasso, including:

- Water Quality Management Alternatives: A Report on the Diagnostic-Feasibility Study of Lake Owasso, Lake Wabasso, and Snail Lake (1991)
- Lake Owasso Lake Management Plan (1995)
- Lake Owasso Management Plan (2000)

Some of the recommendations for water quality improvements to Lake Owasso from these studies have already been completed. However, the water quality of Lake Owasso continues to be a concern due to the fact that it is used for many recreational activities including fishing,

boating and swimming. According to the GLWMO Watershed Management Plan (September 2001) the Secchi disc transparency trend has significantly improved since 1977. Additionally, the chlorophyll *a* and total phosphorus concentrations have improved, indicating improved water quality. If no BMPs are implemented in the watershed, the phosphorus loading to Lake Owasso is predicted to increase 5 percent, which is expected to result in the same summer-average total phosphorus concentration as compared to current conditions. With implementation of BMPs within the watershed, the total phosphorus loading to Lake Owasso would increase by only 3%, while the predicted summer average total phosphorus concentration would remain unchanged.

Because the predicted summer total phosphorus concentrations is not expected to be significantly better with implementation of BMPs in the watershed, the City will continue the current management strategy. This conclusion is also supported by the water quality analysis summarized in Appendix E. Lake Owasso is located in drainage area LO-12 and meets the water quality treatment goals for all methods evaluated. The City will review development and redevelopment plans and look for opportunities to incorporate conventional and alternative BMPs on a site specific basis. The City does not anticipate implementing large-scale BMP projects in the Lake Owasso drainage areas at this time.

2. Lake Wabasso (DNR ID No. 62-82P)

Lake Wabasso is located in the southeastern portion of the City of Shoreview, directly downstream of Lake Owasso (see Figure 12). Lake Wabasso discharges to the north into Grass Lake. Lake Wabasso has a surface area of approximately 52 acres, has a maximum depth of approximately 66 feet and an average depth of 16 feet. Lake Wabasso is used for many recreational activities, including fishing, boating and swimming. Boat access is provided in Lake Owasso County Park on the south side of the lake which is operated and maintained by Ramsey County.

Historically, high water levels have been a concern on Lake Wabasso as reported in the GLWMO Watershed Management Plan. The outlet for Lake Wabasso is a channel which has overflowed in the past, resulting in localized flooding of adjacent residential yards. According to the GLWMO Watershed Management Plan, the insufficient downstream capacity in the culvert under I-694 appears to be the cause of the ditch overflowing. No modifications to the Lake Wabasso outlet have occurred to date. While lower in priority, the City may look at improvements to the outlet channel in the future. Water levels on Grass Lake will be a important consideration if outlet changes are identified.

Water level data has been collected on Lake Wabasso since 1938 by the Minnesota DNR. The MPCA along with their Citizen Lake Monitoring Program have collected water quality data on the lake since 1973. Based on available water quality data, Lake Wabasso is a mesotrophic lake. There has been no significant trend or improvement or degradation of Lake Wabasso based on Secchi disc readings during the period of record.

There are three drainage areas within the Lake Wabasso watershed that have enough water quality treatment capacity according to the water quality assessment in Appendix E. These watersheds (LW-2, LW-3 and LW-5) do not drain directly to Lake Wabasso. Instead, they

combine with the discharge from Lake Wabasso and drain into downstream Grass Lake. Therefore, the opportunity for improvements that would impact Lake Wabasso are limited to the direct drainage area LW-4 and the quality of the discharge from Lake Owasso.

Implementation of storm water treatment BMPs in the watershed is expected to result in predicted phosphorus loading to Lake Wabasso to remain about the same. Like Lake Owasso, because the predicted summer total phosphorus concentrations is not expected to be significantly better with implementation of BMPs in the watershed, the City will continue the current management strategy. The City will review development and redevelopment plans and look for opportunities to incorporate conventional and alternative BMPs on a site specific basis. The City does not anticipate implementing large-scale BMP projects in the Lake Owasso drainage areas at this time.

3. Snail Lake (DNR ID No. 62-73P)

Snail Lake is located in central Shoreview directly south of Highway 96 (see Figure 12). The surface area of the lake covers 190 acres, of which 35 acres is wetland on the northwest side of the basin. The maximum depth of Snail Lake is 28 feet in the southern bay, with an average depth of about 6 feet. Snail Lake is another important recreational lake in Shoreview, providing boating access, along with fishing and swimming. Snail Lake Regional Park which is located on the southern shore also provides public access and pedestrian trails.

Snail Lake functions essentially as a landlocked basin and has been identified as a seepage lake; meaning that it contributes to groundwater recharge. Water does not typically outflow from Snail Lake, unless high water levels reach the elevation of the overflow outlet. The drainage outlet for Snail Lake is routed to a series of wetlands east of Snail lake Road (into drainage area GL-4E) as illustrated in Figure 12.

Until 1990, groundwater was pumped into Snail Lake to augment the water levels when the DNR suspended all augmentation pumping permits. In 1993, the City initiated the Snail Lake Augmentation project which pumps water from Sucker Lake in Vadnais Heights into Snail Lake. This allows the City to purchase water from the St. Paul Water Utility (which controls Sucker Lake) when necessary. The project was constructed as a cooperative project between the City of Shoreview, the Snail Lake Improvement District and Ramsey County. The City and the Snail Lake Improvement District are responsible for the operation of the augmentation system. Snail Lake has a maximum lake level of 883.6 according to the Minnesota DNR permit which governs the pumping.

Water level data has been collected on Snail Lake since 1924 by the Minnesota DNR and MPCA along with their Citizen Monitoring Program have collected water quality data since 1980. Snail Lake is classified as a mesotrophic lake based on available water quality data. There has been no significant trend in water quality parameters during the period of record. Management of the lake to date has been aggressive to ensure the recreational value is maintained. Lake management techniques have included dredging, pumping and chemical treatment.

Drainage areas within the Snail Lake subwatershed which do not have sufficient water quality treatment capacity according to the water quality assessment in Appendix E include: SL-4, SL-7, SL-9, SL-10, SL-11 and SL-12. According the GLWMO Watershed Management Plan (September 2001), if no new BMPs are implemented within the Snail Lake subwatershed, the projected phosphorus loading to Snail Lake would increase by less than 1 percent and the predicted summer average total phosphorus concentration would remain unchanged. If BMPs are implemented within the subwatershed, both the predicted phosphorus loading and summer average total phosphorus concentration would remain the same.

Because the predicted summer total phosphorus concentrations is not expected to be significantly better with implementation of BMPs in the subwatershed, the City will continue the current management strategy. The City will review development and redevelopment plans, implement the Phase II storm water program and look for opportunities to incorporate conventional and alternative BMPs on a site-specific basis. The City does not anticipate implementing large-scale water quality BMP projects in the Snail Lake drainage areas.

4. Turtle Lake (DNR ID No. 62-61P)

Turtle Lake is located in north-central Shoreview just south of County Road I. Turtle Lake is the City's largest recreational lake with a surface area of approximately 452 acres and a maximum depth of about 35 feet. Turtle Lake is using for boating, fishing and swimming with public access provided by Turtle Lake County Park in the southeastern corner of the lake.

Turtle Lake outlets to the northwest into Marsden Lake, which in turn ultimately flows into Rice Creek. Water level data has been collected on Turtle Lake since 1923 by the Minnesota DNR and the MPCA along with their Citizen Monitoring Program have collected water quality data since 1974. There have been no significant trends in Secchi disc (water clarity) readings during the period of record. Turtle Lake continues to be a very high quality water body and one of the unique waters in the metropolitan area.

According to the water quality assessment completed as part of this Plan and as summarized in Appendix E, three of the drainage areas within the Turtle Lake subwatershed do not provide enough water quality treatment. These subwatersheds (TL-1, TL-2 and TL-3) provide some water quality treatment through ponds and wetlands. Turtle Lake is generally high quality, partly due to its relatively small drainage area.

The City will continue the current management strategy including review of development and redevelopment plans, implementing the Phase II storm water program and looking for opportunities to incorporate conventional and alternative BMPs on a site-specific basis. The City does not anticipate implementing large-scale water quality BMP projects in the Turtle Lake drainage areas.

C. Category II Water Bodies

Category II water bodies are typically used for indirect contact recreational activities such as boating and fishing that involve incidental contact with lake water. Category II water bodies

have poorer water quality than Category I water bodies but are still popular with the public. Category II water bodies are discussed individually in the following pages and include:

- Lake Emily
- Shoreview Lake
- Island Lake

1. Lake Emily (DNR ID No. 62-80W)

Lake Emily is located in south central Shoreview. Lake Emily has a surface area of approximately 13 acres, a maximum depth of about 15 feet, and an average depth of 7 feet. All of the land surrounding Lake Emily is privately owned and therefore there is not a public access. Residents who live on the lake use it primarily for boating and fishing.

Surface water from Lake Emily flows through a wetland, then into Charlie Pond in Roseville, and finally into Lake Owasso as illustrated in Figure 12. Only one water level has been recorded by the Minnesota DNR in 1979 on Lake Emily. The MPCA along with their Citizen Monitoring Program have collected water quality data since 1980. The trend analysis completed as part of the GLWMO Watershed Management Plan (September 2001), shows that there are significant tends in Secchi disc readings. These data indicate that there has been negative trend in Secchi disc readings since 1990. In general the Secchi disc depths indicate that Lake Emily is a eutrophic lake. Sufficient data is not available on total phosphorus and chlorophyll *a* to conduct a trend analysis.

Within the Lake Emily subwatershed, there are two drainage areas (LE-1 and LE-3) which do not meet the water quality treatment criteria as shown in the water quality assessment data in Appendix E. However, drainage area LE-1 drains to LE-2 which provides enough water quality treatment for both drainage areas. Similarly, LE-3 drains to LE-4, which also provides enough water quality treatment for both drainage areas (see Figure 12).

Because Lake Emily is a Category II water body and the water clarity trend is current downward, the City intends to encourage development and redevelopment projects in LE-5 to evaluate the benefits of additional water quality treatment BMPs beyond the basis City requirements. The City will also look for opportunities to incorporate BMPs into municipal projects in drainage area LE-5.

2. Shoreview Lake (DNR ID No. 62-79W)

Shoreview Lake is located in the south central portion of the City in the upper reaches of the Lake Wabasso watershed. There is limited information available on Shoreview Lake, from the City, WMO and regulatory agencies. Shoreview Lake is generally not used for recreational activities. Shoreview Lake is within a relatively small self-contained drainage area with only the immediate drainage area draining into the lake. The drainage area has sufficient water quality treatment based on the water quality assessment summarized in Appendix E.

3. Island Lake (DNR ID No. 62-75P)

Island Lake is located in the southwestern portion of Shoreview and is divided into north and south basins by Interstate-694. The combined Island Lake basins have a surface area of approximately 56 acres. South Island has a maximum depth of about 10 feet and North Island Lake has a maximum depth of about 6 feet. The Island Lake County Park, operated by Ramsey County provides public access to Island Lake for boating, fishing and swimming.

South Island Lake drains north through a channel and under I-694 as illustrated in Figure 12. Water level data has been collected on Island Lake since 1924 by the Minnesota DNR. The MPCA has not collected any water quality data for the lake.

According to the water quality assessment summarized in Appendix E, drainage area IL-7 does not meet the water quality treatment criteria. Island Lake is also on the MPCA's TMDL List of Impaired Waters for excess nutrients. The contributing drainage area for Island Lake is self-contained, receiving storm water from only the immediate drainage area. Additional water quality treatment will be considered as municipal projects are implemented in drainage areas IL-7 and IL-8. The City will also look for opportunities to encourage development and redevelopment projects to incorporate water quality BMP beyond the minimum requirements and will coordinate management efforts with MPCA upon completion of the TMDL study for Island Lake.

D. Category III Water Bodies

Category III water bodies serve important functions for wildlife habitat and aesthetic enjoyment and may also provide opportunities for warm-water fishing provided winterkill does not occur. These water bodies have poorer water quality than Category I and II water bodies and typically are not viewed as swimmable. Category III water bodies are discussed individually in the following pages and include:

- Grass Lake
- Lake Judy
- Martha Lake

1. Grass Lake (DNR ID No. 62-72)

Grass Lake is located in the southeastern portion of the City just north of I-694. Grass Lake has a surface area of approximately 141 acres, and is a relatively shallow basin with extensive areas of emergent vegetation. Vadnais-Snail Lakes Regional Park completely surrounds Grass Lake. However, because there is not a public access the lake is not frequently used for recreational activities.

According to the GLWMO Watershed Management Plan, Grass Lake has no outlet under normal conditions. However, there is reference to culverts that allow flow to occur between Grass Lake and West Vadnais Lake during high water periods. In the early 1990's, MNDOT constructed a vault under the railroad and Rice Street along the east side of Grass Lake as part of a culvert construction project. While the gate/vault has not been constructed, the structure was intended to

allow GLWMO to construct a gate that could control the flow between Grass Lake and West Vadnais Lake.

Water level data has been collected on Grass Lake since 1965 by the Minnesota DNR. The MPCA has collected some water quality data, but not enough to analyze any trends. There are several drainage areas within the Grass Lake subwatershed that do not meet the water quality treatment criteria shown in the water quality assessment (see Appendix E). However, these drainage areas (GL-2, GL-3, GL-4W, GL-7 and GL-8) are providing some treatment because there are small ponds or wetlands within the Grass Lake subwatershed. Overall, the Grass Lake subwatershed has sufficient treatment capacity for its management classification. There is not enough water quality data on Grass Lake to predict any trends or conduct any water quality modeling.

2. Lake Judy (DNR ID No. 62-81P)

Lake Judy is located in the southwest corner of the City and drains directly to Lake Emily. Lake Judy has a surface area of 16 acres, a maximum depth of 5 feet, and a mean depth of 3 feet. The lake is used for fishing and canoeing and there is a City park on the north side of the lake that does not provide boat access.

Water level data was only collected twice by the Minnesota DNR for Lake Judy, once in 1979 and once in 1981. The MPCA has collected water quality data as part of the Citizen Lake Monitoring Program, which collected Secchi disc data from 1980 to 1984. The water quality data that has been collected suggests that Lake Judy is a hypereutrophic system.

Lake Judy receives runoff only from its immediate drainage area. Because of the Category III classification on Lake Judy, on a lower priority basis, the City look for opportunities to incorporate BMPs into municipal projects and encourage development/redevelopment projects to upgrade BMPs in drainage area LJ-1.

3. Martha Lake (DNR ID No. 62-64)

Martha Lake is located in the central portion of Shoreview north of Highway 96 and just west of the City's maintenance facility on Victoria Avenue. The Minnesota DNR collected two water level readings in 1972. There has been no water quality data collected on Martha Lake.

There are drainage areas within the Martha Lake watershed that do not meet the water quality treatment criteria according to the water quality assessment. However, these drainage areas do not drain to Martha Lake, they route to a County ditch or directly out of the City. Drainage area ML-4, which discharges out of the City, has storm water ponds and wetlands that provide some treatment. Drainage area ML-5 discharges to CD1-7 and drainage areas ML-6, ML-7, ML-8, ML-9 and ML-11 all discharge to Marsden Lake. The City intends to upgrade the treatment system at their maintenance facility that drains directly to Martha Lake as part of the NPDES Industrial Permit SWPPP.

E. Category IV and V Water Bodies

Category IV and V water bodies are generally classified as nutrient and sediment traps, or storm water treatment basins. Water bodies in Category IV are intended to reduce downstream loading of phosphorus and other nutrients that contribute to water pollution. Category IV ponds are designed to have phosphorus (TP) removal efficiencies of at least 50 percent. Category V water bodies are similar to Category IV water bodies but are too small to effectively remove a significant fraction of nutrients. These basins will generally have TP removal efficiencies of less than 50 percent.

The primary management activity that the City will complete as part of this Plan will be to continue to implement the inspection and maintenance program for ponds as described in the NPDES SWPPP (see Appendix G).

F. Wetlands

In 1990, the City created a wetland inventory that assigned management classifications and identified other details of interest on the wetlands. The intent or use of a wetland was to be considered in its classification. This inventory has been updated as part of this Plan and is provided under separate cover (*2003 Wetland Inventory*, SEH). The wetland categories and their associated characteristics are shown in Table 27.

Table 27. Summary of Wetland Types and Cumulative Surface Area in Shoreview

Wetland Classification	Acres	Description
Protect	1,700	High quality natural basins, unique habitats, rare/threatened/ endangered species, high quality adjacent uplands.
High Management	448	Moderate to high quality basins, some receive direct storm water, high quality adjacent uplands.
Low Management	113	Highly impacted to moderate quality natural basins, most receive direct storm water, low diversity or monotypes.
Utilize	40	Created basins, highly impacted natural basins, isolated monotypes.
Wetlands Not Observed	74	These wetland areas were not physically observed in the field due to property access issues or because the wetland area did not exist when field inspected. Wetlands classified as Not Observed are not illustrated in Figure 10.
Upland (non-wetland)	5,711	All other areas not specifically identified as wetland areas in the national wetlands inventory and City wetland GIS database
Total	**8,086**	

The updated Wetland Inventory includes a new wetland classification system that is consistent with the GLWMO system described in the GLWMO 2001 Watershed Management Plan. The new classification system uses categories based on a wetland's susceptibility to degradation by storm water. The City intends to evaluate the feasibility of and potential benefits of completing a Comprehensive Wetland Protection and Management Plan to help guide decisions relating to wetlands in the future (see Goal 3). Figures 9 and 10 illustrate the extent of wetlands in the City based on the National Wetlands Inventory and City Wetland Classification System, respectively.

This page left intentional blank

S h o r e v i e w • M i n n e s o t a

Second Generation

Surface Water Management Plan

V. IMPLEMENTATION PLAN

A. 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 objectives. The implementation section summarizes capital improvement projects, studies and ongoing maintenance, inspection, monitoring and other management activities recommended for at least the years 2003 through 2008 related to the City's NPDES SWPPP as well as activities that are intended to continue on a much longer-term basis. Estimated costs of recommended actions are not provided recognizing that planning level estimates often set unrealistic expectations of the actual costs of projects and/or activities. Procedures for amending the Plan are presented.

The implementation plan is based on goal and policy-driven action-implementation plans. The process of developing the action and implementation plans is based on four steps:

- Development of goal statements consistent with Minnesota Rules Chapter 8410, the WMOs and Metropolitan Council;
- Identification of issues or problems related to achieving the goals;
- Identification of solutions corresponding to each of the issues; and
- Development of specific action steps, including identification of resources, measurement and anticipated schedules.

Based on the action-implementation plans from each of the nine goals, a process for accomplishing the goals and policies of this SWMP is established.

B. Implementation Priorities and Costs

The implementation plan as described in the implementation Tables for each Plan goal includes identification and prioritization of capital improvements, administration, maintenance and inspections, permitting, plan amendments, financing alternatives, public involvement and monitoring programs. Prioritization of improvements was based on a review of recommended and required actions for the nine individual goal action-implementation plans

The City's water bodies and wetlands are truly exceptional resources for City residents. They offer a range of recreational opportunities and are generally in very good shape from a water quality perspective. The City's challenge in the years ahead will be to successfully implement this SWMP and the requirements of the NPDES Phase II program to maintain, and where feasible, improve these existing resources. Water Quantity, or flooding, issue are another key area for the City to focus efforts on in the coming years. While no significant issues exist, there are several areas throughout the City where localized flooding can be addressed by infrastructure improvements associated with street reconstruction and/or development projects.

The financial goal for this Plan is to fit within the existing funding sources to pay for water resources management activities. Except for the selected items listed below, planning-level estimates of capital expenditures and ongoing program activities have not been made. The primary funding source for Plan activities is the City's Surface Water Management Fund. The Fund is anticipated to be supplemented by special assessments, grant and other available funding on a project specific basis. In consideration of recent municipal budget situations, a renewed focus will be placed on securing grants, enlisting regional watershed funding, seeking local partnerships with adjacent communities and investigating other innovative financing mechanisms. Infrastructure replacements and/or additions will be reviewed, approved and administered in accordance with Shoreview's Capital Improvement Program.

Table 28. Preliminary Cost Estimates for Selected Surface Water Management Activities

Item	Project / Activity	Estimated Cost
Water Quantity Projects		
1	FIRM Revision	$50,000
2	Trunk Storm Sewer Drainage Study	$25,000
	(Marsden Lake areas north of County Rd I)	
3	Capacity of Ponding Available	$10,000
	(Southwest corner of GL-5 area)	
Wetlands Implementation Projects		
4	Wetland Management Plan	$40,000
5	Development Guidelines Affecting Wetlands	$10,000
Erosion Control Projects		
6	Construction Erosion and Sediment Control Ordinance	$5,000
Maintenance & Inspection Implementation		
7	Storm Sewer and BMP Map	$30,000

Except for the activities that are taken from the City NPDES SWPPP, 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 goal of this plan, to accommodate in-fill development and redevelopment in the community while protecting and improving Shoreview's water resources. The Implementation Plan will be reviewed on an annual basis. At that time, each proposed improvement or activity is to be reconsidered, City budgets adjusted, and additional improvement projects or management activities added to or removed from the program.

C. Amendments to the Plan

1. Amendment Procedures

The Surface Water Management Plan is intended to extend approximately through the year 2014. The NPDES SWPPP activities will be reviewed and evaluated annually in a public meeting and the permit program itself will be updated as required by the MPCA NPDES permit program. For the plan to remain dynamic, an avenue must be available to implement new information, ideas, methods, standards, management practices, and any other changes which may affect the intent and/or results of this Plan. Amendment proposals can be requested any time by any person or persons either residing or having business within the City.

2. Request for Amendments

Written requests for plan amendment is 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.

3. Staff Review

Following a request for Plan amendments, staff will make a decision as to the validity of the request. Three options exist:

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

4. Council Consideration

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

5. Public Hearing and Council Approval

This step allows for public input based on public interest. Council shall determine when the public hearing should occur in the process. Based on the Public hearing, Council could approve of the amendments.

6. WMO Approval

All proposed amendments must be reviewed and approved by the appropriate WMOs and WD prior to final adoption of the amendments.

7. Council Adoption

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

D. Annual Report to Council

An annual report will be completed by City staff summarizing water resource management activities that have been completed over each calendar year. To the extent practicable, and to avoid duplication of efforts, the annual report will be coordinated with preparation of the Phase II NPDES program annual report that must be submitted to MPCA by March 10th of each year. The NPDES annual report includes a public notice, meeting and comment process prior to finalizing the annual report. The City will use this annual reporting process to evaluate the storm water program overall. Recommended changes to the Plan will not necessarily require individual amendments, but instead may be considered when the plan is brought up to date.

The Plan will remain in effect through approximately 2014 and should then be reviewed for consistency with current water resources management methods. Staff's intent is to revisit the goals, policies, tools and progress of the Plan on a three to five year basis. Water quality trends will be reviewed, the effectiveness of regulatory programs will be evaluated, and the success of public improvement projects will be assessed. Based on these subsequent reviews, the SWMP will be updated to produce a truly dynamic plan. In addition, NPDES permits issued by MPCA to cities are effective for a maximum term of five years. The original permit for which the City has coverage under is being revised by the MPCA in 2005. Therefore, the City will also be required to revise their SWPPP upon completion of the permit revision by MPCA. The City will also be required to complete updates on at least a five year basis as part of the NPDES program requirements.

APPENDIX A – ACRONYMS, GLOSSARY

Acronyms

BMP	Best Management Practices
BWSR	Minnesota Board of Water and Soil Resources
DNR	Department of Natural Resources
EPA	United States Environmental Protection Agency
EQB	Minnesota Environmental Quality Board
EQC	Environmental Quality Committee
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
SWCD	Soil and Water Conservation District
IMP	Integrated Management Practice
LID	Low Impact Development
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer System
MUSA	Metropolitan Urban Services Area
NPDES	National Pollutant Discharge Elimination System
NURP	Nationwide Urban Runoff Program
SWMP	Surface Water Management Plan
SWPPP	Storm Water Pollution Prevention Program
TP	Total Phosphorus
TSS	Total Suspended Solids
WD	Watershed District
WMO	Water Management Organization

Glossary

100-Year Flood: The flood having a one-percent (1%) chance of being equaled or exceeded in any given year. A 100-year flood is synonymous with Base Flood, Regional or 1% Chance Flood.

Aquatic Bench: A 10- to 15-foot bench around the inside perimeter of a permanent pool that is approximately one-foot deep. Normally vegetated with emergent plants, the bench augments pollutant removal, provides habitat, conceals trash and water level drops, and enhances safety.

BMP (Best Management Practice): A combination of land use, conservation practices, and management techniques, which when applied to a unit of land will result in the opportunity for a reasonable economic return with an acceptable level of water quality or water quantity improvements.

Buffer: The use of land, topography, difference in elevation, space, fences, or landscape planting to screen or partially screen a use or property from the vision of another use or property, and thus reduce undesirable influences such as: sight, noise, dust, and other external effects.

Buffer Strip: An area of vegetated ground cover abutting a wetland that, is intended to sediment or other pollutants from runoff.

Comprehensive Plan: As defined in Minnesota Statutes 394.21, the policies, statements, goals and interrelated plans for private and public land and water use, transportation and community facilities that guide future development (and growth).

Design Storm: A rainfall event of specified size and return frequency that is used to calculate the runoff volume and peak discharge rate to a BMP.

Detention: The temporary storage of runoff from rainfall and snowmelt events to control peak discharge rates and provide an opportunity for physical, chemical and biological treatment to occur.

Development: The construction, installation or alteration of any structure, the extraction, clearing or other alteration of terrestrial or aquatic vegetation, land or the course, current or cross section of any water body or water course or division of land into two (2) or more parcels (source: Burnsville City Code 10-8-2 and 10-4-2). See also re-development, new development, existing development and undeveloped property.

Drawdown: The gradual reduction in water level in a pond BMP due to the combined effect of infiltration and evaporation.

Draining: The removal of surface water or ground water from land.

Drop Structure: Placement of logs with a weir notch across a stream channel. Water flowing through the weir creates a plunge pool downstream of the structure and creates fish habitat.

Easement: A grant of one or more property rights by a property owner for use by the public, a corporation, or another person or entity. Ecologically Harmful Exotic Species: Non-native aquatic plants or wild animals that can naturalize, have high propagation potential, are highly competitive for limiting factors, and cause displacement of, or otherwise threaten, native plants or native animals in their natural communities.

End of Pipe Control: Water quality control technologies suited for the control of existing urban storm water at the point of storm sewer discharge to a stream. Due to typical space constraints, these technologies are usually designed to provide water quality control rather than quantity control.

Erosion: The wearing away of land surface by the action of natural elements.

Exfiltration: The downward movement of runoff through the bottom of an infiltration BMP into the subsoil.

Existing Development: A property or parcel of land that has previously been subject to development, and that is not undeveloped property.

Extended Detention: A storm water design feature that provides for the gradual release of a volume of water (0.25 - 1.0 inches per impervious acre) over a 12 to 48 interval times to increase settling of urban pollutants, and protect channel from frequent flooding.

Extended Detention (ED) Ponds: A conventional ED pond temporarily detains a portion of storm water runoff for up to 24 hours after a storm using a fixed orifice. Such extended detention allows urban pollutants to settle out. The ED ponds are normally "dry" between storm events and do not have any permanent standing water. An enhanced ED pond is designed to prevent clogging and resuspension. It provides greater flexibility in achieving target detention times. It may be equipped with plunge pools near the inlet, a micropool at the outlet, and utilize an adjustable reverse-sloped pipe at the ED control device.

Extended Detention Wetland: A storm water wetland design alternative in which the total treatment volume is equally split between a shallow marsh and temporary detention of runoff above the marsh. After a storm, the normal pool of the shallow marsh may rise by up to two feet. The extra runoff is stored for up to 24 hours to allow pollutants to settle at, before being released downstream.

Flood: A temporary rise in stream flow or stage that results in inundation of the areas adjacent to the channel or water body.

Flood Frequency: The average frequency, statistically determined, for which it is expected that a specific flood stage or discharge may be equaled or exceeded.

Flood Fringe: That portion of the 100-year floodplain outside of the floodway.

Flood Obstruction: Any dam, well, wharf, embankment, levee, dike, pile, abutment, projection, excavation, channel rectification, culvert, building, wire, fence, stockpile, refuse, fill, structure or matter in, along, across or projecting into any channel, watercourse or regulatory flood hazard area which may impede, retard or change the direction of the flow of water, either in itself or by catching or collecting debris carried by such water, or that is placed where the flow of water, either in itself or by catching or collecting debris carried by such water, or that is placed where the flow of water might carry the same downstream to the damage of life or property.

Floodplain: Floodplains are lowland areas adjoining lakes, wetlands, and rivers that are susceptible to inundation of water during a flood. For regulatory purposes, the floodplain is the area covered by the 100-year flood and it is usually divided into districts called the floodway and flood fringe. Areas where floodway and flood fringe have not been determined are called approximate study areas or general floodplain.

Flood Proofing: A combination of structural provisions, changes or adjustments to properties and structures subject to flooding primarily for the reduction or elimination of flood damages to properties, water and sanitary facilities, structures and contents of buildings in a flood hazard area in accordance with the Minnesota State Building Code.

Floodway: The floodway is the channel of a river or other watercourse and the adjacent land areas which must remain open in order to discharge the 100-year flood.

Forebay: An extra storage area provided near an inlet of a pond or BMP to trap incoming sediments, reducing the amount that accumulates in a pond or BMP.

Freeboard: A factor of safety usually expressed in feet above a certain flood level. Freeboard compensates for the many unknown factors (e.g., waves, ice, debris, etc.) that may increase flood levels beyond the calculated level.

General Floodplain Area: The general floodplain area is determined using the best available data, in lieu of performing a detailed engineering study. These data may be from soils mapping, experienced high water profiles, aerial photographs of previous floods, or other appropriate sources. There are no associated published 100-year flood elevations with general floodplain delineations, unlike detailed study areas. General floodplain area is synonymous with approximate study area and unnumbered A-Zone.

Impervious Surface: The portion of the buildable parcel which has a covering which does not permit water to percolate into the natural soil. Impervious surface shall include, but not be limited to, buildings, all driveways and parking areas (whether paved or not), sidewalks, patios, swimming pools, tennis and basketball courts, covered decks, porches, and other structures. Open, uncovered decks are not considered impervious for the purposes of this ordinance. The use of patio blocks, paver bricks or class 5 gravel material are considered impervious surfaces as a majority of water runs-off the surface rather than being absorbed into natural soils underneath.

Infiltration Basin: An impoundment where incoming storm water runoff is stored until it gradually infiltrates into and through the soil of the basin floor.

Infiltration Trench: A conventional infiltration trench is a shallow, excavated trench that has been backfilled with stone to create an underground reservoir. Storm water runoff diverted into the trench gradually exfiltrates from the bottom of the trench into the subsoil and eventually into the water table. An enhanced infiltration trench has an extensive pretreatment system to remove sediment and oil. It requires an on-site geotechnical investigation to determine appropriate design and location.

Infrastructure: Public facilities and services, including transportation, water and sewer, telecommunications, recycling and solid waste disposal, parks and other public spaces, schools, police and fire protection, and health and welfare services.

Integrated Management Practice (IMP): A range of small-scale storm water controls or practices distributed throughout a site and intended to maintain flow patterns, filter pollutants and re-create or maintain existing site hydrology.

Lowest Floor: The lowest floor of a structure, including basement.

Low Impact Development (LID): An approach to storm water management intended to protect water resources, reduce storm sewer infrastructure costs and provide a more attractive storm water management system. LID practices include infiltration systems, bioretention areas, rain barrels, green roofs, porous pavements and a long list of additional innovative storm water treatment practices.

New Development: Development of a property or portion thereof that is currently undeveloped property.

NURP: Nationwide Urban Runoff Program, a study by the U.S. Environmental Protection Agency. A key component of this program was to assess the effectiveness of urban runoff detention/retention basins (e.g., ponds) in removing pollutants from storm water runoff.

Off-Line BMP: A water quality facility designed to treat a portion of storm water (usually 0.5 to 1.0 inches per impervious acre) which has been diverted from a stream or storm drain.

Off-Line Treatment: A BMP system that is located outside of the stream channel or drainage path. A flow diverter is used to divert runoff from the channel and into the BMP for subsequent treatment.

Ordinary High Water Level: The boundary of public waters and wetlands, and shall be an elevation delineating the highest water level which has been maintained for a sufficient period of time to leave evidence upon the landscape, commonly that point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial. For watercourses, the ordinary high water level is the elevation of the top of the bank of the channel. For reservoirs and flowage, the ordinary high water level is the operating elevation of the normal summer pool.

Permanent Pool: A 3- to 10-foot deep pool in a storm water pond system that provides removal of urban pollutants through settling and biological uptake. (Also referred to as a wet pond).

Porous Pavement: An alternative to conventional pavement whereby runoff is diverted through a porous asphalt layer and into an underground stone reservoir. The stored runoff then gradually infiltrates into the subsoil.

Public Waters: Those waters of the state identified as public waters or wetlands under Minnesota Statutes, Section 103G.005.

Reach: A hydraulic engineering term to describe a longitudinal segment of a stream or river influenced by the natural or man-made obstruction. In an urban area, the segment of a stream or river between two (2) consecutive bridge crossings would most typically constitute a reach.

Redevelopment: Any development including but not limited to rebuilding, renovation, revision, remodel, reconstruction or redesign of or at an existing development.

Regional Flood: A flood which is representative of large floods known to have occurred generally in Minnesota and reasonably characteristics of what can be expected to occur on an average frequency in the magnitude of the 100-year recurrence interval. Regional flood is synonymous with the term _base flood" used in the Flood Insurance Study.

Regulatory Flood Protection Elevation (RFPE): The elevation established by local ordinance to which all new floodplain development must be protected against flood damage. At a minimum, this is an elevation no lower than the 100-year flood elevation plus any increase in flood levels resulting from the designation of floodway areas.

Regulatory Flood Protection Elevation: A point not less than one-foot (1') above the water surface profile associated with the 100-year flood as determined by the use of the 100-year flood profile and surrounding technical data in the Flood Insurance Study plus any increase in flood heights attributable to encroachments on the floodplain. It is the elevation to which uses regulated by City ordinance are required to be elevated or flood proofed.

Retention: The permanent storage of runoff from rainfall and snowmelt events with volume reduction coming from infiltration evaporation or emergency release.

Riprap: A combination of large stone, cobbles and boulders used to line channels, stabilize banks, reduce runoff velocities, or filter out sediment.

Runoff (Storm Water): The overland and near surface flow from storm water and snowmelt.

Runoff Conveyance: Methods for safely conveying runoff to a BMP to minimize disruption of the stream network, and promote infiltration or filtering of the runoff.

Runoff Pretreatment: Techniques to capture or trap coarse sediments before they enter a BMP to preserve storage volumes or prevent clogging within the BMP. Examples include forebays and

micropools for pond BMPs, and plunge pools, grass filter strips and filter fabric for infiltration BMPs.

Sand Filter: A relatively new technique for treating storm water, whereby the first flush or runoff is diverted into a self-contained bed of sand. The runoff is then strained through the sand, collected in underground pipes and returned back to the stream or channel.

Sediment Forebay: Storm water design feature that employs the use of a small settling basin to settle out incoming sediments before they are delivered to a storm water BMP. Particularly use full in tandem with infiltration devices, wet ponds or marshes. See also Forebay.

Shoreland: Land located within the following distances from public waters: one thousand feet (1,000') from the ordinary high water level of a lake, pond, or flowage; and three hundred feet (300') from a river or stream, or the landward extent of a floodplain designated by ordinance on a river or stream, whichever is greater. The limits of shoreland may be reduced whenever the waters involved are bounded by topographic divides which extend landward from the waters for lesser distances and when approved by the Commissioner.

Short Circuiting: The passage of runoff through a BMP in less than the theoretical or design treatment time.

Storm Water Treatment: Detention, retention, filtering or infiltration of a given volume of storm water to remove urban pollutants and/or reduce flooding.

Stream Buffer: A variable width strip of vegetated land adjacent to a stream that is preserved from development activity to protect water quality aquatic and terrestrial habitats. See also buffer strip.

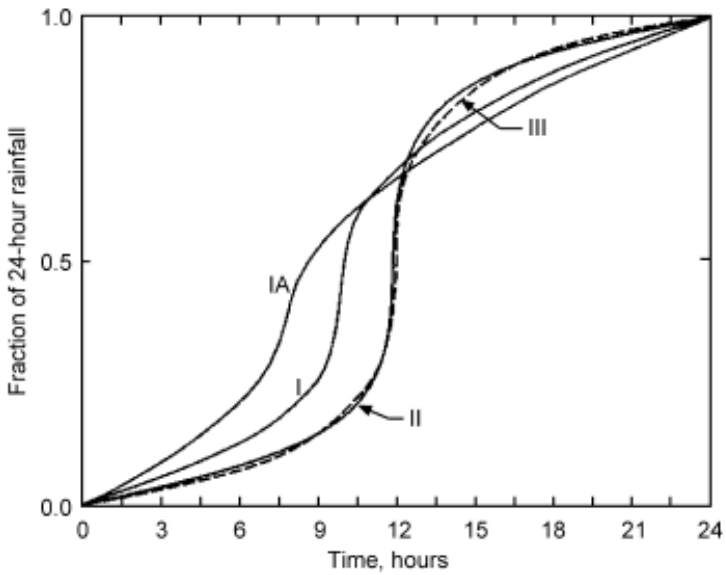
Structure: Anything which is built, constructed or erected; an edifice or building of any kind; or any piece of work artificially built up and/or composed of parts joined together in some definite manner whether temporary or permanent in character. Among other things, structures including but not limited to buildings, gazebos, decks, retaining walls, walls, fences over six feet (6') in height, and swimming pools.

Ten-Day Runoff with Type "C" Distribution (100-Year/10-day runoff): A modeled runoff event that represents snowmelt conditions over a 10-day period for a return period snow depth of 100 years. The runoff event is simulated for a curve number (CN) of 100 which represents frozen soil conditions or where all surfaces are considered impervious. For some drainage basins the ten-day runoff event is the critical event for identifying the high water level of the basin or water body. The Type C distribution is similar in concept to the Type I and II distributions, and for this event, establishes the time distribution of runoff volume over the ten-day period.

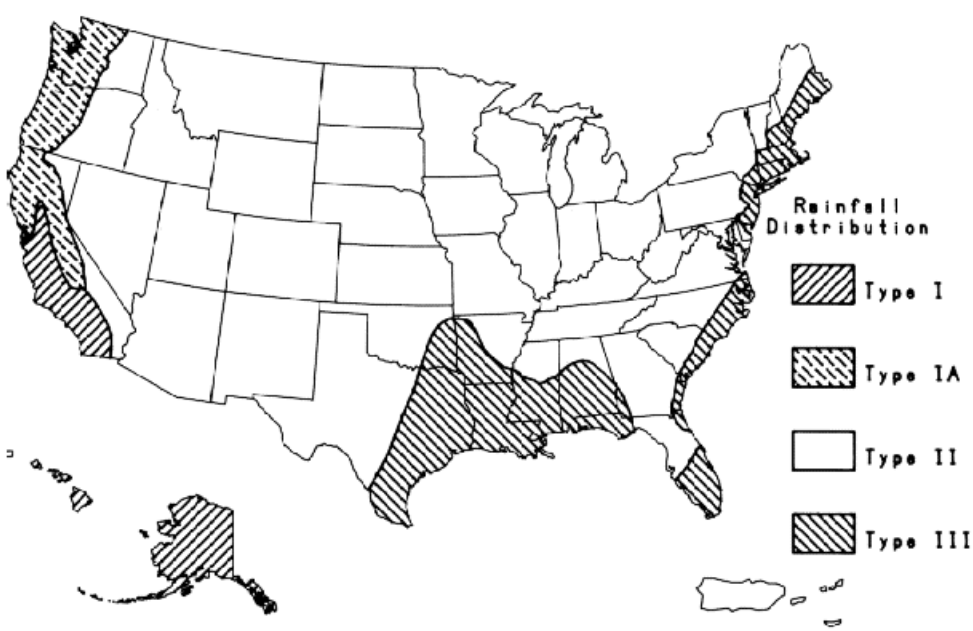
Treatment Volume (Vt): The volume of storm water runoff that is treated within a BMP or IMP storm water wetland. Typically expressed in terms of inches of runoff per impervious acre. In the Washington metropolitan area, the recommended Vt for sizing a storm water wetland is 1.25 inches per impervious acre.

Type I, IA, II and III Storm Distributions - NRCS: These storm types represent the time distribution of a 24-hour rainfall event for areas throughout the United States. The total storm depth is distributed according to the diagram in subpart A. Type II storms are more "flashy" (i.e., convective/thunderstorms) than a Type I or IA storm. Subpart B illustrates that all of Minnesota is within the Type II rainfall distribution area.

A. SCS 24-hour rainfall distributions (SCS, 1986):



B. Approximate geographic boundaries for SCS rainfall distributions (SCS, 1986):



Underdrain: Plastic pipes with holes drilled through the top, installed on the bottom of an infiltration BMP, or sand filter, which are used to collect and remove excess runoff.

Vegetated Filter Strip: A vegetated section of land designed to accept runoff as overland sheet flow from upstream development. It may adopt any natural vegetated form, from grassy meadow to small forest. The dense vegetative cover facilitates pollutant removal. A filter strip cannot treat high velocity flows; therefore, they have generally been recommended for use in agriculture and low-density development. A vegetated filter strip differs from a natural purpose of pollutant removal. A filter strip can also be an enhanced natural buffer, however, whereby the removal capability of the natural buffer is improved through engineering and maintenance activities such as land grading or the installation of a level spreader. A filter strip also differs from a grassed swale in that a swale is a concave vegetated conveyance system, whereas a filter strip has a fairly level surface.

Watershed: The 81 major watershed units delineated by the State of Minnesota Watershed Boundaries 1979 map.

Wetland: Lands transitional between terrestrial and aquatics systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this definition, wetlands must have three (3) of the following attributes:

- A predominance of hydric soils.
- Inundation or saturation by surface or ground water at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions.
- Under normal circumstances, support a prevalence of such vegetation.

Wetlands: Areas inundated or saturated by surface or ground water at a frequency and duration to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for saturated soil conditions. In short, wetlands are areas inundated or saturated for long enough periods of time to result in the development of hydric soils and dominance by hydrophytic (water tolerant) vegetation.

Wetland Mitigation: Regulatory requirement to replace wetland areas destroyed or impacted by proposed land disturbances with artificially created wetland areas.

Wet Pond: A conventional wet pond has a permanent pool of water for treating incoming storm water runoff (see detail cross section in Appendix C).

This page left intentional blank

APPENDIX B - LITERATURE REVIEW, WATER MANAGEMENT AGENCY/ORGANIZATION CONTACTS

Literature Review

1. Adams and Leete 1982. *Shoreview Lakes - Water Quality Status and Trends.*
2. Adams and Leete. February 1984. *1983 Lake Issues Survey*.
3. Banister Eng. December 1962. *Master Plan for Storm Sewers for Roseville, MN*.
4. Barr Engineering Company. September 2001. *GLWMO Watershed Management Plan*.
5. Barr Engineering Company November 1991. *Water Quality Management Alternatives: A report on the Diagnostic-Feasibility Study of Lake Owasso, Lake Wabasso and Snail Lake*.
6. BRW. November 1986. *Evans/Piche/Suzanne Ponds - Drainage Study*.
7. Donohue and Associates, Inc. December 1982. *Watershed Study of Lake Owasso, Grass and Snail Lakes for Ramsey County*.
8. Minnesota Department of Natural Resources. September 2000. *Wetlands Guidance for the Anoka Sand Plain*.
9. Minnesota Pollution Control Agency. March 2000. *Protecting Water Quality in Urban Areas, Best Management Practices for Dealing with Storm Water Runoff from Urban, Suburban and Developing Areas of Minnesota*.
10. Montgomery Watson. June 2000. *Rice Creek Meander Restoration Feasibility Study* (RCWD).
11. Montgomery Watson. July 2000. *Middle Rice Creek Flow Reduction Feasibility Study* (RCWD).
12. Montgomery Watson. August 1994. *RCWD Water Resource Management Plan*.
13. OSM. December 1971. *Village of Shoreview Southern Portion Storm Sewer Study.*
14. Ramsey Soil and Water Conservation District. December 1981. *City of Shoreview Wetland Inventory.*
15. Ramsey Soil and Water Conservation District. 1989. *Ramsey County Erosion and Sediment Control Handbook.*
16. Shoreview, City of. 2003. *City of Shoreview Municipal Code.*
17. Shoreview, City of. December 1982. *Storm Water Management Planning- A Special Report.*
18. Shoreview, City of. July 1996. *Open Space and Park Land Study.*
19. Shoreview, City of. April 2000. *Comprehensive Plan.*

20. Short Elliott Hendrickson Inc. October 1979. *Lakes Judy and Emily Drainage Basin- Storm Sewers Investigation.*

21. Short Elliott Hendrickson Inc. January 1990. *Excerpts from past GLWMO Studies: A supplement to the Operational Manual Lake Level Management Plan for Grass Lake Water Management Organization.*

22. Short Elliott Hendrickson Inc. May 1990. *City of Shoreview Surface Water Management Plan.*

23. Short Elliott Hendrickson Inc. August 1990. *Project Manual for Lake Owasso Outlet Modifications.*

24. Short Elliott Hendrickson Inc., April 1991. *Lake Survey Project for Lady Slipper Park of Lake Owasso and South Bay of Lake Wabasso for Grass Lake Water Management Organization.*

25. Short Elliott Hendrickson Inc. March 1993. *Project Manual for Snail Lake Augmentation-Phase I.*

26. Short Elliott Hendrickson Inc. May 1993. *Project Manual for Snail Lake Augmentation-Phase II.*

27. Short Elliott Hendrickson Inc. October 1993. *Storm Water Quality Monitoring Report for Grass Lake Water Management Organization.*

28. Short Elliott Hendrickson Inc. October 1994. *Snail Lake Status Report for Grass Lake Water Management Organization.*

29. Short Elliott Hendrickson Inc. October 1994. *Lake Owasso Lake Status Report for Grass Lake Water Management Organization.*

30. Short Elliott Hendrickson Inc. October 1994. *Lake Wabasso Lake Status Report for Grass Lake Water Management Organization.*

31. Short Elliott Hendrickson Inc. December 1994. *SWMM Model Calibration/Verification and Diagnostic Study-Lake Response Update.*

32. Short Elliott Hendrickson Inc. January 1995. *Recent Historic Lake Water Quality Trend Analysis and In-Lake Total Phosphorus Goal Setting Report for Grass Lake Water Management Organization.*

33. Short Elliott Hendrickson Inc. April 1995. *Lake Wabasso Lake Management Plan for Grass Lake Water Management Organization.*

34. Short Elliott Hendrickson Inc. April 1995. *Lake Owasso Lake Management Plan for Grass Lake Water Management Organization.*

35. Short Elliott Hendrickson Inc. July 1995. *Lake Management Plans for Owasso, Wabasso and Snail Lakes for Grass Lake Water Management Organization.*

36. Silker, Christine, et al. December 1992. *A Water Resource Assessment of Kerry Lake.*

37. U.S. Environmental Protection Agency. 1983. *Nationwide Urban Runoff Program*.

38. West, Paula and Orning, George. December 2000. *Sustainable Lakes Project: A Lake Management Model for the future.*

Water Management Agency/Organization Contacts

Numerous agencies and organizations in Minnesota have varying authorities and/or interest in surface water management activities relative to the City of Shoreview's Plan. A summary of these agencies and organizations is listed below with a link to their respective website at the time this Plan was created. More detailed information is available on each web page including contacts and key responsibilities relative to surface water management.

Agency/Organization	Website Link
MN Pollution Control Agency	http://www.pca.state.mn.us
MN Department of Natural Resources	http://www.dnr.state.mn.us
Board of Water and Soil Resources	http://www.bwsr.state.mn.us
Shoreview	http://www.ci.shoreview.mn.us
Grass Lake WMO	http://www.glwmo.org
Rice Creek WD	http://www.ricecreekwd.com
Vadnais Lake Area WMO	http://www.vlawmo.org
Ramsey County	http://www.co.ramsey.mn.us
US Army Corps of Engineers	http://www.usace.army.mil
Natural Resources Conservation service	http://www.nrcs.usda.gov

This page left intentional blank

APPENDIX C – DEVELOPMENT GUIDELINES

These development guidelines are intended to be used by developers and/or project proposers in design and layout of their site plans and storm water management features. These guidelines do not replace or supercede City ordinances, watershed district regulations, state and federal rules or permits required for the project. The guidelines have been updated from the original guidelines completed as part of the City's 1990 Surface Water Management Plan.

All plans shall be reviewed and stamped "Approved by the City Engineer" and all applicable permits must be obtained prior to commencing construction. For all newly constructed storm water facilities (ponds, retention areas, infiltration basins, storm sewer, etc.) or existing facilities that are modified, as-built plans shall be prepared by the developer. As-built plans shall be signed and certified by a licensed professional engineer in the State of Minnesota and record drawings shall be provided to the City.

A maintenance agreement may also be required by the City. An example agreement for ponds is provided at the end of this appendix. The agreement may be modified to address a wide range of BMPs (infiltration systems, retention areas, grit chambers, etc.) with the addition of maintenance activities and schedules specific to the selected BMP. Recommended maintenance activities may be found at number of sources including the Stormwater Manager's Research Center website http://www.stormwatercenter.net.

Guidelines summarized in this Plan consist of the following major sections:

- General Elements
- Facility Design Elements
- Erosion and Sediment Control
- Wetland Elements

GENERAL ELEMENTS

A. Hydrologic Analysis

1. Storm distributions and volumes for hydrologic analysis shall be based upon Hershfield, D.M., 1961, Rainfall Frequency Atlas of the United States for Durations of 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years, Technical Publication 40 (TP-40).

2. Design of major facilities (e.g., ponds, detention areas, retention areas) shall be based on the U.S.D.A. NRCS methods, 100-year return period, 24-hour duration, type II distribution with average soil moisture conditions (AMC-2). The analysis of flood levels, storage volumes and discharge rates for detention basins shall utilize the design storm/freeboard evaluation storm concept.

3. Minor drainage systems (storm sewer) shall be analyzed and designed to protect for the 10-year frequency rainfall, and shall be evaluated for the 100-year frequency rainfall. Full pipe flow analysis shall be used unless special conditions can be demonstrated to consider pressure flow.

4. The Rational Method is the accepted design method for the design of minor systems (storm sewer). The preferred method of design would be a method utilizing a hydrograph approach with factors for land use and soil moisture conditions. NRCS methodology is not acceptable for minor system design unless approved by the City Engineer.

5. Available storage volume of landlocked areas shall be established by estimating the water surface elevation resulting from a 100-year/10 day runoff (7.2 inches) with CN=100. For landlocked areas, available freeboard and infiltration capacity of in-place soils should be analyzed (if analyzed for unfrozen soil conditions). When freeboard is unavailable, an annual water balance should be used, considering the 100-year annual runoff and average annual losses from evaporation, transpiration and infiltration.

B. Peak Discharge Rates

1. Peak storm water discharge rates and storage volumes from any drainage area, watershed, subwatershed, detention basin, wetland or conveyor shall be consistent with the values shown in this plan for the 100-year storm event.

2. No increase in peak discharge may result from the proposed project for the 2-year storm, the 10-year storm and the 100-year storm event. Variances *may* be allowed if computations can be provided which demonstrate no adverse downstream effects will result from the proposed system. If the methodology is inconsistent with City standards, and the results are significantly different from the City's, then the City results shall control. Cumulative storm depths for the required events are:

   2-Year = 2.8 inches
   10-Year = 4.2 inches
   100-Year = 5.9 inches

C. General Facility Planning

1. Developments shall maximize preservation and use of natural detention areas and regional detention areas shall be used to the greatest practical extent. Multiple purpose detention areas are encouraged to maximize recreational opportunities (aesthetics) within proposed developments while providing the proper flood control and water quality features.

2. Water level fluctuations (peak elevation and duration) for detention or retention areas shall be minimized so as to prevent the destruction of wildlife habitat.

3. The construction of detention basins will involve the direct participation of individual developers. Where regional basins serve multiple properties and may lie outside of the ownership of the specific development, the City and WMOs will take an active role on implementing policy. Because the basis for the hydrology is based on the developer's grading plan, the developer is required to obtain and submit the certification of a licensed engineer that the detention areas are constructed to the specifications of the approved design.

D. Filling of Low Areas

1. Filling of low areas shall be allowed only to the extent that:
   a. Flood storage volume is maintained or the loss of storage has no net downstream effect.

b. The peak discharge rate causes no adverse downstream effect.
c. The natural condition of the area will not be adversely disturbed.
d. In State designated protected waters and wetlands, a DNR permit is required.
e. U.S. Army Corps of Engineers National Permit Requirements are met.

MAJOR FACILITY DESIGN ELEMENTS

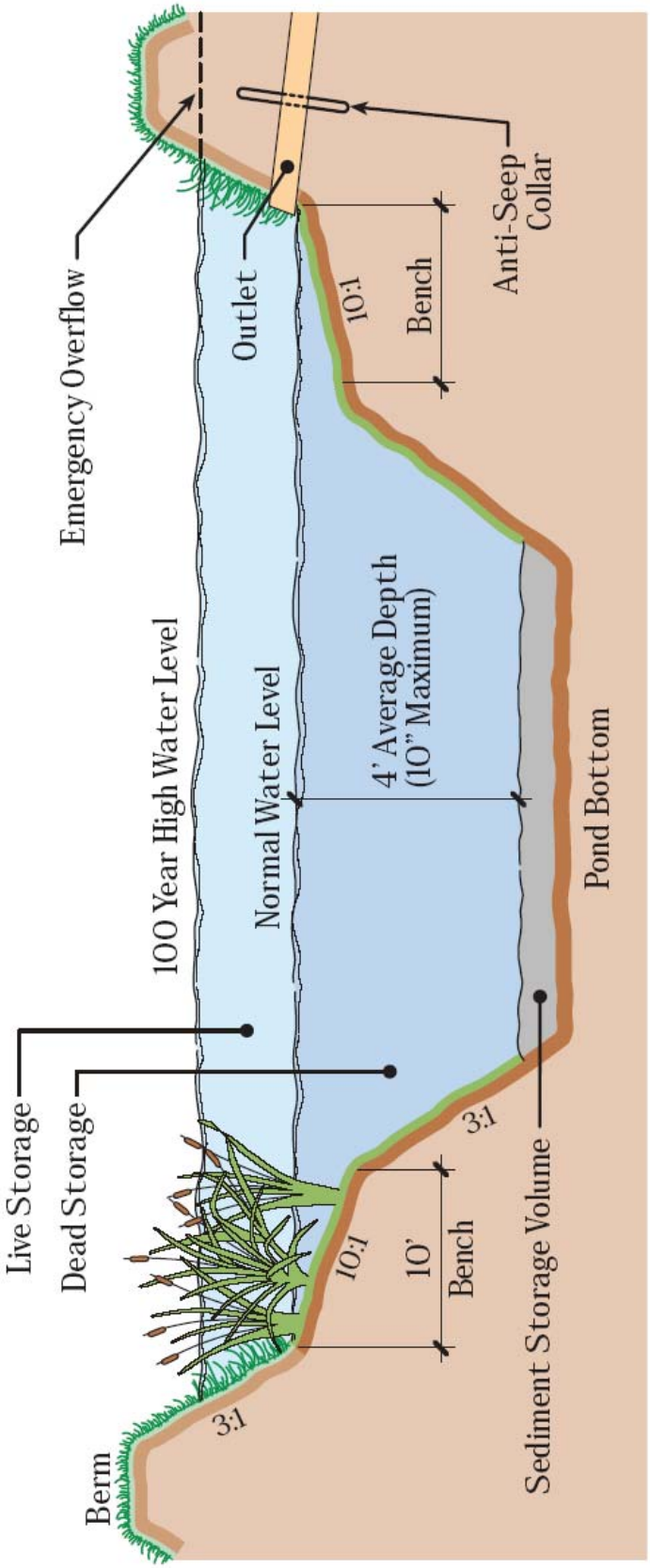
A. Facility Design Criteria

1. For design or modification of storm water facilities, the following criteria shall be followed:
   a. All hydrologic data and computations shall be based on NRCS (formerly SCS) methodology. Computer modeling may be completed using HydroCAD, TR20/TR55, SWMM or comparable City-approved modeling software.
   b. Hydraulic computations shall be completed using the rational method for storm sewer design, or in commonly used software packages including FHWA HY-8, Geopack, Eagle Point or SWMM compatible software.
   c. Water quality modeling shall be completed using the P8 Urban Catchment Model or comparable software.
   d. Outlet structures shall provide peak flow rate controls that limit post-project peak rates to not more than existing peak rates for the 2-year, 10-year and 100-year events.
   e. As required in the MPCA's NPDES construction permit, discharge for the water quality storm (0.5 inches or 1.0 inches depending on the water body designation) should be discharged at no more than 5.66 cfs per acre of pond surface area.
   f. An emergency overflow spillway shall be identified and designed to convey storm flows from events greater than the 100-year event.
   g. 100-year peak discharge rates shall be consistent with those identified in Appendix D.
   h. Maximum 3:1 (H:V) side slopes (see diagram next page).
   i. 10:1 (H:V) safety bench from normal water level (see diagram next page).
   j. For basins intended to have permanent water levels, a minimum of four feet of standing water (dead storage depth) and a maximum of ten feet shall be provided. (see diagram).
   k. Proper allowance shall be made for future access and maintenance.
   l. Separation between the inlet(s) and outlet shall be maximized to prevent short-circuiting.

2. The facility design shall provide adequate live storage to provide protection from the design storm, consistent with minimum building elevation standards in Appendix D of this Plan. Minimum building elevation is defined as the lowest slab elevation for a home or building, including basements and crawl spaces. The minimum building elevation for structures adjacent to wetlands and water bodies shall be the greatest of the following:

   a. An elevation two feet above the design storm (DS) elevation.
   b. An elevation determined from the Freeboard Evaluation storm (FES) event (24-hour rainfall or 100-year/10-day runoff).

   Overflow conditions may also be considered. Where the overflow elevation plus one foot is less than the elevation determined in "a" or "b" above, then the minimum building elevation shall equal the overflow elevation plus one foot.



- Bench areas promote growth of emergent vegetation.
- Maximize distance between the outlet and all inlets to prevent short circuiting of flows.

Shoreview SWMP
Appendix C

Typical Storm Pond Cross Section

SEH

3. Newly constructed or modified detention basins shall provide storage volume below the outlet (dead storage) to allow for water quality treatment in accordance with the following, whichever is most restrictive:
   a. Water quality features meeting the MPCA NPDES construction permit for Permanent Storm Water Management Systems;
   b. Water quality treatment consistent with NURP criteria (90% removal of TSS and 65% removal of TP for a standard NURP particle size distribution); and/or
   c. A permanent pool dead storage volume of at least the runoff from a 2.5 rainfall over the area tributary to the pond. The runoff volume shall be determined by evaluating separate subcatchment areas for the pervious and impervious surfaces.

4. Aeration (mechanical or by vegetation) may be considered for certain water bodies. Wetlands and storm water basins can turn anaerobic on a seasonal basis, which decreases some of the more desirable biological activities and can generate strong odors. Decreased oxygen levels in the water bodies discharge water may have a detrimental affect on the receiving body because many pollutants are resuspended or resolublized under anaerobic conditions.

B. Skimmers and Outlets

1. Skimming devices should be designed to remove oils and floatable materials up to a one-year frequency event. The skimmer should be set four inches below the normal surface water elevation and should control the discharge velocity to 0.5 fps.

2. Outlets shall be evaluated for the need to dissipate energy so as to reduce velocities to permissible levels as allowed by the soil and vegetation. At a minimum, flared end sections should be provided with riprap consistent with Mn/DOT standards. For areas with high flows or where excessive erosion occurs or is anticipated, energy dissipation per Federal Highway Administration standards shall be followed.

3. Riprap shall be provided below the channel grade and above the outfall or channel bottom to insure that riprap will not be undermined by scour or rendered ineffective by displacement. Riprap consisting of natural angular stone suitably graded by weight shall be designed for anticipated velocities. Riprap shall be placed over a suitable filter material or filter fabric to insure that soil particles do not move through the riprap and reduce its stability.

4. For outlets through berms or roadway embankments and all culverts under public traveled streets, anti-seepage collars shall be used. The collars shall be installed so as to increase the creep distance or seepage line along conduit by 15 percent. The locations for the use of collars include:
   a. All water and pond structures with a pool depth of two feet and a two-day duration.
   b. 250 Acre watershed or more.
   c. Design head of 10 feet or more.

EROSION AND SEDIMENT CONTROL

A. Erosion and Sediment Control Plans

1. An erosion and sediment control plan shall be created for any land disturbing activity. Erosion and sediment control elements shall be implemented before any grading can begin. A schedule of significant grading work will be required as part of the erosion and sediment control plan. Projects disturbing 1 acre or more must also comply with all required provisions of the MPCA's NPDES Construction Storm Water Permit.

2. The MPCA's BMP Manual (2000 – or subsequent updates as available) shall be used to develop sediment and erosion control plans. These manuals shall take precedence over sediment and erosion control standards stated herein, except where specific requirements are identified in permits for the project.

3. Site access roads (entrances to construction sites) shall be graded or otherwise protected with silt fences, diversion channels or dikes and pipes to prevent sediment from exiting the site via the access road. Primary site access roads shall be surfaced with crushed rock. The rock entrance shall extend for a distance of 100 feet beginning at existing paved surface. All construction traffic shall utilize the entire length of the rock entrance.

4. Soil tracked from the site by motor vehicles shall be cleaned from paved roadway surfaces daily throughout the duration of construction. Roadway cleaning shall be the responsibility of the party or parties having a building permit with the City.

5. Streambank stabilization and stream bed control structures shall be designed based on the unique site conditions present including soil conditions, flow rate, slope, and flow velocity.

6. Where inadequate natural vegetation exists or where it becomes necessary to remove existing natural vegetation, the following criteria to be used for determining the timing for establishing vegetative cover shall be in accordance with the NPDES construction permit.
   a. A temporary vegetative cover shall consist of a suitable fast growing dense grass seed mix spread at 1.5 times the usual rate per acre with mulch (disc anchored) at a rate of two tons per acre. If temporary cover is to remain in place beyond the present growing season, two-thirds of the seed mix shall be composed of perennial grasses.
   b. A permanent vegetative cover shall consist of sod and/or suitable grass seed mixture or a combination thereof. Seeded areas shall be either mulched or covered by a fibrous blanket to protect seeds and limit erosion.

B. Sediment Basins

1. Detention basins may be used for temporary sediment retention during the construction phase. The design should include providing permanent storage volume for construction and restoration phase sediment accumulation or the removal of the sediment to restore the required permanent pool volume in the detention area.

2. Detention areas intended to permanently trap sediments shall provide excess dead storage beyond the required water quality volume, to allow for sediment accumulation. Sediment

basins shall be capable of removing coarse suspended sediment from storm water for all runoff events and the greatest practical grain size (#40 typically). Sediment storage volume should be estimated by the universal soil loss equation and 0.5 tons per watershed acre per year. Volume below the outlet can be estimated by using the runoff volume resulting from a 2.5" rainfall.

WETLAND ELEMENTS

A. Wetland Alteration

1. Wetland alteration will only be allowed with the approval of and receipt appropriate permits from the City, the water management organization, watershed district, the Department of Natural Resources, and the U.S. Army corps of Engineers. Mitigation efforts shall be determined by the review agencies. For each acre of wetland impacted, two acres of upland must be converted to wetland as the minimum compensatory action.

2. Water level fluctuations (peak elevation and duration) for wetlands shall be limited to two feet and duration not to exceed 48 hours so as to prevent the destruction of wildlife habitat and wetland vegetation.

3. Sedimentation basins or sediment removal devices must be provided prior to discharge into any DNR protected wetland or water.

4. Variable bottom contours should be considered to provide deeper holes and flat shallow benches. This feature will provide habitat for diversity of plants and wetland inhabitants for wetland mitigation sites and storm water basins.

CITY OF SHOREVIEW, MN

MAINTENTANCE AGREEMENT (EXAMPLE)

REGARDING STORM WATER MANAGEMENT PRACTICES: WATER QUALITY TREATMENT POND

I. THIS AGREEMENT made this _____ day of _____, 200__ by and among the City of Shoreview, Minnesota (hereinafter referred to as the "City") and, _____, a _____ [corporation, individual] (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 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 Shoreview, 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.

_____ _____

Date

Title _____

for the City of Shoreview, Minnesota

_____ _____

[Corporation/individual] Date

THIS INSTRUMENT DRAFTED BY _____

This page left intentional blank

APPENDIX D – HYDROLOGIC SYSTEM DATA SUMMARY TABLES

Hydrologic Summary

The tables in this appendix summarize the results of the hydrologic modeling for . In the tables you will also find base information on the subwatersheds and water bodies in the City; such as, DNR Protected Water/Wetland Designation (if applicable), subwatershed's drainage area, curve number and time of concentration. The City Water Body Designation ID corresponds to the subwatershed ID number in the drainage area maps, Figures 12 and 12A.

The remainder of the information in the table is related to the reservoir and results of the modeling hydrologic. Three storm events were modeled to determine the recommended minimum building elevation (MBE):

- Design Storm: 100-year, 24-hour, Type II distribution with normal antecedent moisture conditions (AMC-2)
- Flood Evaluation Storm: 100-year, 24-hour, Type II distribution with antecedent moisture conditions (AMC-3)
- 10-day Runoff: 100-year, 10-day runoff, "C" distribution (NEH-4)

The 1990 recommended MBE is listed along with the 2005 elevations. The recommended MBE is the greater of 2-feet plus the high water elevation from the design storm or the high water elevation from either the Flood Evaluation Storm or 10-day Runoff storm. Proposed development should plan to meet the 2003 minimum building elevations, although the City may consider each individual project on a case-by-case basis.

All survey data was collected on the National Geodetic Vertical Datum of 1929 (NGVD29); however, because it is one of the goals of the FEMA Map Modernization Program to convert all flood maps from the NGVD29 to the North American Vertical Datum of 1988 (NAVD88) all effective BFE's and proposed BFE's were converted to the NAVD88 on the Draft FIRM panels. The elevations found in the HEC-HMS models are on the NGVD29.

The conversion from the NGVD29 to the NAVD88 was done using the NGS VERTCON software. The maximum offset from the average conversion factor, calculated by following the FEMA conversion criteria, is less than 0.25 foot. Because the maximum offset is less than 0.25 foot, a single conversion factor was applied. To convert elevations in feet to the NAVD88, add 0.167 to the NGVD29 elevation and to convert to the local datum (1912), add 0.44 to the NGVD29 value. See the following table for a summary of conversion factors.

Datum	Conversion from NGVD (1929) in feet
NGVD (1929)	+ 0.000
NAVD (1988)	+ 0.167
Local (1912)	+ 0.440

Note that elevations for most lakes and water bodies in Shoreview are listed in County and Minnesota DNR publications according to the local (1912) datum.

APPENDIX E – WATER QUALITY ASSESSMENT DATA TABLES

Water Quality Assessment Summary

A water quality assessment of all subwatersheds throughout the City was completed to evaluate the approximate level of treatment capacity provided in existing ponding areas and water bodies. Results of the assessment are presented in summary tables provided in this Appendix. The Rice Creek Watershed District standard of dead storage volume equal to the volume of runoff generated from a 2.5-inch rainfall over the contributing impervious drainage area was used as the treatment criterion for this evaluation.

Using a dead storage volume of 2.5 inches of runoff is comparable to providing treatment that would remove approximately 65 percent total phosphorus (TP) and 90 percent total suspended solids (TSS). This assumption relates to results reported in the Nationwide Urban Runoff Program (NURP) study completed by the EPA, and assumes a particle size distribution consistent with that reported in the NURP study. Instead of requiring that developers model pollutant removal efficiencies with available computer programs (e.g., the P8 Urban Catchment Model) the 2.5 inch standard is typically a more conservative, yet simplified, approach to sizing treatment capacity in storm ponds.

Two different methodologies were used to calculate dead storage (or treatment) volume provided in each subwatershed depending on the information available. Method 1 used knowledge of the actual dead storage provided in the subwatershed, based on actual pond grading plans or lake information. For lake information, the dead storage volume was calculated by multiplying the surface area of the lake by the mean depth, provided the mean depth information was available.

For basins with an unknown mean depth (or that was not available at the time of this analysis), and estimation approach (Method 2) was used. Method 2 uses the surface area at the Normal Water Level (NWL) and assumptions of depths of 2 feet, 4 feet and 6 feet. The volume of dead storage was calculated for the 2-foot depth by assuming two-thirds of the NWL area multiplied by the estimated depth which corresponds approximately to a basin with 3:1 (H:V) side slopes. A multiplier of one-half was used for the 4 and 6-foot depths in order to achieve a more conservative approximation of the available dead storage, with the assumption that many basins would have a slope flatter than 3:1.

Results of the water quality assessment presented in Appendix E show that, based on the estimated described above, roughly half of the City's individual drainage areas (see Figure 12) have adequate dead storage volume to meet the Rice Creek Watershed District water quality goal (2.5 inches of dead storage for each acre of impervious contributing area). Regional treatment was also included in the assessment, meaning that natural basins were assumed to provide treatment even though they were not designed for this or intended to function as treatment systems. In all cases, this tool will be used primarily by City staff to guide decisions for treatment requirements in the various drainage areas. Data presented in the table should not be

used to justify the elimination of a treatment system for a development or redevelopment project. Instead, all developments will need to comply with the treatment standards described in this Plan and the respected watershed for which the project is located.

The watersheds were ranked from low to high priority for water quality treatment based on the water body classification of the receiving water along with its use, and if they are on the TMDL List of Impaired Waters. Section IV of this Plan discusses the water bodies, their classifications, any significant water quality trends, if known, and more detail on the results of the water quality treatment assessment. In general, the quality of Shoreview's water bodies is promising as most of the subwatersheds currently have adequate treatment capacity. From the results of the assessment, the highest priority watersheds are Turtle Lake, Snail Lake and Island Lake. One of the higher priority activities is to address the direct storm sewer system discharges identified in the Direct Discharge Report information that is provided in Appendix E.

One method the City may use to approach future water quality management decisions is to consider three key factors:

- The priority (or category) of the receiving water;
- The degree of anticipated land use change in terms of impervious surface cover; and
- The existing treatment capacity available (excess or deficit).

This and/or other prioritization methods can be used along with the actions the City has already committed to as part of the MS4 NPDES SWPPP (submitted to the MPCA in March 2003) to guide future water quality-related projects and decisions.

APPENDIX F – FIGURES

APPENDIX G – NPDES PHASE II PROGRAM SUMMARY

Link to NPDES Phase II MS4 Permit (City web page)

Link to NPDES Industrial Permit (City web page)

Link to NPDES Phase II Construction Permit (MPCA web page)

BASIS OF DESIGN
WMO: RICE CREEK WATERSHED DISTRICT
DRAINAGE AREA: COUNTY DITCH 8
BALDWIN LAKE

City Water Body Designation		DNR Protected Water/Wetland Designation	2-year Event		10-year Event		100-year Event	
ID	NAME		Q peak (CFS)	HWL (FEET) (1)	Q peak (CFS)	HWL (FEET) (1)	Q peak (CFS)	HWL (FEET) (1)
PL-1	SHW OAKS-N	-	3.2701	910.147	4.4169	912.027	60.891	913.027
PL-2	SHW OAKS-NW	-	3.5107	896.597	5.8013	897.317	9.3944	899.967
PL-3		-	DIRECT RUNOFF TO POPLAR LAKE					
PL-4E	POPLAR WET.	-	DIRECT RUNOFF TO POPLAR LAKE					
PL-4W		-						
KL-1		-	0.26454	897.837	0.9899	898.167	2.5654	898.687
KL-2		-	0.0037369	896.667	0.060963	896.697	0.34205	896.807
KL-3		-	0.60729	896.037	2.2716	896.737	5.7134	898.307
KL-4	SHERWOOD-N	62-96W	6.1472	894.917	12.333	896.077	45.4	896.667
KL-5	EVERGREEN-S	62-96W	6.1472	894.917	12.333	896.077	45.4	896.667
KL-6	BLWN/EVGRN	62-97W/62-95W	1.1462	889.877	2.3446	890.397	4.2038	891.167
KL-7	BALDWIN-W	62-97W	1.2078	887.027	2.4996	887.417	4.4811	887.967
CD8-1	ROYAL OKS-N	-	0.36122	889.507	0.84224	889.707	1.6556	890.067
CD8-2	LEXINGTON	62-166W	0.52587	889.867	1.263	890.257	2.5258	890.967
CD8-3	ROYAL OKS-S	62-256W	0.60976	887.007	1.2207	887.417	2.1022	888.067
CD8-4	SERENE-E	-	0.09432	891.157	1.249	891.357	4.5303	891.917
CD8-5		-	2.6549	889.897	4.5254	890.277	6.5786	890.667
CD8-6	HEATHR RG-N	-	0.75682	891.067	2.7674	891.877	4.6549	892.687
CD8-7		-	2.4756	887.577	9.3668	888.477	22.697	889.667
CD8-8		-	9.0007	899.527	17.048	900.197	30.514	900.997
CD8-9	WE. PINES-E	-	9.4782	895.557	16.935	896.537	24.499	897.977
CD8-10	WE. PINES-W	-	9.4587	891.297	25.735	892.497	44.155	894.527
CD8-11		-	0.24824	887.457	1.3047	887.837	3.3595	888.667
CD8-12A		-	DIRECT RUNOFF TO CD8-15		DIRECT RUNOFF TO CD8-15		DIRECT RUNOFF TO CD8-15	
CD8-12B								
CD8-13	CHEERYWOOD	-	0.39076	886.997	0.84492	887.197	1.58	887.567
CD8-14		-	DIRECT RUNOFF TO CD8-15		DIRECT RUNOFF TO CD8-15		DIRECT RUNOFF TO CD8-15	
CD8-15	CO DITCH 8	62-256W	13.124	884.817	26.084	885.857	34.085	886.567

(1) All elevations converted to NAVD 88. See Page D-1 for conversion factors to 1912 and 1929 Datum

BASIS OF DESIGN
WMO: RICE CREEK WATERSHED DISTRICT
DRAINAGE AREA: LEXINGTON AVENUE
LAKE JOSHEPHINE, LAKE JOHANNA, VALENTINE LAKE

City Water Body Designation		DNR Protected Water/Wetland Designation	2-year Event		10-year Event		100-year Event	
ID	NAME		Q peak (CFS)	HWL (FEET)	Q peak (CFS)	HWL (FEET)	Q peak (CFS)	HWL (FEET)
IL-7	MCT-W	-	2.3947	964.847	4.9847	965.947	7.0383	967.397
IL-8	ISLAND		0.002666	945.137	0.0048394	945.447	0.0080683	945.867
GR-1	CRYSTAL-E	-	2.882	973.067	6.371	973.637	10.492	974.427
GR-2	CRYSTAL-W	-	5.3505	968.837	10.62	970.477	14.557	972.727
GR-3	GRAMSIE-E	62-218W	2.3375	946.617	3.736	947.077	4.8668	947.277
LLP-1		-	9.3568	945.567	13.359	946.457	15.596	947.197
LLP-2		-	3.4087	941.307	6.0715	941.717	9.3594	942.267
LLP-3		-	DIRECT RUNOFF TO ARDEN HILLS					
LLP-4		-	DIRECT RUNOFF TO ARDEN HILLS					
LLP-5		-	5.6415	983.037	7.5474	984.207	14.083	985.197
LLP-6	ROBERTS-N	-	DIRECT RUNOFF TO LLP-7					
LLP-7	ROBERTS-S	-	4.0088	969.287	5.5515	970.227	6.5867	971.517
LLP-8		-	DIRECT RUNOFF TO ARDEN HILLS					
BD-2	LANGE-E&W	62-193W	2.5433	928.227	5.8168	929.387	9.3957	931.127
BD-5		-	DIRECT RUNOFF TO ARDEN HILLS					
BD-6		-	DIRECT RUNOFF TO ARDEN HILLS					
BD-7		-	DIRECT RUNOFF TO BD-11					
BD-8		-	4.1978	943.077	5.5422	943.687	6.959	944.477
BD-9		-	8.95	933.047	18.081	933.747	30.291	934.577
BD-11	I 694-E&W	-	DIRECT RUNOFF TO ARDEN HILLS					
BD-12		-	DIRECT RUNOFF TO ARDEN HILLS					
RP-1	ST ODILA	-	3.63	945.527	6.9422	946.297	14.473	947.187
RP-2	RICHMOND-E	62-221W	1.9717	933.817	2.8824	934.517	6.4151	935.387
RP-3	RICHMOND-W	62-221W	14.895	933.157	19.619	933.537	27.002	934.127
LJA-1		-	DIRECT RUNOFF TO ARDEN HILLS					
LLJ-1		-	DIRECT RUNOFF TO ROSEVILLE					
LLJ-2		-	DIRECT RUNOFF TO ROSEVILLE					

(1) All elevations converted to NAVD 88. See Page D-1 for conversion factors to 1912 and 1929 Datum

BASIS OF DESIGN
WMO: GRASS LAKE WATERSHED MANAGEMENT ORGANIZATION
DRAINAGE DISTRICT: GRASS LAKE
ALL SUB-DISTRICTS

City Water Body Designation		DNR Protected Water/Wetland Designation	2-year Event		10-year Event		100-year Event	
ID	NAME		Q peak (CFS)	HWL (FEET) (1)	Q peak (CFS)	HWL (FEET) (1)	Q peak (CFS)	HWL (FEET) (1)
CP-1		-						
LJ-1	JUDY	62-81P	1.0554	943.677	4.4117	944.007	8.4454	944.467
LE-1	ARBOGAST-E3	-	0.011833	940.537	0.015902	941.347	0.024788	942.407
LE-2	ARBOGAST-E2	-	0.82987	942.077	1.7277	942.347	3.1815	942.717
LE-3		-	0.19696	932.267	0.94249	932.667	2.4528	933.477
LE-4		-	0.010641	922.297	0.017434	923.657	0.98888	924.657
LE-5	EMILY	62-80W	7.5751	918.547	11.095	919.077	14.103	920.167
LO-10	JOHNSTON	-	DIRECT RUNOFF TO ROSEVILLE SEE LO-11 FOR MIN. BLD. ELEVATION					
LO-11	CHARLIE	-	7.8544	897.447	15.002	898.737	17.335	902.357
LO-12	OWASSO	62-56P	2.7884	886.977	4.929	887.157	13.785	887.467
SV-1	SHOREVIEW	62-79W	1.1706	946.257	2.3133	946.527	3.9852	945.927
LW-1	HARRIET	-	2.4303	935.697	6.7305	936.147	24.36	936.697
LW-2	KROISS	62-136W	12.76	896.287	19.631	897.367	27.496	899.037
LW-3		-	13.043	885.947	20.18	886.547	28.871	887.197
LW-4	WABASSO	62-82P	6.2562	886.017	14.294	886.327	29.63	886.767
LW-5		-	6.2562	886.017	14.294	886.327	29.63	886.797
SL-1	BRENNAN	62-63W	4.4376	894.057	10.75	895.377	16.069	896.867
SL-2	SUMMIT	-	0.20739	902.267	0.41406	902.367	0.73871	902.527
SL-3	PICHE	-	0.99324	886.097	2.0819	887.217	3.5241	889.217
SL-4	EVANS	-	2.2878	888.537	4.9654	890.147	7.4599	893.237
SL-5	WILSON PK-E	-	0.66351	970.237	1.8676	970.717	6.9526	970.867
SL-6	WILSON PK-W	-	1.7367	963.987	3.8769	964.637	38.275	965.277
SL-7	TELEFARM	-	17.619	969.247	18.914	970.107	20.221	970.977
SL-8	WILSON PK-W	-	5.6546	964.677	12.96	965.437	21.961	966.907
SL-9	MILTON-S	-	17.541	958.657	53.087	959.537	101.18	959.667
SL-10	MILTON-C	-	23.186	937.167	45.206	940.797	84.948	945.307
SL-11	PHEASNT H-S	-	43.631	894.227	94.578	894.637	204.25	894.927
SL-12		-	1.1302	920.217	3.6798	920.317	8.4104	920.507
SL-13A			13.089	887.437	31.447	888.507	53.159	890.017
SL-13B			11.972	887.487	27.997	888.767	67.973	890.457
SL-13C	SNAIL	62-73P/62-216W	0.011268	882.417	0.013017	882.767	0.015576	883.267
GL-1	WILLOW-N	62-114W	0.54992	898.737	1.4417	899.657	3.0647	901.337

GL-2	WILLOW-S	-	10.684	897.667	21.407	898.867	33.796	900.347
GL-3		-	4.9738	894.517	11.456	895.117	22.517	896.127
GL-4E	SNAIL LK-E	-	0.0039607	880.957	0.00957	882.077	0.016176	883.407
GL-4W		-	0.0039607	880.957	0.00957	882.077	0.016176	883.407
GL-5	SUZANNE	-	1.1167	873.837	1.1304	875.187	6.7291	875.677
GL-5W			0	876.407	0	877.637	0.0	879.017
GL-7		-	78.881	926.957	120.95	929.847	179.37	932.807
GL-8	STAHL	-	47.5	882.777	70.794	884.677	96.397	887.227
GL-9	GRASS	62-74W	0.0048814	879.657	0.0089307	880.057	4.1577	880.667
VR-1			2.0986	900.577	4.2695	902.107	73.375	902.907

(1) All elevations converted to NAVD 88. See Page D-1 for conversion factors to 1912 and 1929 Datum

BASIS OF DESIGN
WMO: VADNAIS LAKE AREA WATERSHED MANAGEMENT ORGANIZATION
DRAINAGE DISTRICT: CHARLIE LAKE
CHARLIE LAKE

City Water Body Designation		DNR Protected Water/Wetland Designation	2-year Event		10-year Event		100-year Event	
ID	NAME		Q peak (CFS)	HWL (FEET) (1)	Q peak (CFS)	HWL (FEET) (1)	Q peak (CFS)	HWL (FEET) (1)
CL-1		-	3.045	907.187	5.9337	908.147	7.3062	908.987
CL-2	SHR OAKS-C	-	0.045035	905.667	0.29004	905.767	1.0096	906.047
CL-3	SHR OAKS-S	-	3.7404	896.377	7.4434	897.067	10.454	897.817
CL-4		-	DIRECT RUNOFF TO CASEY POND		DIRECT RUNOFF TO CASEY POND		DIRECT RUNOFF TO CASEY POND	
CL-6	HEATHR RG-S	-	0.67223	898.397	2.326	899.437	3.9703	900.687
CL-8	SHERWOOD-S	-	5.5668	896.347	13.287	897.217	27.869	898.167
CL-9		-	DIRECT RUNOFF TO CASEY POND		DIRECT RUNOFF TO CASEY POND		DIRECT RUNOFF TO CASEY POND	
CL-10		-	DIRECT RUNOFF TO CASEY POND		DIRECT RUNOFF TO CASEY POND		DIRECT RUNOFF TO CASEY POND	
CL-11N		-	PART OF CL-11 DRAINING					
CL-11S		-	DIRECTLY TO CHARLIE LAKE					
CL-11			0.52342	902.337	5.8434	903.577	18.226	906.627
SuL-1		-	DRAINS TO SUCKER LAKE					
SuL-2		-	DRAINS TO SUCKER LAKE					
SuL-3		-	DRAINS TO SUCKER LAKE					

(1) All elevations converted to NAVD 88. See Page D-1 for conversion factors to 1912 and 1929 Datum

BASIS OF DESIGN

WMO: RICE CREEK WATERSHED DISTRICT

DRAINAGE AREA: RICE CREEK

MARSDEN LAKE, TURTLE LAKE, UPPER RICE CREEK

ALL ELEVATIONS ARE NGVD (1929) Datum, Refer to page D-1 of Appendix D for conversion factors to 1912 (Local) and 1988 (NAVD) Datums

City Water Body Designation		DNR Protected Water/Wetland	1990 Recommended Minimum Building Elevation	2005 Recommended Minimum Building Elevation	RESERVOIR DATA [1]					DRAINAGE AREA DATA				BASE DATA USED TO DETERMINE MINIMUM BUILDING ELEVATIONS HYDROLOGIC DATA (100-YEAR STORMS)								WETLAND BOUNCE
					NORMAL		DESIGN STORM							RESERVOIR DATA [1]		DESIGN STORM		FLOOD EVAL. STORM		TEN-DAY RUNOFF		
ID	NAME	Designation	(FEET)	(FEET)	Water Level (FEET)	Surface Area (ACRES)	Water Level (FEET)	Surface Area (ACRES)	Storage Volume (AC-FT)	Direct Tributary Area (ACRES)	Direct Tributary Area (SQ MI)	CN	Tc (HRS)	Normal Water Level (FEET)	Overflow Elevation (FEET)	Elevation (FEET)	Q (CFS)	Elevation (FEET)	Q (CFS)	Elevation (FEET)	Q (CFS)	(FEET)
TL-1	MAPLE	-	903.33	903.3	896.0	0.1	901.3	1.4	4.2	27.58	0.0431	65	0.49	896.0	901.3 +	901.3 *	2	901.7	29	901.4	8	
TL-2	SCHIFSKEY	-	895.06	897.0	892.8	0.1	895.0	0.1	0.1	11.46	0.0179	67	0.64	892.8	895.0	895.0 *	16	895.1	36	892.9	3	
TL-3	MERCURY	-	895.94	897.2	892.8	0.2	895.2	0.5	0.5	18.18	0.0284	68	0.49	892.8	895.0 +	895.2 *	50	895.5	99	895.0	16	
TL-4	TURTLE	62-61P	894.53	894.6	892.0	452.0	892.6	456.0	228.0	680.64	1.0635	88	1.80	892.0	896.0	892.6 *	2	892.7	2	892.9	3	0.3
ML-1	PARK PLACE	-	897.34	897.8	895.3	0.4	895.8	0.4	0.1	7.81	0.0122	59	0.82	895.3	899.0	895.8 *	5	896.2	12	895.5	2	
ML-2	STONE	-	893.8	894.1	890.3	0.5	892.1	0.6	0.6	12.16	0.0190	63	0.54	890.3	894.0	892.1 *	7	893.7	14	891.7	5	
ML-3		-	891.06	890.6	887.2	0.7	888.6	4.3	4.4	18.69	0.0292	69	0.99	887.2	890.0	888.6 *	6	889.1	11	888.6	6	
ML-4		TRIB. TO 62-59P	DIRECT TO MARSDEN LAKE	890.6			888.6			32.26	0.0504	80	0.66			888.6 *	20	889.1	32	888.0	13	
ML-5		-	DIRECT TO CD1-7							9.86	0.0154	82	0.76									
ML-6		-	DIRECT TO MARSDEN LAKE	894.1			892.1			41.15	0.0643	55	0.46			892.1 *	24	894.0	92	890.9	11	
ML-7		-	DIRECT TO MARSDEN LAKE							14.27	0.0223	69	0.59									
ML-8		-	DIRECT TO MARSDEN LAKE		0.0					55.36	0.0865	70	1.95									
ML-9		-	895.64	896.4	891.2	0.0	894.4	0.1	0.1	4.29	0.0067	75	0.97	891.2	895.0	894.4 *	5	894.8	7	893.2	1	
ML-10	MARTHA	62-64W	901.15	901.1	898.2	25.1	899.1	30.5	29.9	120.32	0.1880	81	0.90	898.2	899.0 +	899.1 *	13	899.3	33	899.3	25	0.90
ML-11		-	DIRECT RUNOFF TO ML-AHS							6.40	0.0100	72	0.45									
ML-AHS		-	FROM AH VIA LEXINGTON PONDS							46.75	0.0730	71	0.34			836.3	10	937.5 *	11	935.4	9	
ML-13	MARSDEN PD	62-59P	894.75	893.8	889.7	0.2	891.8	11.3	18.2	71.49	0.1117	86	0.61	889.7	896.0	891.8 *	16	892.5	23	892.4	21	2.15
ML-AHN		-	FROM AH VIA MARSDEN LK							972.80	1.5200	80	2.20			888.6 *	322	888.9	576	888.5	285	
KAL-1	BARTLETT-N	-	959.15	959.3	956.2	0.2	957.3	0.3	0.3	2.94	0.0046	79	0.52	956.2	960.0	957.3 *	4	957.7	5	956.4	1	
KAL-2	BARTLETT-S	-	958.87	958.8	955.3	1.7	956.8	1.9	3.0	16.19	0.0253	78	0.20	955.3	963.0	956.8 *	7	957.4	10	956.1	4	
KAL-3		-	DIRECT RUNOFF TO ML-AHN							2.82	0.0044	86	0.10									
CD1-1		62-257W	893.62	893.9	891.1	9.5	891.9	23.5	11.9	65.60	0.1025	82	0.51	891.1	892.5	891.9 *	4	892.1	5	891.8	4	0.85
CD1-2	SERENE-W	-	DIRECT RUNOFF TO CD1-3							25.02	0.0391	60	0.65			894.6 *	8	895.4	43	894.1	6	
CD1-3		62-257W	894.54	894.7	891.3	9.0	892.7	13.4	14.6	26.50	0.0414	86	0.61	891.3	894.5	892.7 *	1	893.1	2	893.7	4	1.40
CD1-4		62-257W	DIRECT RUNOFF TO CD1-5							4.67	0.0073	61	0.70			890.3	0	891.9	0	892.7 *	0	
CD1-5		62-257W	892.48	892.5	889.5	2.2	890.5	4.3	3.9	30.02	0.0469	66	0.82	889.5	893.0	890.5 *	3	891.0	6	890.6	4	1.00
CD1-6		62-257W	890.99	891.1	887.5	0.5	889.1	9.2	7.3	47.68	0.0745	81	0.96	887.5	892.0	889.1 *	18	889.4	30	889.0	13	1.60
CD1-7		-	890.12	890.2	883.8	0.1	888.2	9.3	18.0	25.28	0.0395	90	0.40	883.8	887.3 +	888.2 *	341	888.5	608	888.1	301	
CD1-8	WILLOW CK-W	-	893.75	893.5	889.5	0.3	891.5	1.6	2.0	21.25	0.0332	64	0.51	889.5	898.0	891.5 *	7	892.5	8	890.9	5	
CD1-9	WILLOW CK-E	-	892.92	892.7	888.0	0.1	890.7	0.6	0.9	2.82	0.0044	82	0.23	888.0	892.0	890.7 *	6	891.7	8	890.1	5	
CD1-10	HAMLINE-C	62-167W	893.52	893.7	891.2	7.2	891.7	7.4	2.2	19.52	0.0305	76	0.39	891.2	893.0	891.7 *	2	891.9	2	891.6	2	0.50
CD1-11	HAMLINE-S	-	892.42	892.1	889.1	1.6	890.1	3.5	3.7	15.81	0.0247	65	0.28	889.1	892.0	890.1 *	2	890.6	3	890.3	3	
CD1-12	SHAMROCK	-	894.26	894.8	891.3	0.8	892.8	1.0	1.0	30.98	0.0484	51	0.81	891.3	897.0	892.8 *	2	894.7	3	894.3	3	
CD1-13	NORTH POINT	-	896.29	894.2	887.0	0.7	890.5	1.4	5.1	57.15	0.0893	59	0.78	887.0	900.0	890.5	9	894.2 *	12	891.5	10	
CD1-14		-	COMBINED WITH CD1-4							5.89	0.0092	53	0.54			893.0 *	0	894.3	0	894.7	0	
CD1-15A	HAMLINE-N	-	892.25	892.9	888.0	0.0	890.9	0.8	1.1	12.16	0.0190	65	0.43	888.0	892.0	890.9 *	9	892.0	13	890.8	7	
CD1-15B		-			0.0					4.29	0.0067	58	0.25									
CD1-16		-	888.71	889.0	886.6	4.3	887.0	4.3	0.5	17.92	0.0280	71	0.43	886.6	890.0	887.0 *	7	887.3	9	886.8	4	
CD1-17	CO. DITCH 1	PROT. WTRCRS.	889.53	889.4	880.7	1.0	887.4	39.0	101.5	94.59	0.1478	72	1.86	880.7	886.5 +	887.4 *	292	887.7	612	887.5	332	
CD1-18		-	884.66	885.5	882.0	0.2	883.5	0.4	0.3	7.42	0.0116	62	0.40	882.0	886.0	883.5 *	0	884.2	0	884.4	1	
RC-1	CHRYWD II-E	-	886.65	886.8	884.1	11.5	884.8	12.3	7.6	41.47	0.0648	74	0.50	884.1	888.0	884.8 *	2	885.1	3	884.9	2	
RC-2		-	COMBINED WITH RC-3																			
RC-3	CHRYWD II-W	-	885.15	885.0	882.0	11.8	883.0	14.1	16.4	86.72	0.1355	66	0.50	882.0	885.0	883.0 *	5	883.7	8	883.5	8	
RC-4	RICE CREEK	PROT. WTRCRS.	DIRECT RUNOFF TO RICE CREEK							27.78	0.0434	69	0.69									
RC-5		-	DIRECT RUNOFF TO RC-6	ELIMINATED																		
RC-6		PROT. WTRCRS.	DIRECT RUNOFF TO RICE CREEK							32.26	0.0504	76	0.78									
RC-8	SNELLING	-	DIRECT RUNOFF TO RICE CREEK							67.39	0.1053	61	1.67									
RC-9	SNELLING	-	DIRECT RUNOFF TO RICE CREEK							27.33	0.0427	63	0.91									
RC-10		-	DIRECT RUNOFF TO RICE CREEK							93.50	0.1461	62	2.07									
RC-11		-	COMBINED WITH RC-13	908.0	902.0	1.2	906.0	2.3	7.4	36.54	0.0571	85	0.33	902.0	906.0	906.0 *	13	906.1	100	903.9	7	
RC-12E		-	COMBINED WITH RC-13	907.9	903.6	0.6	905.9	0.8	1.6	9.98	0.0156	81	0.25	903.6	910.0	905.9 *	5	906.6	6	904.6	2	
RDC-12W		-		0.0	0.0					53.82	0.0841	84	0.58									
RC-13		-	DESIGN FOR FUTURE DISCHARGE AND VOLUME ONLY	892.2	884.0	0.4	890.2	0.7	3.5	117.82	0.1841	82	0.75	884.0	894.0	890.2 *	47	892.1	52	889.6	39	
RC-14	RICE CREEK	PROT. WTRCRS.	DIRECT RUNOFF TO RICE CREEK							307.00	0.4797	65	1.69									

ALL ELEVATIONS ARE ON NGVD29 (1929 Datum, Refer to page D-1 of Appendix D for conversion factors to 1912 (Local) and 1988 (NAVD) datums

* VALUE CONTROLING MINIMUM BUILDING ELEVATION - (CRITERIA: GREATER OF THE DESIGN STORM +2.0 FT, FLOOD EVALUATION STORM, OR 10-DAY RUNOFF) REV. 9/89

\+ OVERFLOW OPERATING FOR DESIGN EVENT REV. 4/03

1 RESERVOIR DATA IS FROM 1990 SWMP, EXCEPT DESIGN STORM WATER LEVEL IS FROM 2005 MODEL

AND CITY DESIGNATION RC-11, RC-12E, AND RC-13 WHICH INCLUDE INFORMATION FROM NEW PONDS.

BASIS OF DESIGN

WMO: RICE CREEK WATERSHED DISTRICT

DRAINAGE AREA: COUNTY DITCH 8

BALDWIN LAKE

ALL ELEVATIONS ARE NGVD (1929) Datum, Refer to page D-1 of Appendix D for conversion factors to 1912 (Local) and 1988 (NAVD) Datums

City Water Body Designation		DNR Protected Water/Wetland	1990 Recommended Minimum Building Elevation	2005 Recommended Minimum Building Elevation	RESERVOIR DATA [1] NORMAL		RESERVOIR DATA [1] DESIGN STORM			DRAINAGE AREA DATA				BASE DATA USED TO DETERMINE MINIMUM BUILDING ELEVATIONS HYDROLOGIC DATA (100-YEAR STORMS) RESERVOIR DATA [1]		DESIGN STORM		FLOOD EVAL. STORM		TEN-DAY RUNOFF		WETLAND BOUNCE
ID	NAME	Designation	(FEET)	(FEET)	Water Level (FEET)	Surface Area (ACRES)	Water Level (FEET)	Surface Area (ACRES)	Storage Volume (AC-FT)	Direct Tributary Area (ACRES)	Direct Tributary Area (SQ MI)	CN	Tc (HRS)	Normal Water Level (FEET)	Overflow Elevation (FEET)	Elevation (FEET)	Q (CFS)	Elevation (FEET)	Q (CFS)	Elevation (FEET)	Q (CFS)	(FEET)
PL-1	SHW OAKS-N	-	910.34	914.9	908.0	0.7	912.9	0.7	2.1	3.52	0.0055	76	0.26	908.0	912.5 +	912.86 *	1	909.0	2	908.4	1	
PL-2	SHW OAKS-NW	-	899.07	901.8	895.2	0.3	899.8	1.2	1.8	23.30	0.0364	68	0.99	895.2	900.0	899.8 *	7	898.9	8	897.0	6	
PL-3		-	DIRECT TO POPLAR LAKE							13.44	0.0210	77	1.37									
PL-4E	POPLAR WET.	-	DIRECT TO POPLAR LAKE							162.05	0.2532	70	1.00									
PL-4W		-								25.34	0.0396	64	0.75									
KL-1		-	900.48	900.5	897.6	0.4	898.5	0.5	0.4	7.68	0.0120	61	0.90	897.6	903.0	898.52 *	3	899.5	5	898.3	2	
KL-2		-	898.94	898.6	896.5	0.1	896.6	0.1	0.1	1.02	0.0016	48	0.65	896.5	901.0	896.64 *	0	897.0	1	896.6	0	
KL-3		-	901.54	901.4	895.7	0.4	898.1	0.7	1.9	18.18	0.0284	59	0.76	895.7	901.0	898.14	6	901.4 *	9	898.1	6	
KL-4	SHERWOOD-N	62-96W	DIRECT RUNOFF TO KL-5				896.5			21.31	0.0333	67	0.97			896.5 *						
KL-5	EVERGREEN-S	62-96W	898.3	898.5	893.5	0.0	896.5	5.5	7.0	30.21	0.0472	80	0.73	893.5	896.5	896.5 *	45	896.6	123	896.2	13	3.00
KL-6	BLWN/EVGRN	62-97W/62-95W	892.97	893.0	889.2	25.0	891.0	29.0	47.1	148.10	0.2314	75	0.98	889.2	894.0	891 *	4	891.8	6	892.0	6	1.80
KL-7	BALDWIN-W	62-97W	889.76	889.8	886.5	0.3	887.8	0.6	0.8	9.28	0.0145	66	0.47	886.5	896.0	887.8 *	4	889.2	6	889.5	7	1.30
CD8-1	ROYAL OKS-N	-	891.79	891.9	889.2	7.3	889.9	7.8	5.0	30.08	0.0470	69	0.64	889.2	892.5	889.9 *	2	890.2	3	890.1	2	
CD8-2	LEXINGTON	62-166W	892.73	892.8	889.4	8.0	890.8	9.7	12.4	70.66	0.1104	68	1.02	889.4	897.0	890.8 *	3	891.6	4	891.4	3	1.38
CD8-3	ROYAL OKS-S	62-256W	890.03	889.9	886.5	7.5	887.9	17.1	18.5	62.98	0.0984	73	0.58	886.5	890.0	887.9 *	2	888.4	3	889.4	4	1.40
CD8-4	SERENE-E	-	894.12	893.8	890.8	0.8	891.8	2.3	2.1	17.15	0.0268	64	0.48	890.8	895.1	891.75 *	5	892.4	12	891.7	4	
CD8-5		-	892.48	892.5	889.2	0.5	890.5	3.3	4.1	16.83	0.0263	82	1.46	889.2	892.0	890.5 *	7	891.0	9	890.2	5	
CD8-6	HEATHR RG-N	-	894.78	894.5	890.6	0.0	892.5	2.6	3.4	32.51	0.0508	60	1.54	890.6	894.5	892.52 *	5	893.5	6	892.6	5	
CD8-7		-	890.79	891.5	887.0	0.1	889.5	0.3	0.5	20.48	0.0320	61	0.50	887.0	895.4	889.5 *	23	890.7	35	888.9	16	
CD8-8		-	DIRECT RUNOFF TO CD8-9	902.8	898.0	0.1	900.8	0.4	0.6	9.22	0.0144	83	0.30	898.0	902.0	900.83 *	31	900.9	49	898.7	3	
CD8-9	WE. PINES-E	-	899.01	899.8	893.9	0.0	897.8	0.3	0.5	7.50	0.0117	73	0.18	893.9	899.0	897.81 *	24	899.0	30	894.7	5	
CD8-10	WE. PINES-W	-	895.31	896.4	890.0	0.5	894.4	0.7	1.8	37.80	0.0591	65	0.84	890.0	895.0	894.36 *	44	895.2	115	891.5	15	
CD8-11		-	890.74	890.5	887.2	0.1	888.5	0.2	0.3	6.66	0.0104	58	0.79	887.2	890.0	888.5 *	3	890.0	8	887.9	2	
CD8-12A		-	DIRECT RUNOFF TO CD8-15							13.51	0.0211	68	0.54									
CD8-12B										9.15	0.0143	61	0.54									
CD8-13	CHEERYWOOD	-	888.88	889.4	886.7	0.4	887.4	0.4	0.1	4.54	0.0071	77	0.30	886.7	889.7	887.4 *	2	887.7	2	887.0	1	
CD8-14		-	DIRECT RUNOFF TO CD8-15							4.60	0.0072	40	1.06									
CD8-15	CO DITCH 8	62-256W	888.28	888.4	882.9	0.0	886.4	64.5	81.1	368.00	0.5750	72	1.21	882.9	888.5	886.4 *	34	886.9	39	886.6	36	3.47

ALL ELEVATIONS ARE ON NGVD29 (1929 Datum, Refer to page D-1 of Appendix D for conversion factors to 1912 (Local) and 1988 (NAVD) datums

* VALUE CONTROLING MINIMUM BUILDING ELEVATION - (CRITERIA: GREATER OF THE DESIGN STORM +2.0 FT, FLOOD EVALUATION STORM, OR 10-DAY RUNOFF) REV. 9/89

\+ OVERFLOW OPERATING FOR DESIGN EVENT REV. 4/03

1 RESERVOIR DATA IS FROM 1990 SWMP, EXCEPT DESIGN STORM WATER LEVEL IS FROM 2003 MODEL. REV. 8/03

PL-4 FROM THE 1990 SWMP WAS DIVIDED INTO PL-4E AND PL-4W, AND CD8-12 WAS DIVIDED INTO CD8-12A AND CD8-12B.

BASIS OF DESIGN

WMO: RICE CREEK WATERSHED DISTRICT

DRAINAGE AREA: LEXINGTON AVENUE

LAKE JOSHEPHINE, LAKE JOHANNA, VALENTINE LAKE

ALL ELEVATIONS ARE NGVD (1929) Datum, Refer to page D-1 of Appendix D for conversion factors to 1912 (Local) and 1988 (NAVD) Datums

City Water Body Designation		DNR Protected Water/Wetland	1990 Recommended Minimum Building Elevation	2005 Recommended Minimum Building Elevation	RESERVOIR DATA [1]					DRAINAGE AREA DATA				BASE DATA USED TO DETERMINE MINIMUM BUILDING ELEVATIONS HYDROLOGIC DATA (100-YEAR STORMS)								WETLAND BOUNCE
					NORMAL		DESIGN STORM							RESERVOIR DATA [1]		DESIGN STORM		FLOOD EVAL. STORM		TEN-DAY RUNOFF		
					Water Level	Surface Area	Water Level	Surface Area	Storage Volume	Direct Tributary Area		CN	Tc	Normal Water Level	Overflow Elevation	Elevation	Q	Elevation	Q	Elevation	Q	
ID	NAME	Designation	(FEET)	(FEET)	(FEET)	(ACRES)	(FEET)	(ACRES)	(AC-FT)	(ACRES)	(SQ MI)		(HRS)	(FEET)	(FEET)	(FEET)	(CFS)	(FEET)	(CFS)	(FEET)	(CFS)	(FEET)
IL-7	MCT-W	-	969.20	969.2	963.5	0.2	967.2	0.3	1.1	6.21	0.0097	91	0.66	963.5	968.0	967.2 *	7	967.7	8	964.4	2	
IL-8	ISLAND		947.57	947.7	944.6	53.9	945.7	41.6	56.1	180.60	0.2822	84	0.94	944.6	947.0	945.7 *	0	946.0	0	946.8	0	
GR-1	CRYSTAL-E	-	975.74	976.3	972.0	0.2	974.3	0.3	0.4	6.66	0.0104	81	0.55	972.0	975.0	974.3 *	10	974.9	12	972.6	2	
GR-2	CRYSTAL-W	-	973.93	974.6	967.0	0.5	972.6	1.0	3.5	24.83	0.0388	79	0.30	967.0	973.0	972.6 *	15	973.1	56	969.3	8	
GR-3	GRAMSIE-E	62-218W	949.09	949.1	945.8	4.3	947.1	65.0	14.0	39.68	0.0620	78	1.09	945.8	949.0	947.1 *	5	947.2	5	947.0	4	1.3
LLP-1		-	948.34	949.0	943.2	0.0	947.0	1.4	2.2	18.94	0.0296	92	0.20	943.2	949.0	947.0 *	16	947.3	16	945.2	8	
LLP-2		-	943.55	944.1	940.2	0.3	942.1	0.5	0.6	6.14	0.0096	92	0.69	940.2	944.0	942.1 *	9	942.2	10	940.7	2	
LLP-3		-	DIRECT RUNOFF TO ARDEN HILLS							26.50	0.0414	92	0.56									
LLP-4		-	DIRECT RUNOFF TO ARDEN HILLS							12.35	0.0193	93	0.52									
LLP-5		-	986.31	987.0	980.2	0.1	985.0	0.7	1.6	13.57	0.0212	92	0.61	980.2	985.0 +	985.0 *	14	985.1	21	981.8	4	
LLP-6	ROBERTS-N	-	DIRECT RUNOFF TO LLP-7							6.91	0.0108	79	0.20									
LLP-7	ROBERTS-S	-	973.45	973.4	968.0	1.7	971.4	3.9	8.5	20.74	0.0324	79	0.52	968.0	972.6	971.4 *	7	972.2	7	969.9	5	
LLP-8		-	DIRECT RUNOFF TO ARDEN HILLS							17.73	0.0277	86	0.96									
BD-2	LANGE-E&W	62-193W	932.2	933.0	927.2	0.3	931.0	1.2	2.7	34.24	0.0535	74	1.56	927.2	933.4	931.0 *	9	932.3	11	929.5	7	3.81
BD-5		-	DIRECT RUNOFF TO ARDEN HILLS							33.80	0.0528	77	0.73									
BD-6		-	DIRECT RUNOFF TO ARDEN HILLS							20.03	0.0313	91	0.30									
BD-7		-	DIRECT RUNOFF TO BD-11							21.10	0.0330	63	0.50									
BD-8		-	945.61	946.3	941.6	0.2	944.3	0.4	0.7	5.82	0.0091	92	0.20	941.6	945.0	944.3 *	7	944.5	7	942.2	2	
BD-9		-	935.53	936.4	931.9	1.0	934.4	0.2	2.4	19.65	0.0307	91	0.62	931.9	940.0	934.4 *	30	934.6	34	932.6	6	
BD-11	I 694-E&W	-	DIRECT RUNOFF TO ARDEN HILLS							24.00	0.0375	90	2.00									
BD-12		-	DIRECT RUNOFF TO ARDEN HILLS							0.90	0.0014	92	0.10									
RP-1	ST ODILA	-	947.07	949.0	944.2	0.6	947.0	0.9	0.8	14.65	0.0229	89	0.53	944.2	947.0 +	947.0 *	14	947.1	31	945.3	3	
RP-2	RICHMOND-E	62-221W	936.45	937.2	932.6	0.4	935.2	7.2	7.6	42.94	0.0671	75	0.87	932.6	935.2	935.2 *	6	935.3	20	934.9	3	2.65
RP-3	RICHMOND-W	62-221W	935.37	936.0	931.0	0.0	934.0	5.9	4.0	52.22	0.0816	85	1.45	931.0	935.8	934.0 *	27	934.3	31	933.0	15	2.92
LJA-1		-	DIRECT RUNOFF TO ARDEN HILLS							57.09	0.0892	78	0.63									
LLJ-1		-	DIRECT RUNOFF TO ROSEVILLE							47.50	0.0742	76	0.81									
LLJ-2		-	DIRECT RUNOFF TO ROSEVILLE							2.37	0.0037	72	0.28									

ALL ELEVATIONS ARE ON NGVD29 (1929 Datum, Refer to page D-1 of Appendix D for conversion factors to 1912 (Local) and 1988 (NAVD) datums

* VALUE CONTROLING MINIMUM BUILDING ELEVATION - (CRITERIA: GREATER OF THE DESIGN STORM +2.0 FT, FLOOD EVALUATION STORM, OR 10-DAY RUNOFF) REV. 1/89

\+ OVERFLOW OPERATING FOR DESIGN EVENT REV. 4/90

1 RESERVOIR DATA IS FROM 1990 SWMP, EXCEPT DESIGN STORM WATER LEVEL IS FROM 2003 MODEL. REV. 4/03

BASIS OF DESIGN

WMO: GRASS LAKE WATERSHED MANAGEMENT ORGANIZATION

DRAINAGE DISTRICT: GRASS LAKE

ALL SUB-DISTRICTS

ALL ELEVATIONS ARE NGVD (1929) Datum, Refer to page D-1 of Appendix D for conversion factors to 1912 (Local) and 1988 (NAVD) Datums

City Water Body Designation		DNR Protected Water/Wetland	1990 Recommended Minimum Building Elevation	2005 Recommended Minimum Building Elevation	RESERVOIR DATA [1]					DRAINAGE AREA DATA				BASE DATA USED TO DETERMINE MINIMUM BUILDING ELEVATIONS HYDROLOGIC DATA (100-YEAR STORMS)								WETLAND BOUNCE
					NORMAL		DESIGN STORM							RESERVOIR DATA [1]		DESIGN STORM		FLOOD EVAL. STORM		TEN-DAY RUNOFF		
					Water Level	Surface Area	Water Level	Surface Area	Storage Volume	Direct Tributary Area		CN	Tc	Normal Water Level	Overflow Elevation	Elevation	Q	Elevation	Q	Elevation	Q	
ID	NAME	Designation		(FEET)	(FEET)	(ACRES)	(FEET)	(ACRES)	(AC-FT)	(ACRES)	(SQ MI)		(HRS)	(FEET)	(FEET)	(FEET)	(CFS)	(FEET)	(CFS)	(FEET)	(CFS)	(FEET)
CP-1		-	TOTAL RUNOFF CONTRIBUTION FROM ROSEVILLE VIA CENTRAL PARK	TOTAL RUNOFF CONTRIBUTION FROM ROSEVILLE VIA CENTRAL PARK						1617.00	2.5266	75	0.90									
LJ-1	JUDY	62-81P	946.3	946.3	943.3	15.5	944.3	18.3	24.7	108.61	0.1697	79	0.80	943.3	947.0	944.3 *	8	944.7	11	944.4	9	1.05
LE-1	ARBOGAST-E3	-	944.4	944.2	938.2	0.0	942.2	0.4	0.6	1.92	0.0030	70	0.51	938.2	945.4	942.2 *	0	942.6	0	942.6	0	
LE-2	ARBOGAST-E2	-	944.3	944.6	941.6	0.4	942.6	1.2	0.5	8.70	0.0136	74	1.49	941.6	944.5	942.6 *	3	942.9	5	942.2	2	
LE-3		-	934.9	935.3	930.7	0.0	933.3	0.2	0.2	3.90	0.0061	65	0.52	930.7	936.7	933.3 *	2	934.2	4	932.6	1	
LE-4		-	926.4	926.5	920.9	0.3	924.5	0.7	1.8	7.81	0.0122	69	0.45	920.9	928.4	924.5 *	1	925.4	3	925.1	2	
LE-5	EMILY	62-80W	921.8	922.0	918.0	14.0	920.0	15.0	28.0	114.56	0.1790	78	1.02	918.0	928.0	920.0 *	14	920.9	16	919.9	14	0.91
LO-10	JOHNSTON	-	DIRECT RUNOFF TO ROSEVILLE SEE LO-11 FOR MIN. BLD.	DIRECT RUNOFF TO ROSEVILLE SEE LO-11 FOR MIN. BLD. ELEVATION						49.09	0.0767	72	0.72									
LO-11	CHARLIE	-	904.9	905.2	894.0	1.9	902.2	4.9	25.0	114.60	0.1791	70	0.40	894.0	900.0 +	902.2	17	905.2 *	22	902.8	18	
LO-12	OWASSO	62-56P	889.7	889.3	886.6	393.0	887.3	625.0	600.0	956.22	1.4941	84	0.58	886.6		887.3 *	14	887.5	21	888.6	44	0.70
SV-1	SHOREVIEW	62-79W	948.6	948.8	945.7	9.7	946.8	10.4	8.0	35.90	0.0561	88	0.48	945.7	949.0	946.8 *	4	946.0	5	946.5	3	0.06
LW-1	HARRIET	-	938.5	938.5	935.2	1.1	936.5	1.6	1.8	17.98	0.0281	73	0.48	935.2	936.5 +	936.5 *	24	936.6	66	936.0	7	
LW-2	KROISS	62-136W	900.7	900.9	895.0	2.9	898.9	5.3	16.5	95.42	0.1491	80	1.00	895.0	906.0	898.9 *	28	900.2	29	897.1	19	3.87
LW-3		-	889.1	889.0	884.0	0.0	887.0	0.9	1.5	9.15	0.0143	75	0.41	884.0	888.0	887.0 *	29	887.3	33	886.4	20	
LW-4	WABASSO	62-82P	COMBINED WITH LW-5	888.6	885.5	50.0	886.6		70.0	134.98	0.2109	81	0.65	885.5	893.0	886.6 *	30	886.9	34	887.8	47	1.10
LW-5		-	888.7							10.80	0.0169	80	0.25									
SL-1	BRENNAN	62-63W	897.9	898.7	893.0	3.1	896.7	7.4	13.0	163.84	0.2560	66	1.20	893.0	899.0	896.7 *	16	897.9	18	896.8	16	3.70
SL-2	SUMMIT	-	904.3	904.4	902.0	0.7	902.4	0.7	1.0	9.09	0.0142	78	0.12	902.0	908.0	902.4 *	1	902.5	1	902.3	1	
SL-3	PICHE	-	891.4	891.5	884.9	0.7	889.1	1.7	4.1	25.15	0.0393	76	0.72	884.9	897.0	889.1	4	891.5 *	5	888.5	3	
SL-4	EVANS	-	890.6	896.2	887.0	1.0	893.1	1.3	3.8	63.49	0.0992	73	0.57	887.0	909.2	893.1	7	896.2 *	10	893.1	7	
SL-5	WILSON PK-E	-	972.6	972.7	969.8	0.2	970.7	1.5	0.8	9.15	0.0143	68	0.55	969.8	970.6 +	970.7 *	7	970.8	14	970.6	2	
SL-6	WILSON PK-W	-	966.5	967.1	962.6	1.3	965.1	1.4	2.1	26.50	0.0414	73	0.56	962.6	965.0 +	965.1 *	38	965.1	155	964.9	6	
SL-7	TELEFARM	-	971.8	972.8	965.5	0.4	970.8	1.3	0.9	12.29	0.0192	91	0.12	965.5	977.0	970.8 *	20	971.0	21	966.1	3	
SL-8	WILSON PK-W	-	968.7	968.7	962.6	0.9	966.7	1.1	1.8	15.81	0.0247	76	0.18	962.6	970.0	966.7 *	22	968.7 *	27	965.1	11	
SL-9	MILTON-S	-	961.4	961.5	965.5	0.0	959.5	0.3	0.3	26.24	0.0410	73	0.35	965.5	964.0	959.5 *	101	959.6	144	958.6	18	
SL-10	MILTON-C	-	945.8	947.1	933.6	0.0	945.1	0.7	1.2	19.58	0.0306	70	0.70	933.6	945.0 +	945.1 *	85	945.7	170	937.1	24	
SL-11	PHEASNT H-S	-	896.1	896.8	890.0	0.0	894.8	1.2	0.3	57.86	0.0904	73	0.28	890.0	894.0 +	894.8 *	204	895.0	294	892.1	16	
SL-12		-	922.1	922.3	920.0	0.0	920.3	0.4	0.1	6.98	0.0109	66	0.38	920.0	925.0	920.3 *	8	920.6	15	920.1	2	
SL-13A				892.0	885.8	1.4	890.0	1.8	6.7	45.38	0.0709	83	0.28	885.8	890.1	890.0 *	53	890.6	99	887.2	12	
SL-13B				892.3	885.8	0.7	890.3	1.1	4.0	37.31	0.0583	79	0.28	885.8	890.1	890.3 *	68	891.0	132	887.2	10	
SL-13C	SNAIL	62-73P/62-216W	885.0	885.1	881.9	167.0	883.1		230.0	491.97	0.7687	82	0.67	881.9	893.0	883.1 *	0	883.5	0	884.8	0	1.20
GL-1	WILLOW-N	62-114W	904.5	903.6	898.0	2.0	901.2	2.2	9.1	55.68	0.0870	64	0.27	898.0	915.0	901.2	3	903.6 *	5	902.8	5	3.17
GL-2	WILLOW-S	-	900.3	902.2	896.3	0.2	900.2	0.7	1.3	27.20	0.0425	81	0.22	896.3	908.0	900.2 *	34	900.7	36	897.6	11	
GL-3		-	897.3	898.0	893.9	2.4	896.0	5.9	13.3	110.27	0.1723	69	0.71	893.9	911.0	896.0 *	23	897.1	32	895.8	21	
GL-4E	SNAIL LK-E	-	886.6	885.9	880.0	5.3	883.2	52.5	117.7	236.35	0.3693	68	0.30	880.0	885.7	883.2	0	884.8	0	885.9 *	25	
GL-4W		-								44.42	0.0694	62	0.42									
GL-5	SUZANNE	-	877.5	877.5	872.0	1.3	875.5	4.0	9.2	46.44	0.0726	76	0.12	872.0	875.5 +	875.5 *	7	875.6	71	875.5	3	
GL-5W				881.4	874.0	0.0		0.3	0.8	2.90	0.0045	76	0.12	874.0	888.0	878.9	0	879.9	0	881.4	0	
GL-7		-	931.7	934.6	921.7	0.4	932.6	0.8	3.7	79.94	0.1249	91	0.45	921.7	934.0	932.6 *	179	933.2	192	923.4	22	
GL-8	STAHL	-	887.3	889.1	879.0	0.2	887.1	3.6	16.6	68.35	0.1068	88	0.36	879.0	890.0	887.1 *	96	887.9	102	881.8	37	
GL-9	GRASS	62-74W	884.2	883.7	879.0	141.0	880.5		364.0	431.74	0.6746	81	0.57	879.0	900.0	880.5	4	880.9	8	883.7 *	50	1.50
VR-1				904.7	899.5	0.9	902.7	1.2	3.4	47.62	0.0744	57	0.33	899.5	902.5	902.7	73	903.4	168	902.5	50	

ALL ELEVATIONS ARE ON NGVD29 (1929 Datum, Refer to page D-1 of Appendix D for conversion factors to 1912 (Local) and 1988 (NAVD) datums

* VALUE CONTROLING MINIMUM BUILDING ELEVATION - (CRITERIA: GREATER OF THE DESIGN STORM +2.0 FT, FLOOD EVALUATION STORM, OR 10-DAY RUNOFF) REV. 1/89

\+ OVERFLOW OPERATING FOR DESIGN EVENT REV. 4/90

1 RESERVOIR DATA IS FROM 1990 SWMP, EXCEPT DESIGN STORM WATER LEVEL IS FROM 2003 MODEL REV. 4/03

AND CITY DESIGNATIONSL-13A, SL-13B, AND VR-1 WHICH INCLUDE INFORMATION FROM NEW PONDS. REV. 8/03

BASIS OF DESIGN

WMO: VADNAIS LAKE ARE WATERSHED MANAGEMENT ORGANIZATION

DRAINAGE DISTRICT: CHARLIE LAKE

CHARLIE LAKE

ALL ELEVATIONS ARE NGVD (1929) Datum, Refer to page D-1 of Appendix D for conversion factors to 1912 (Local) and 1988 (NAVD) Datums

City Water Body Designation		DNR Protected Water/Wetland	1990 Recommended Minimum Building Elevation	2005 Recommended Minimum Building Elevation	RESERVOIR DATA [1]					DRAINAGE AREA DATA				BASE DATA USED TO DETERMINE MINIMUM BUILDING ELEVATIONS HYDROLOGIC DATA (100-YEAR STORMS)								WETLAND BOUNCE
					NORMAL		DESIGN STORM							RESERVOIR DATA [1]		DESIGN STORM		FLOOD EVAL. STORM		TEN-DAY RUNOFF		
ID	NAME	Designation	(FEET)	(FEET)	Water Level (FEET)	Surface Area (ACRES)	Water Level (FEET)	Surface Area (ACRES)	Storage Volume (AC-FT)	Direct Tributary Area (ACRES)	Direct Tributary Area (SQ MI)	CN	Tc (HRS)	Normal Water Level (FEET)	Overflow Elevation (FEET)	Elevation (FEET)	Q (CFS)	Elevation (FEET)	Q (CFS)	Elevation (FEET)	Q (CFS)	(FEET)
CL-1		-	909.10	910.8	905.9	0.1	908.8	0.2	0.2	6.00	0.0094	82	0.18	905.9	911.5	908.8 *	7	909.3	8	906.5	2	
CL-2	SHR OAKS-C	-	909.09	907.9	905.5	0.4	905.9	0.4	1.5	5.95	0.0093	52	0.60	905.5	911.0	905.9 *	1	906.6	13	906.0	1	
CL-3	SHR OAKS-S	-	898.83	899.7	895.5	2.8	897.7	3.6	4.0	32.45	0.0507	81	0.64	895.5	898.5	897.7 *	10	898.3	13	896.9	8	
CL-4		-	DIRECT RUNOFF TO CASEY POND	REMOVED FROM MODEL						12.32	0.0193	61	0.84									
CL-6	HEATHR RG-S	-	902.22	902.5	897.8	0.1	900.5	0.7	0.7	16.96	0.0265	64	0.87	897.8	902.0	900.5 *	4	901.9	5	900.1	4	
CL-8	SHERWOOD-S	-	900.00	900.0	895.1		898.0	1.3	2.1	33.90	0.0530	78	1.50	895.1	899.8	898.0 *	28	898.5	33	896.9	11	
CL-9		-	DIRECT RUNOFF TO CASEY POND	REMOVED FROM MODEL						3.91	0.0061	70	1.08									
CL-10		-	DIRECT RUNOFF TO CASEY POND	REMOVED FROM MODEL						34.16	0.0534	66	0.54									
CL-11N		-	908.00	COMBINED INTO CL-11						24.20	0.0378	56	0.37									
CL-11S		-	PART OF CL-11 DRAINING DIRECTLY TO CHARLIE LAKE	COMBINED INTO CL-11						13.89	0.0217	52	0.62									
CL-11				908.5	902.0	0.2	906.5	0.2	0.6	42.00	0.0656	53	0.37	902.0	907.7	906.5 *	18	908.1	143	904.4	11	
SuL-1		-	DRAINS TO SUCKER LAKE							25.28	0.0395	64	0.33									
SuL-2		-	DRAINS TO SUCKER LAKE							60.35	0.0943	65	0.50									
SuL-3		-	DRAINS TO SUCKER LAKE							90.94	0.1421	66	0.67									

ALL ELEVATIONS ARE ON NGVD29 (1929 Datum, Refer to page D-1 of Appendix D for conversion factors to 1912 (Local) and 1988 (NAVD) datums

* VALUE CONTROLING MINIMUM BUILDING ELEVATION - (CRITERIA: GREATER OF THE DESIGN STORM +2.0 FT, FLOOD EVALUATION STORM, OR 10-DAY RUNOFF) REV. 1/89

\+ OVERFLOW OPERATING FOR DESIGN EVENT REV. 4/90

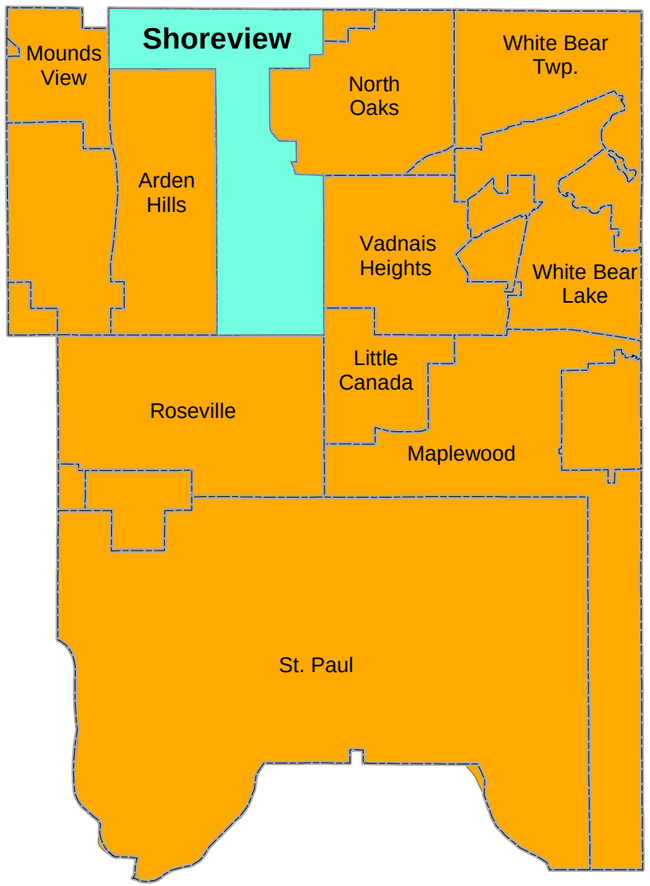
1 RESORVOIR DATA IS FROM 1990 SWMP, EXCEPT DESIGN STORM WATER LEVEL IS FROM 2003 MODEL. REV. 4/03

Watershed Treatment Capacity
Water Quality Assessment for the 2.5-inch Rainfall

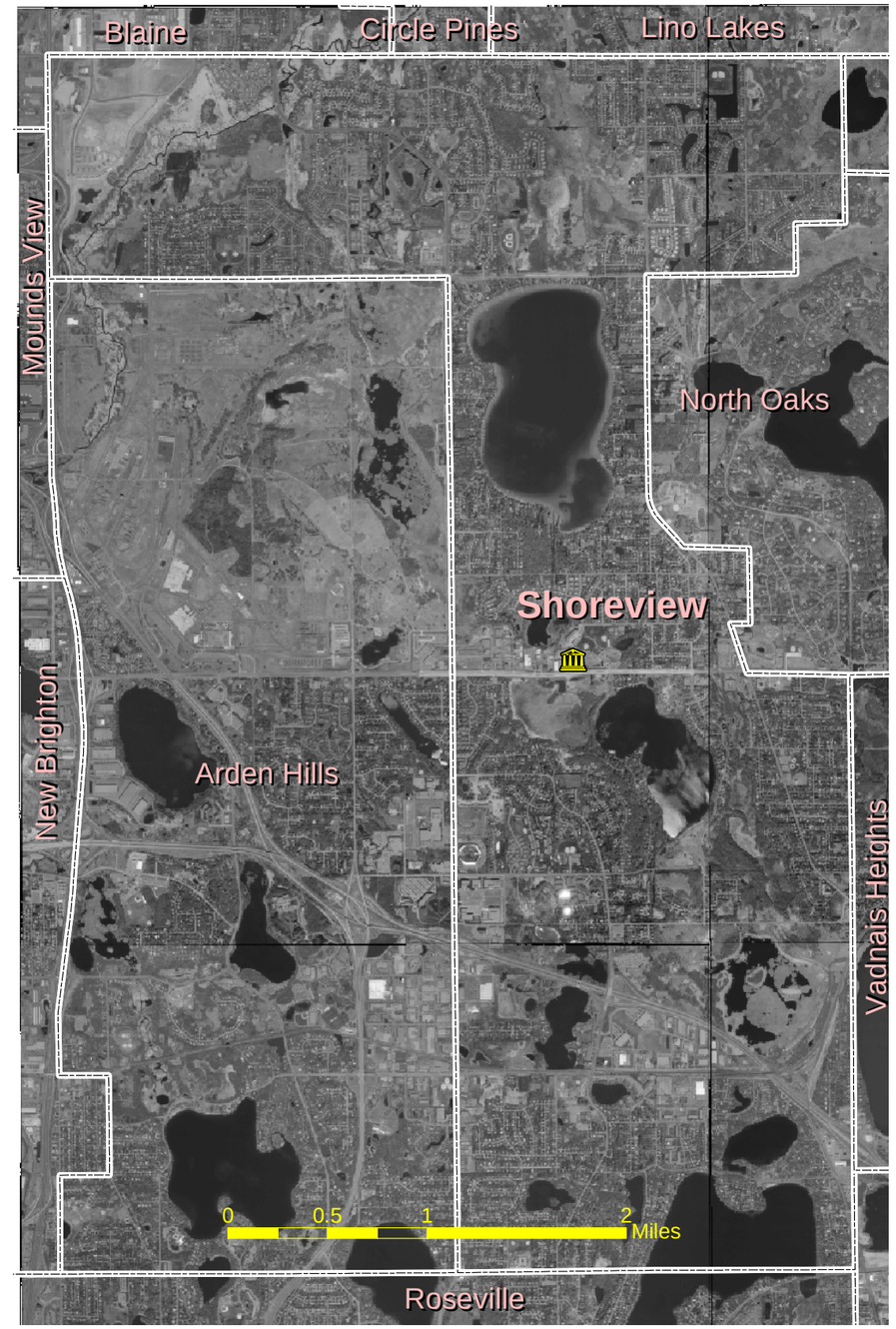
Watershed ID	Drainage Area (ac)	CN	Percent Impervious	Storage Required(ac-ft)	Method 1 Surface Area of Water Body (ac)	Method 1 Area of bottom Elevation (ac)	Method 1 Dead Storage (ac-ft)	Method 2 NWL	Method 2 NWL Area (ac)	Method 2 Design Storm Elev.	Method 2 Design Storm Area (ac)	Method 2 Flood Volume (ac-ft)	Volume 2' Depth (ac-ft)	Volume 4' Depth (ac-ft)	Volume 6' Depth (ac-ft)	Method 1 Meets Requirements	Meets Requirement for 2' Depth	Meets Requirement for 4' Depth	Meets Requirment for 6' Depth	Strategy	Watershed
RC-1	41.5	74	31	2.68				884.10	11.5	884.78	12.3	7.6	15.4	23.0	34.5	N/A	Yes	Yes	Yes	Meets requirement	
RC-2	Combined with RC-3															N/A				Meets requirement, combined with RC-3	
RC-3	86.7	66	33	5.96				882.00	11.8	883.02	14.1	16.4	15.9	23.7	35.5	N/A	Yes	Yes	Yes	Meets requirement	
RC-4	27.8	69	23	1.33												N/A	No	No	No	Drains to Rice Creek	
RC-6	32.3	76	14	0.94												N/A	No	No	No	Drains to Rice Creek	
RC-8	67.4	61	19	2.67												N/A	No	No	No	Drains to Rice Creek	
RC-9	27.3	63	2	0.11												N/A	No	No	No	Drains to Rice Creek	
RC-10	93.5	62	24	4.68												N/A	No	No	No	Drains to Rice Creek/Future project	
RC-11	36.5	85	72	5.48	1.18	0.46	4.6	902.00	1.2	906.00	2.3	7.4	1.6	2.4	3.5	No	No	No	No	Drains to RC-13	
RC-12E	10.0	81	72	1.50	0.59	0.23	2.2	903.60	0.6	905.92	0.8	1.6	0.8	1.2	1.8	Yes	No	No	Yes	Meets requirement, drains to RC-13	
RC-12W	53.8	84	76	8.52												N/A	No	No	No	Meets requirement, drains to RC-13	
RC-13	117.8	82	72	17.67	4.6	1.7	22.2	884.00	4.6	890.21	7.6	38.5	6.2	9.2	13.8	Yes	No	No	No	Meets requirement	
RC-14	307.0	65	18	11.51												N/A	No	No	No	Rice Creek	
CD1-1	65.6	82	26	3.55				891.05	9.5	891.85	23.5	11.9	12.8	19.0	28.6	N/A	Yes	Yes	Yes	Meets requirement	Low priority
CD1-2	25.0	60	44	2.29												N/A	No	No	No	Meets requirement, drains to CD1-3	
CD1-3	26.5	86	43	2.37				891.30	9.0	892.67	13.4	14.6	12.1	18.1	27.1	N/A	Yes	Yes	Yes	Meets requirement	
CD1-4	4.7	61	30	0.29												N/A	No	No	No	Meets requirement, drains to CD1-5	
CD1-5	30.0	66	32	2.00				889.50	2.2	890.45	4.3	3.9	2.9	4.4	6.5	N/A	Yes	Yes	Yes	Meets requirement	
CD1-6	47.7	81	28	2.78				887.50	0.5	889.13	9.2	7.3	0.7	1.1	1.6	N/A	No	No	No	Drains to CD1-17	
CD1-7	25.3	90	70	3.69				883.78	0.1	888.18	9.3	18.0	0.1	0.2	0.3	N/A	No	No	No	Drains to CD1-17	
CD1-8	21.3	64	33	1.46				889.50	0.3	891.51	1.6	2.0	0.4	0.7	1.0	N/A	No	No	No	Drains to CD1-17	
CD1-9	2.8	82	15	0.09				888.00	0.1	890.7	0.6	0.9	0.1	0.1	0.2	N/A	No	Yes	Yes	Meets requirement	
CD1-10	19.5	76	28	1.14				891.20	7.2	891.69	7.4	2.2	9.6	14.3	21.5	N/A	Yes	Yes	Yes	Meets requirement	
CD1-11	15.8	65	35	1.15				889.08	1.6	890.14	3.5	3.7	2.1	3.1	4.7	N/A	Yes	Yes	Yes	Meets requirement	
CD1-12	31.0	51	8	0.52				891.28	0.8	892.77	1.0	1.0	1.0	1.6	2.3	N/A	Yes	Yes	Yes	Meets requirement	
CD1-13	57.2	59	35	4.17				887.00	0.7	890.48	1.4	5.1	1.0	1.5	2.2	N/A	No	No	No	Drains to CD1-17	
CD1-14	5.9	53	25	0.31												N/A	No	No	No	Meets requirement, drains to CD1-5	
CD1-15A	12.2	65	44	1.11				888.00	0.0	890.93	0.8	1.1	0.0	0.0	0.0	N/A	No	No	No	Drains to CD1-17	
CD1-15B	4.3	58	43	0.38												N/A	No	No	No	Meets requirement, drains to CD1-5	
CD1-16	17.9	71	30	1.12				886.60	4.3	887	4.3	0.5	5.7	8.5	12.8	N/A	Yes	Yes	Yes	Meets requirement	
CD1-17	94.6	72	7	1.38				880.73	1.0	887.4	39.0	101.5	1.3	2.0	3.0	N/A	No	Yes	Yes	Meets requirement	
CD1-18	7.4	62	23	0.36				882.00	0.2	883.48	0.4	0.3	0.3	0.4	0.6	N/A	No	Yes	Yes	Meets requirement	
CD8-1	30.1	69	28	1.75				889.20	7.3	889.86	7.8	5.0	9.8	14.6	21.9	N/A	Yes	Yes	Yes	Meets requirement	Low priority
CD8-2	70.7	68	30	4.42				889.42	8.0	890.75	9.7	12.4	10.7	16.0	24.0	N/A	Yes	Yes	Yes	Meets requirement	
CD8-3	63.0	73	33	4.33				886.50	7.5	887.92	17.1	18.5	10.1	15.0	22.5	N/A	Yes	Yes	Yes	Meets requirement	
CD8-4	17.2	64	39	1.39				890.80	0.8	891.75	2.3	2.1	1.1	1.6	2.4	N/A	No	Yes	Yes	Meets requirement	
CD8-5	16.8	82	3	0.11				889.21	0.5	890.52	3.3	4.1	0.7	1.0	1.5	N/A	Yes	Yes	Yes	Meets requirement	
CD8-6	32.5	60	34	2.30				890.60	0.0	892.52	2.6	3.4				N/A	No	No	No	Drains to CD8-15	
CD8-7	20.5	61	37	1.58				887.00	0.1	889.52	0.3	0.5	0.1	0.2	0.3	N/A	No	No	Yes	Meets requirement	
CD8-8	9.2	83	70	1.34												N/A	No	No	No	Drains to CD8-15/Future project	
CD8-9	7.5	73	46	0.72				893.85	0.0	899.01	0.3	0.5	0.0	0.0	0.0	N/A	No	No	No	Drains to CD8-15	
CD8-10	37.8	65	35	2.76				890.00	0.5	894.33	0.7	1.8	0.7	1.0	1.5	N/A	No	No	No	Drains to CD8-15	
CD8-11	6.7	58	31	0.43				887.20	0.1	888.5	0.2	0.3	0.1	0.2	0.3	N/A	No	No	No	Drains to CD8-15	
CD8-12A	13.5	68	31	0.87												N/A	No	No	No	Drains to CD8-15	
CD8-12B	9.2	61	35	0.67					0.3				0.4	0.6	0.9	N/A	No	No	Yes	Meets requirement	
CD8-13	4.5	77	46	0.44				886.65	0.4	887.36	0.4	0.1	0.5	0.8	1.2	N/A	Yes	Yes	Yes	Meets requirement	
CD8-14	4.6	40	2	0.02												N/A	No	No	No	Drains to CD8-15	
CD8-15	368.0	72	10	7.67				882.93	0.0	886.41	64.5	81.1	0.0	0.0	0.0	N/A	No	No	No	County Ditch 8	
KL-1	7.7	61	34	0.54				897.55	0.4	898.52	0.5	0.4	0.5	0.8	1.2	N/A	No	Yes	Yes	Meets requirement, drains to KL-6	No work needed in this watershed
KL-2	1.0	48	15	0.03				896.50	0.1	896.64	0.1	0.1	0.1	0.2	0.3	N/A	Yes	Yes	Yes	Meets requirement, drains to KL-6	
KL-3	18.2	59	31	1.17				895.67	0.4	898.14	0.7	1.9	0.5	0.8	1.2	N/A	No	No	Yes	Meets requirement, drains to KL-6	
KL-4	21.3	67	15	0.67												N/A	No	No	No	Meets requirement, drains to KL-6	
KL-5	30.2	80	24	1.51				893.50	0.0	896.53	5.5	7.0	0.0	0.0	0.0	N/A	No	No	No	Meets requirement, drains to KL-6	
KL-6	148.1	75	25	7.71				889.20	25.0	891.02	29.0	47.1	33.5	50.0	75.0	N/A	Yes	Yes	Yes	Kerry Lake	
KL-7	9.3	66	23	0.44				886.50	0.3	887.84	0.6	0.8	0.4	0.6	0.9	N/A	No	Yes	Yes	Meets requirement	
TL-1	27.6	65	28	1.61				896.00	0.1	901.33	1.4	4.2	0.1	0.2	0.3	N/A	No	No	No	Drains to TL-4	High priority-
TL-2	11.5	67	27	0.64				892.75	0.1	895	0.1	0.1	0.1	0.2	0.3	N/A	No	No	No	Drains to TL-4	There is no signifcant trend in Secchi disc
TL-3	18.2	68	34	1.29				892.75	0.2	895.22	0.5	0.5	0.3	0.5	0.7	N/A	No	No	No	Drains to TL-4	readings, however Turtle Lake is on the
TL-4	680.6	88	7	9.93	452		3616	892.00	452.0	892.6	456.0	228.0	605.7	904.0	1,356.0	Yes	Yes	Yes	Yes	Turtle Lake	TMDL List of Impaired Waters for mercury
ML-1	7.8	59	3	0.05				895.25	0.4	895.77	0.4	0.1	0.6	0.8	1.3	N/A	Yes	Yes	Yes	Meets requirement	Low priority
ML-2	12.2	63	35	0.89				890.30	0.5	892.1	0.6	0.6	0.6	0.9	1.4	N/A	No	Yes	Yes	Meets requirement	No information on Marsden Lake
ML-3	18.7	69	27	1.05				887.20	0.7	888.6	4.3	4.4	0.9	1.3	2.0	N/A	No	Yes	Yes	Meets requirement	in the RCWD WRMP
ML-4	32.3	80	29	1.95					1.3	888.6			1.7	2.6	3.9	N/A	No	Yes	Yes	Meets requirement	
ML-5	9.9	82	79	1.62												N/A	No	No	No	Drains to CD1-17	
ML-6	41.2	55	29	2.49						892.1			0.0	0.0	0.0	N/A	No	No	No	Drains to Marsden Lake	
ML-7	14.3	69	33	0.98												N/A	No	No	No	Drains to Marsden Lake	
ML-8	55.4	70	32	3.69				0.00								N/A	No	No	No	Drains to Marsden Lake	
ML-9	4.3	75	46	0.41				891.17	0.0	894.35	0.1	0.1	0.0	0.0	0.0	N/A	No	No	No	Drains to Marsden Lake	
ML-10	120.3	81	36	9.02	25.1		125.5	898.20	25.1	899.13	30.5	29.9	33.6	50.2	75.3	Yes	Yes	Yes	Yes	Martha Lake	
ML-11	6.4	72	39	0.52												N/A	No	No	No	Drains to Marsden Lake	
ML-13	71.5	86	59	8.79				889.65	0.2	891.78	11.3	18.2	0.2	0.4	0.5	N/A	No	No	No	Drains to Marsden Lake	
GR-1	6.7	81	66	0.92				972.00	0.2	974.26	0.3	0.4	0.2	0.3	0.5	N/A	No	No	No	Meets requirement, drains to GR-3	No work needed in this watershed
GR-2	24.8	79	56	2.90				967.00	0.5	972.56	1.0	3.5	0.7	1.0	1.5	N/A	No	No	No	Meets requirement, drains to GR-3	
GR-3	39.7	78	64	5.29				945.83	4.3	947.11	65.0	14.0	5.8	8.6	12.9	N/A	Yes	Yes	Yes	Gramsie Pond	
KaL-1	2.9	79	63	0.39				956.17	0.2	957.34	0.3	0.3	0.3	0.4	0.7	N/A	No	Yes	Yes	Meets requirement	No work proposed in this watershed
KaL-2	16.2	78	41	1.38				955.26	1.7	956.78	1.9	3.0	2.2	3.3	5.0	N/A	Yes	Yes	Yes	Meets requirement	No information on Karth Lake
KaL-3	2.8	86	80	0.47												N/A	No	No	No	Drains out of City	in the RCWD WRMP

Watershed Treatment Capacity
Water Quality Assessment for the 2.5-inch Rainfall

Watershed ID	Drainage Area (ac)	CN	Percent Impervious	Storage Required(ac-ft)	Method 1 Surface Area of Water Body (ac)	Method 1 Area of bottom Elevation (ac)	Method 1 Dead Storage (ac-ft)	Method 2 NWL	Method 2 NWL Area (ac)	Method 2 Design Storm Elev.	Method 2 Design Storm Area (ac)	Method 2 Flood Volume (ac-ft)	Volume 2' Depth (ac-ft)	Volume 4' Depth (ac-ft)	Volume 6' Depth (ac-ft)	Method 1 Meets Requirements	Meets Requirement for 2' Depth	Meets Requirement for 4' Depth	Meets Requirment for 6' Depth	Strategy	Watershed
LLP-1	18.9	92	86	3.39				943.24	0.0	947.03	1.4	2.2	0.0	0.0	0.0	N/A	No	No	No	Drains out of City	Low priority
LLP-2	6.1	92	85	1.09				940.20	0.3	942.1	0.5	0.6	0.4	0.6	0.9	N/A	No	No	No	Drains out of City	Land of Lakes Pond
LLP-3	26.5	92	87	4.80												N/A	No	No	No	Drains out of City	
LLP-4	12.4	93	86	2.21												N/A	No	No	No	Drains out of City	
LLP-5	13.6	92	84	2.37				980.20	0.1	985.03	0.7	1.6	0.1	0.2	0.3	N/A	No	No	No	Meets requirement, drains to LLP-7	
LLP-6	6.9	79	41	0.59												N/A	No	No	No	Meets requirement, drains to LLP-7	
LLP-7	20.7	79	51	2.20				968.00	1.7	971.35	3.9	8.5	2.3	3.4	5.1	N/A	Yes	Yes	Yes	Meets requirement	
LLP-8	17.7	86	67	2.47												N/A	No	No	No	Drains out of City	
IL-7	6.2	91	87	1.13				963.50	0.2	967.23	0.3	1.1	0.2	0.3	0.5	N/A	No	No	No	Drains to IL-7	High prioity -No information on Island Lake in the RCWD WRMP
IL-8	180.6	84	25	9.41	53.9		269.5	944.60	53.9	945.73	41.6	56.1	72.2	107.8	161.7	Yes	Yes	Yes	Yes	Island Lake	however, Island Lake is on TMDL List of Impaired Waters for nutrients
BD-2	34.2	74	16	1.14				927.15	0.3	930.96	1.2	2.7	0.4	0.6	0.9	N/A	No	No	No	Drains out of City	Low priority
BD-5	33.8	77	42	2.96												N/A	No	No	No	Drains out of City	Bethel Ditch District
BD-6	20.0	91	82	3.42					0.3				0.4	0.6	0.9	N/A	No	No	No	Drains out of City	
BD-7	21.1	63	9	0.40					1.2				1.6	2.4	3.6	N/A	Yes	Yes	Yes	Meets requirement	
BD-8	5.8	92	85	1.03				941.60	0.2	944.31	0.4	0.7	0.3	0.4	0.6	N/A	No	No	No	Drains out of City	
BD-9	19.7	91	88	3.60				931.89	1.0	934.41	0.2	2.4	1.3	2.0	3.0	N/A	No	No	No	Drains out of City	
BD-11	24.0	90	92	4.60												N/A	No	No	No	Drains out of City	
BD-12	0.9	92	91	0.17												N/A	No	No	No	Drains out of City	
RP-1	14.7	89	73	2.23				944.20	0.6	947.02	0.9	0.8	0.8	1.2	1.8	N/A	No	No	No	Drains out of City (some treatment)	Low priority
RP-2	42.9	75	20	1.79				932.57	0.4	935.2	7.2	7.6	0.5	0.8	1.2	N/A	No	No	No	Drains out of City (some treatment)	Richmond Pond District
RP-3	52.2	85	64	6.96				931.04	0.0	933.96	5.9	4.0	0.0	0.0	0.0	N/A	No	No	No	Drains out of City (some treatment)	
LJA-1	57.1	78	47	5.59												N/A	No	No	No	Drains out of City	Medium priority- Lake Josephine
LLJ-1	47.5	76	42	4.16												N/A	No	No	No	Drains out of City	Low priority
LLJ-2	2.4	72	36	0.18												N/A	No	No	No	Drains out of City	Little Lake Josephine
PL-1	3.5	76	15	0.11				908.00	0.7	908.7	0.7	2.1	0.9	1.4	2.1	N/A	Yes	Yes	Yes	Meets requirement	Low priority
PL-2	23.3	68	33	1.60				895.20	0.3	897.72	1.2	1.8	0.4	0.6	0.9	N/A	No	No	No	Drains to Poplar Lake	No information on Poplar Lake
PL-3	13.4	77	32	0.90												N/A	No	No	No	Drains to Poplar Lake	in the RCWD WRMP
PL-4E	162.1	70	4	1.35												N/A	No	No	No	Poplar Lake	
PL-4W	25.3	64	2	0.11												N/A	No	No	No	Drains to Poplar Lake	
LJ-1	108.6	79	27	6.11	15.5		77.5	943.25	15.5	944.31	18.3	24.7	20.8	31.0	46.5	Yes	Yes	Yes	Yes	Lake Judy	Medium priority
LE-1	1.9	70	15	0.06				938.20	0.0	942.24	0.4	0.6	0.0	0.0	0.0	N/A	No	No	No	Meets requirement, drains to LE-2	No work needed in this watershed
LE-2	8.7	74	20	0.36				941.60	0.4	942.55	1.2	0.5	0.5	0.7	1.1	N/A	Yes	Yes	Yes	Meets requirement	
LE-3	3.9	65	15	0.12				930.70	0.0	933.31	0.2	0.2	0.0	0.0	0.0	N/A	No	No	No	Meets requirement, drains to LE-5	
LE-4	7.8	69	27	0.44				920.90	0.3	924.49	0.7	1.8	0.4	0.6	0.9	N/A	No	Yes	Yes	Meets requirement	
LE-5	114.6	78	29	6.92	14		56	918.00	14.0	920.04	15.0	28.0	18.8	28.0	42.0	Yes	Yes	Yes	Yes	Lake Emily	
LO-10	49.1	72	21	2.15												N/A	No	No	No	Drains out of City	Low priority
LO-12	956.2	84	11	21.91	393		3537	886.60	393.0	887.28	625.0	600.0	526.6	786.0	1,179.0	Yes	Yes	Yes	Yes	Lake Owasso	
SV-1	35.9	88	69	5.16				945.70	9.7	946.76	10.4	8.0	13.0	19.4	29.1	N/A	Yes	Yes	Yes	Shoreview Lake	Medium priority
LW-1	18.0	73	45	1.69				935.20	1.1	936.53	1.6	1.8	1.4	2.1	3.2	N/A	No	Yes	Yes	Meets requirement	Medium priority
LW-2	95.4	80	53	10.54				895.00	2.9	898.87	5.3	16.5	3.9	5.8	8.7	N/A	No	No	No	Drains to GL-9	There is no signifcant trend in Secchi disc
LW-3	9.2	75	40	0.76				884.00	0.0	887.03	0.9	1.5	0.0	0.0	0.0	N/A	No	No	No	Drains to GL-9	readings
LW-4	135.0	81	21	5.91	50		800	885.50	50.0	886.63		70.0	67.0	100.0	150.0	Yes	Yes	Yes	Yes	Lake Wabasso	
LW-5	10.8	80	72	1.62												N/A	No	No	No	Drains to GL-9	
SL-1	163.8	66	33	11.26				893.00	3.1	896.73	7.4	13.0	4.2	6.3	9.4	N/A	No	No	No	Drains to SL-13C	High priority
SL-2	9.1	78	53	1.00				902.00	0.7	902.36	0.7	1.0	0.9	1.4	2.1	N/A	No	Yes	Yes	Meets requirement	There is no signifcant trend in Secchi disc
SL-3	25.2	76	36	1.89				884.90	0.7	889.05	1.7	4.1	1.0	1.5	2.2	N/A	No	No	Yes	Meets requirement	readings, however Snail Lake is on the
SL-4	63.5	73	31	4.10				887.00	1.0	893.07	1.3	3.8	1.4	2.0	3.0	N/A	No	No	No	Drains to SL-13C	TMDL List of Impaired Waters for mercury
SL-5	9.2	68	20	0.38				969.80	0.2	970.7	1.5	0.8	0.3	0.5	0.7	N/A	No	Yes	Yes	Meets requirement	
SL-6	26.5	73	19	1.05				962.60	1.3	965.11	1.4	2.1	1.7	2.6	3.9	N/A	Yes	Yes	Yes	Meets requirement	
SL-7	12.3	91	85	2.18				965.50	0.4	970.81	1.3	0.9	0.5	0.7	1.1	N/A	No	No	No	Drains to SL-13C	
SL-8	15.8	76	47	1.55				962.60	0.9	966.74	1.1	1.8	1.1	1.7	2.6	N/A	No	Yes	Yes	Meets requirement	
SL-9	26.2	73	45	2.46				965.50	0.0	959.5	0.3	0.3	0.0	0.0	0.0	N/A	No	No	No	Drains to SL-13C	
SL-10	19.6	70	33	1.35				933.60	0.0	945.14	0.7	1.2	0.0	0.0	0.0	N/A	No	No	No	Drains to SL-13C	
SL-11	57.9	73	33	3.98				890.00	0.0	894.76	1.2	0.3	0.0	0.0	0.0	N/A	No	No	No	Drains to SL-13C	
SL-12	7.0	66	15	0.22				920.00	0.0	920.34	0.4	0.1	0.0	0.0	0.0	N/A	No	No	No	Drains to SL-13C	
SL-13A	45.4	83	66	6.24	1.4	0.51	8.4	885.83	1.4	889.95	1.8	6.7	1.9	2.8	4.2	Yes	No	No	No	Drains to SL-13C	
SL-13B	37.3	79	64	4.97	0.74	0.24	4.2	885.83	0.7	890.29	1.1	4.0	1.0	1.5	2.2	No	No	No	No	Drains to SL-13C	
SL-13C	492.0	82	14	14.35	167		1169	881.90	167.0	883.12		230.0	223.8	334.0	501.0	Yes	Yes	Yes	Yes	Snail Lake	
GL-1	55.7	64	37	4.29				898.00	2.0	901.17	2.2	9.1	2.7	4.0	5.9	N/A	No	No	Yes	Meets requirement	Low priority
GL-2	27.2	81	69	3.91				896.30	0.5	900.18	0.7	1.3	0.7	1.0	1.5	N/A	No	No	No	Drains to GL-9	There is not enough information
GL-3	110.3	69	39	8.96				893.90	2.4	895.96	5.9	13.3	3.2	4.8	7.2	N/A	No	No	No	Meets requirements	to predict any water quality trends in
GL-4E	236.4	68	25	12.31				880.00	5.3	883.23	52.5	117.7	7.1	10.6	15.9	N/A	No	No	Yes	Meets requirement	Grass Lake
GL-4W	44.4	62	8	0.74									0.0	0.0	0.0	N/A	No	No	No	Drains to GL-9	
GL-5	46.4	76	22	2.13				872.00	1.3	875.51	4.0	9.2	1.7	2.6	3.9	N/A	No	Yes	Yes	Meets requirement	
GL-5W	2.9	76	22	0.13				-	-	-	-	-	-	-	-	N/A	No	Yes	Yes	Drains to GL-5 (depression area)	
GL-7	79.9	91	83	13.82				921.68	0.4	932.64	0.8	3.7	0.6	0.9	1.3	N/A	No	No	No	Drains to GL-9	
GL-8	68.4	88	73	10.39				879.00	0.2	887.06	3.6	16.6	0.2	0.3	0.5	N/A	No	No	No	Drains to GL-9	
GL-9	431.7	81	30	26.98	141		705	879.00	141.0	880.47		364.0	188.9	282.0	423.0	Yes	Yes	Yes	Yes	Grass Lake	
VR-1	47.62	57	45	4.46	0.88	0.51	3	899.50	0.9	902.7	1.2	3.4	1.2	1.7	2.6	No	No	No	No	Some treatment	Low priority



Ramsey County



Legend

- CityHall
- Municipal Boundaries
- City of Shoreview
- Ramsey County

Source: SEH, Metropolitan Council, and Mn/DOT.

Projection:
UTM Zone 15 Meters NAD83
Figure 1 General Location Map.mxd

SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

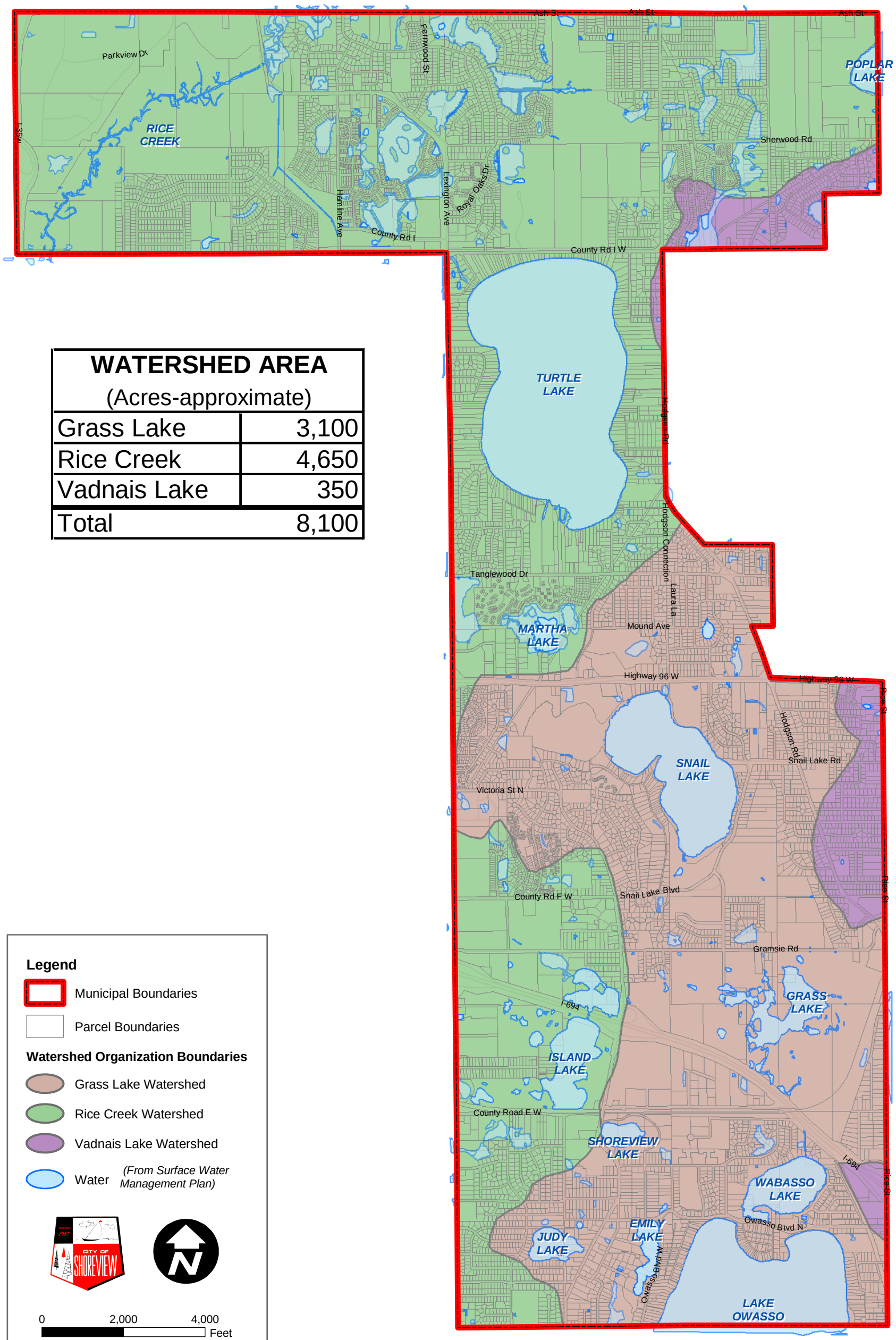
Project Number
ASHORE0201.00

Date
01/27/04
sh

SURFACE WATER MANAGEMENT PLAN
Shoreview, Minnesota

City Location Map

Figure 1



WATERSHED AREA (Acres-approximate)	
Grass Lake	3,100
Rice Creek	4,650
Vadnais Lake	350
Total	8,100

Legend

Municipal Boundaries

Parcel Boundaries

Watershed Organization Boundaries

Grass Lake Watershed

Rice Creek Watershed

Vadnais Lake Watershed

Water *(From Surface Water Management Plan)*

0 2,000 4,000 Feet

SOURCES:
City of Shoreview Comunity Development Dept, and MetroGIS.

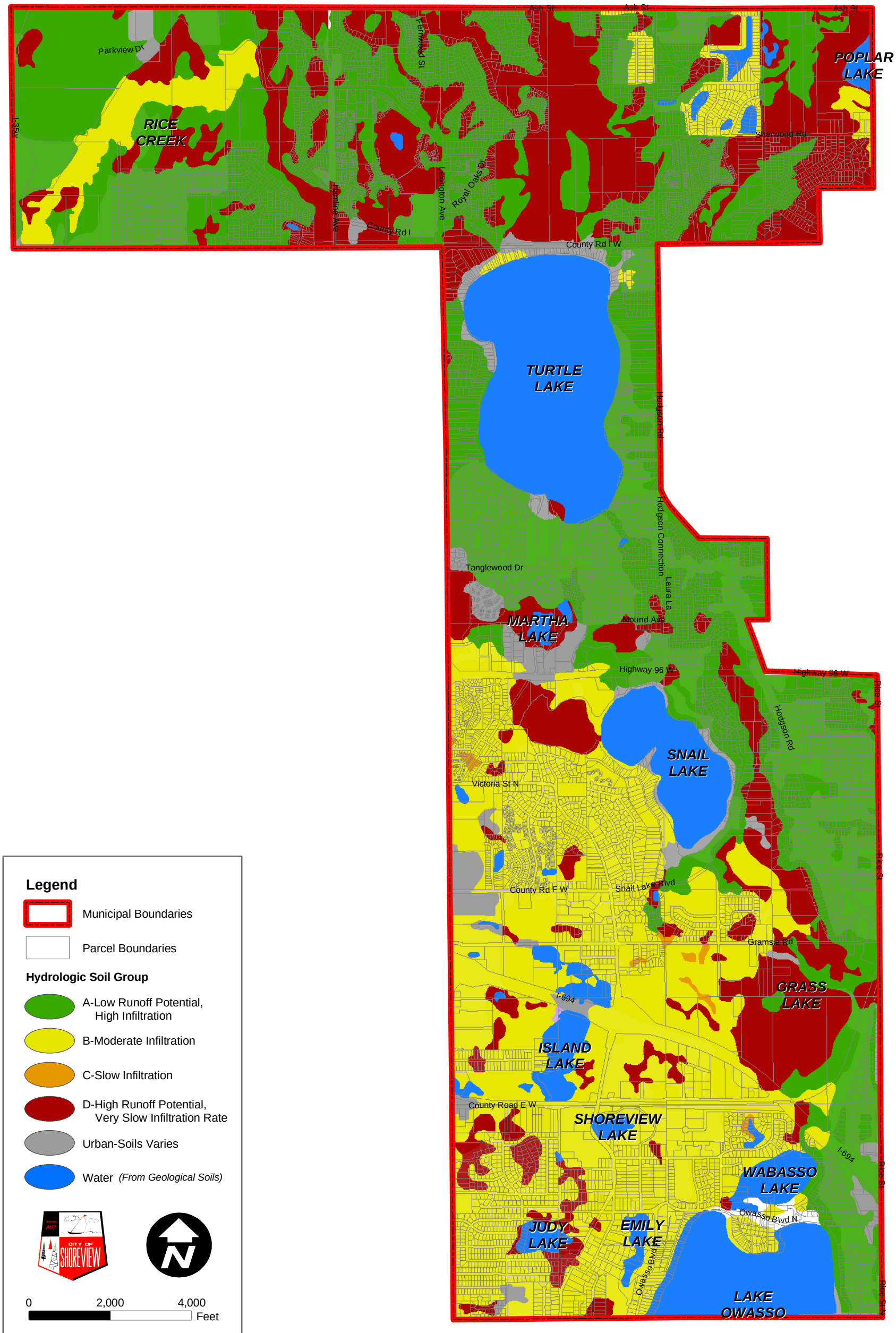
SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

FILE NO.
ASHORE0201.00

DATE:
01/27/04

Watershed Boundaries
City of Shoreview, Minnesota

Figure 2



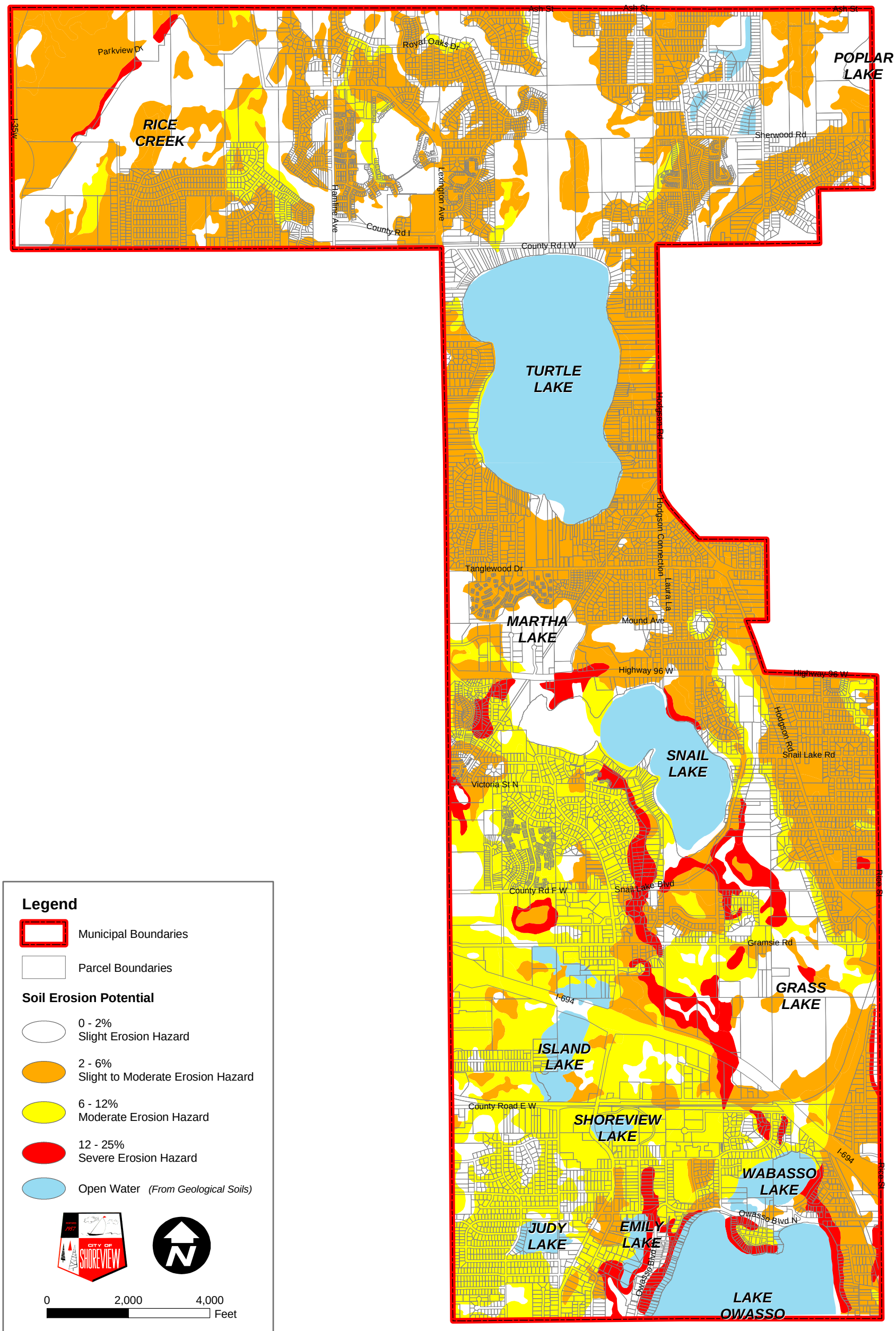
SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

FILE NO.
ASHORE0201.00

DATE:
01/27/04

Soil Hydrologic Group
City of Shoreview, Minnesota

Figure 3



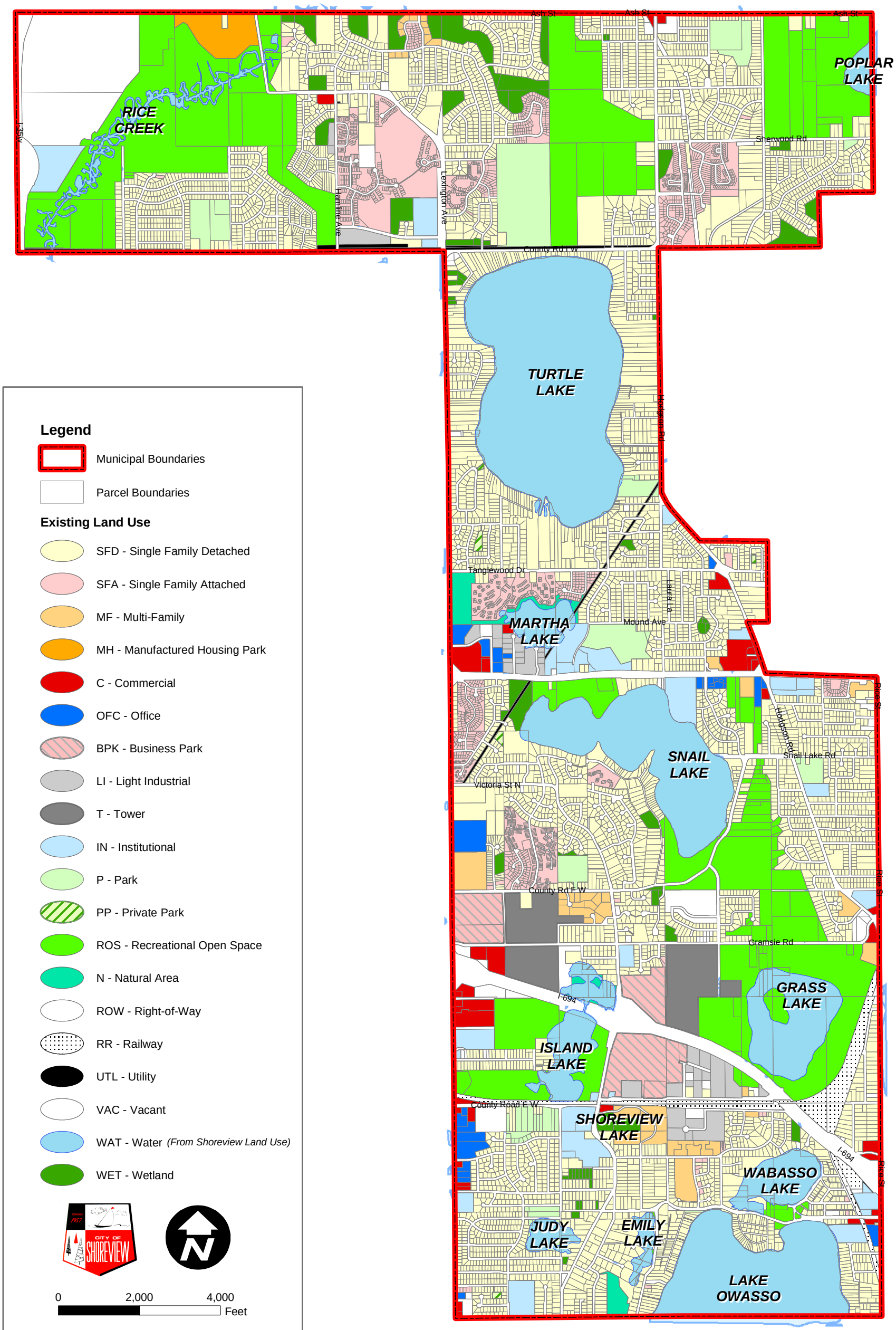
SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

FILE NO.
ASHORE0201.00

DATE:
01/27/04

Soil Erosion Potential
City of Shoreview, Minnesota

Figure
4



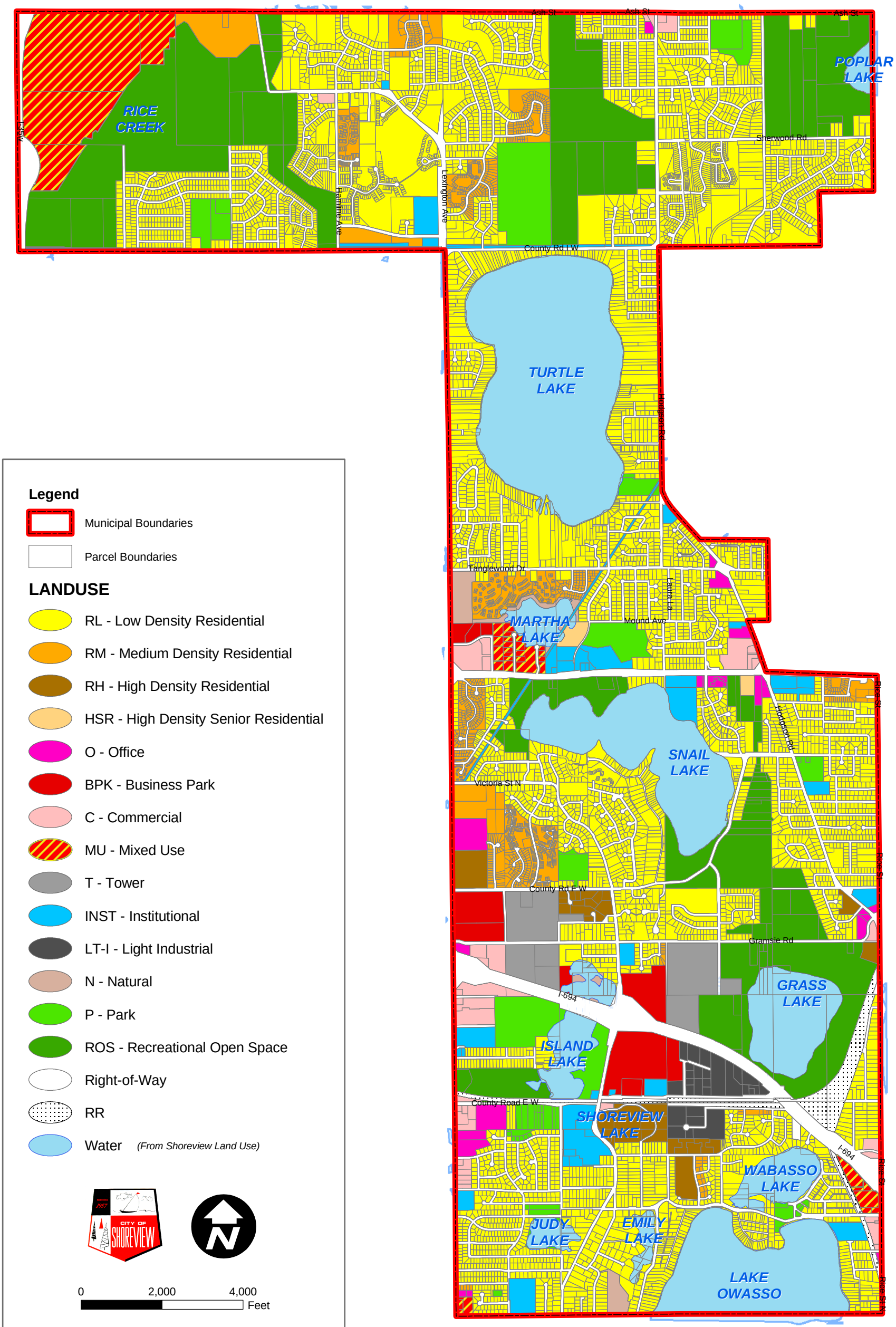
SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

FILE NO.
ASHORE0201.00

DATE:
01/27/04

Existing Land Use
City of Shoreview, Minnesota

Figure
5



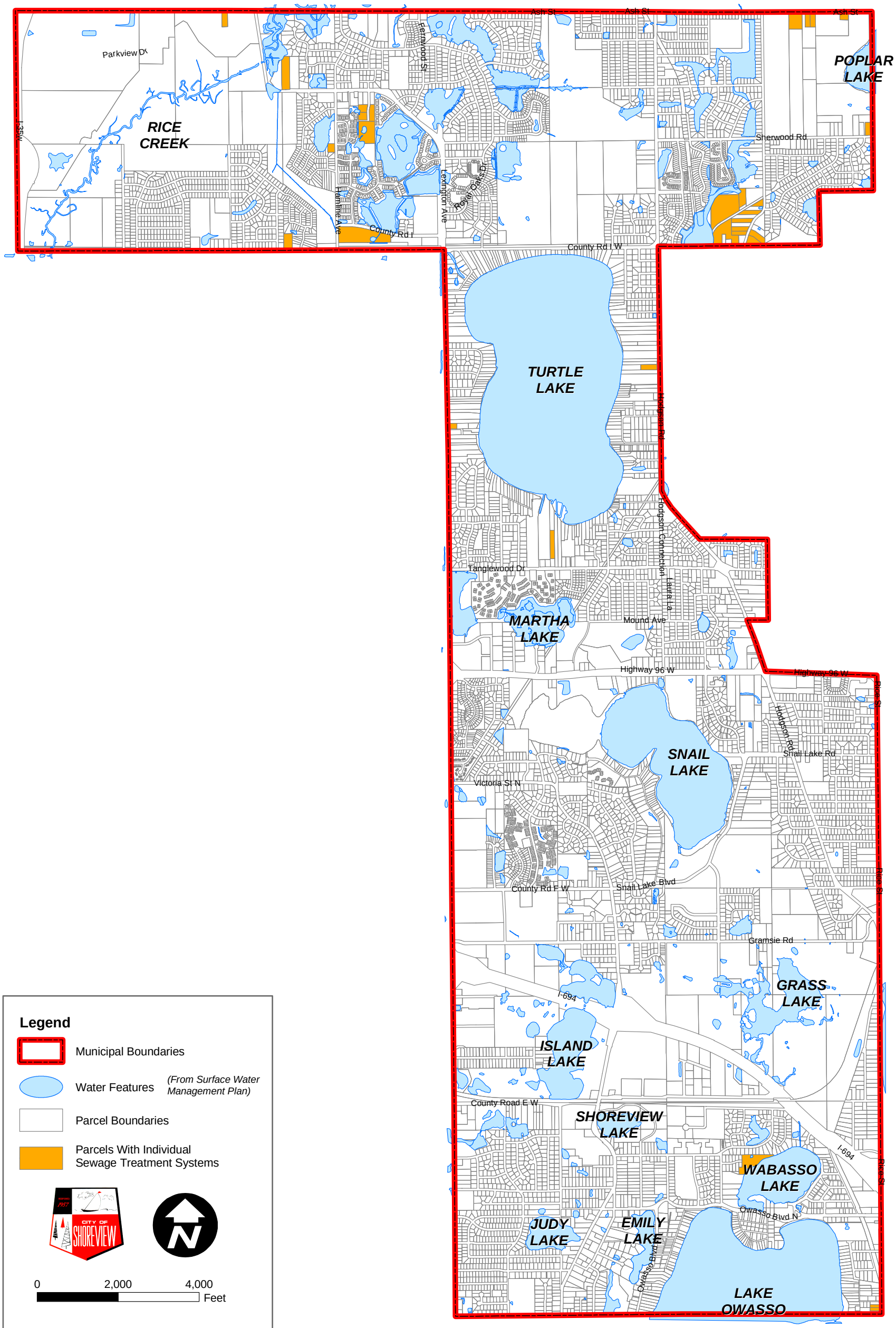
PHONE: (651) 490-2000
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110

FILE NO.
ASHORE0201.00

DATE:
07/07/03

Proposed Land Use
City of Shoreview, Minnesota

Figure
6



Legend

- Municipal Boundaries
- Water Features *(From Surface Water Management Plan)*
- Parcel Boundaries
- Parcels With Individual Sewage Treatment Systems

0 2,000 4,000 Feet

SOURCES:
City of Shoreview Comunity Development Dept, Mn/DOT, and MetroGIS.

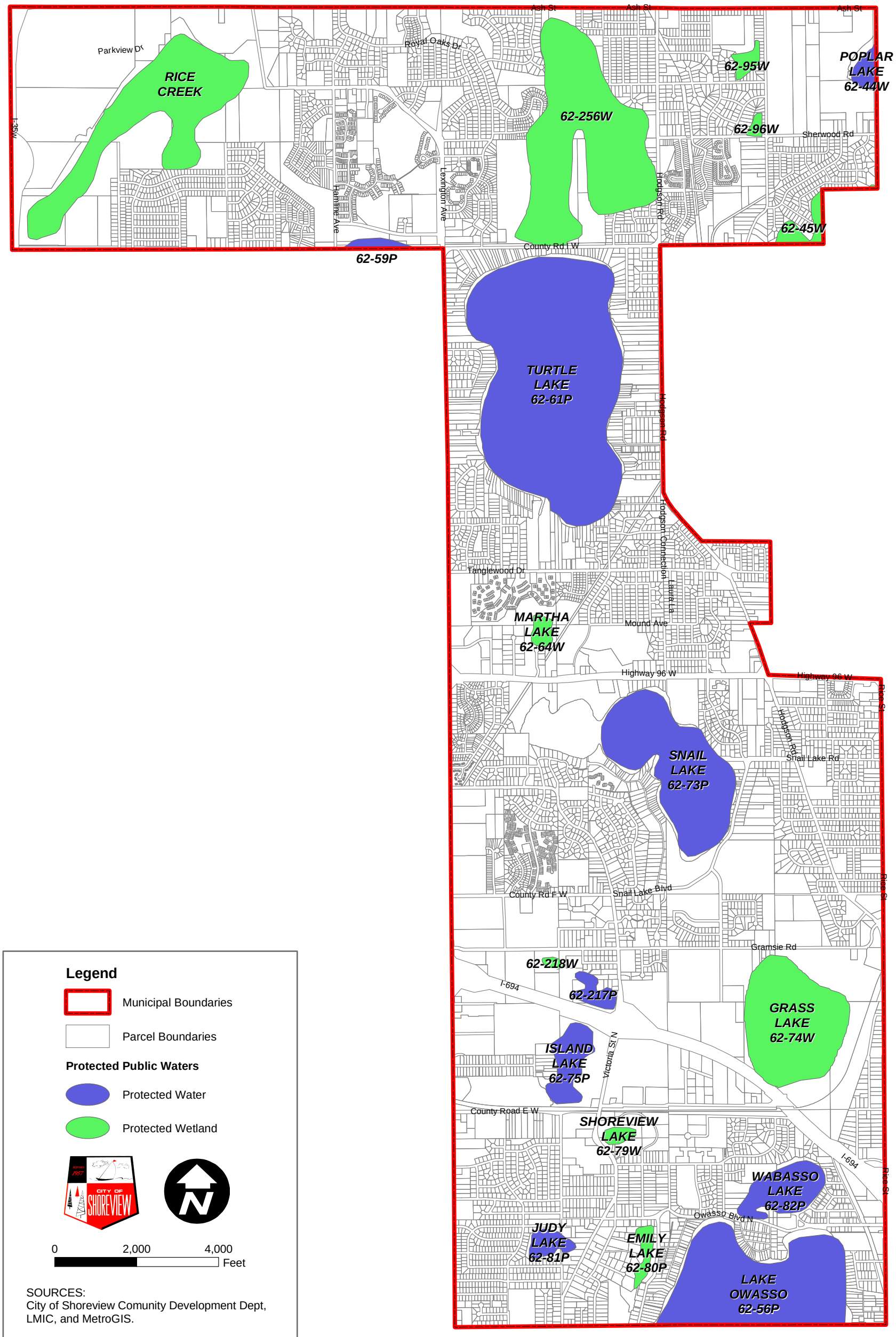
SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

FILE NO.
ASHORE0201.00

DATE:
02/09/04

ISTS Sites
City of Shoreview, Minnesota

Figure 7



Legend

Municipal Boundaries

Parcel Boundaries

Protected Public Waters

Protected Water

Protected Wetland

0 2,000 4,000 Feet

SOURCES:
City of Shoreview Comunity Development Dept, LMIC, and MetroGIS.

NOTE:
Map illustrates water bodies from DNR data.
No regulatory boundary is intended or implied.

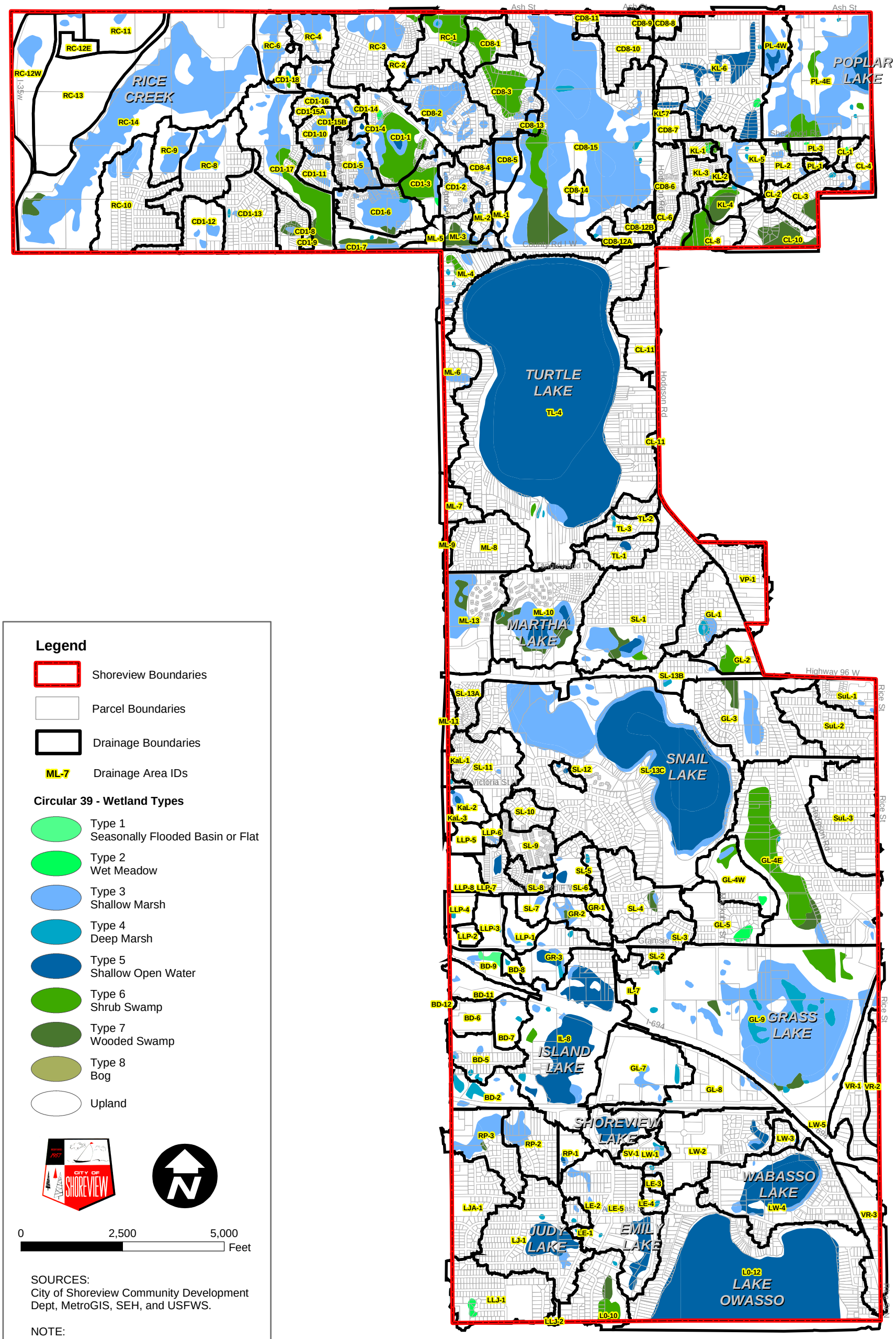
SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

FILE NO.
ASHORE0201.00

DATE:
01/27/04

Protected Waters
City of Shoreview, Minnesota

Figure 8



Legend

- Shoreview Boundaries
- Parcel Boundaries
- Drainage Boundaries
- ML-7 Drainage Area IDs

Circular 39 - Wetland Types

- Type 1 Seasonally Flooded Basin or Flat
- Type 2 Wet Meadow
- Type 3 Shallow Marsh
- Type 4 Deep Marsh
- Type 5 Shallow Open Water
- Type 6 Shrub Swamp
- Type 7 Wooded Swamp
- Type 8 Bog
- Upland

0 2,500 5,000 Feet

SOURCES:
City of Shoreview Community Development Dept, MetroGIS, SEH, and USFWS.

NOTE:
Map illustrates water bodies from NWI data. No regulatory boundary is intended or implied.

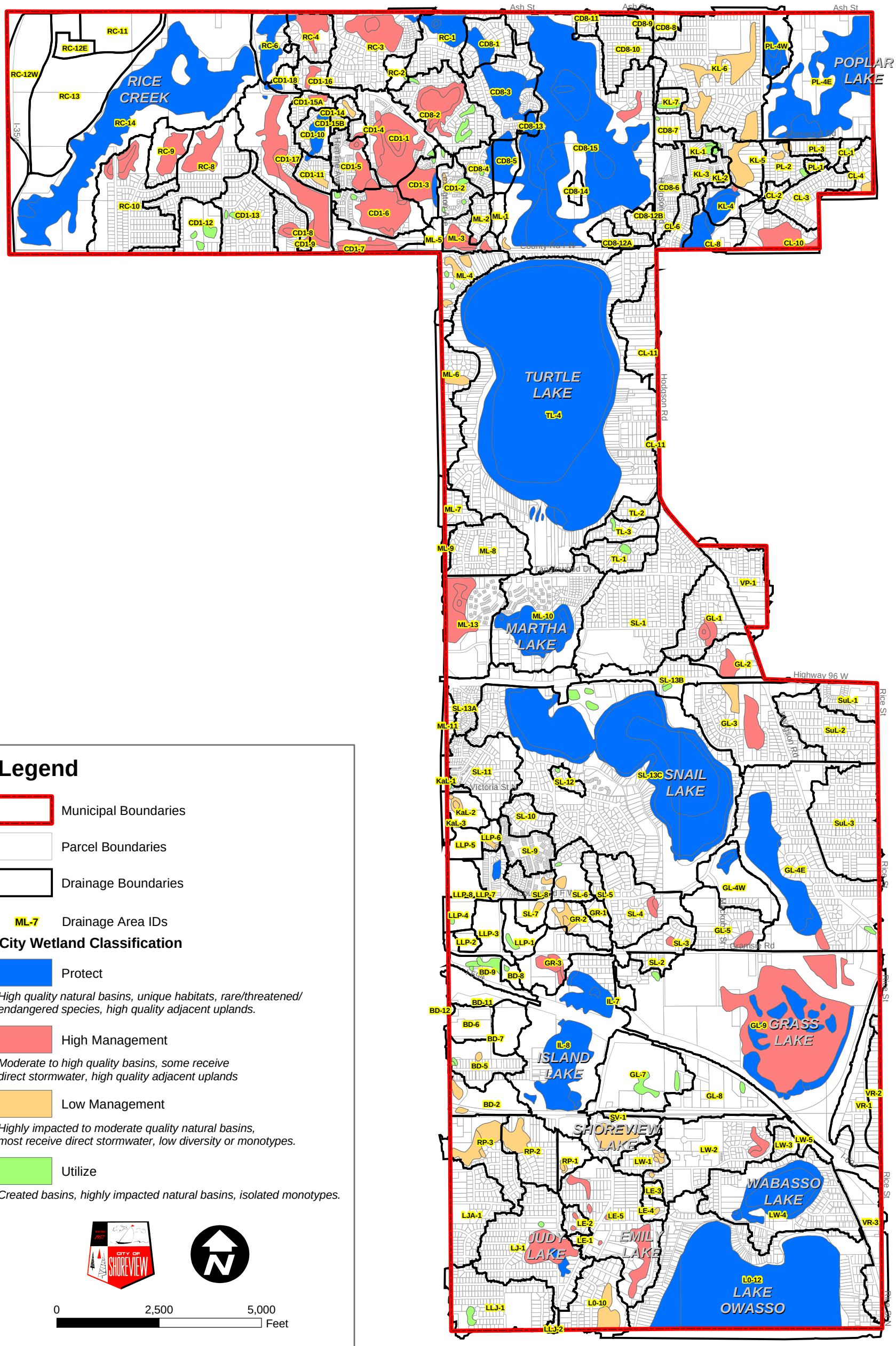
SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

FILE NO.
ASHORE0201.00

DATE:
01/27/04

National Wetland Inventory
City of Shoreview, Minnesota

Figure 9



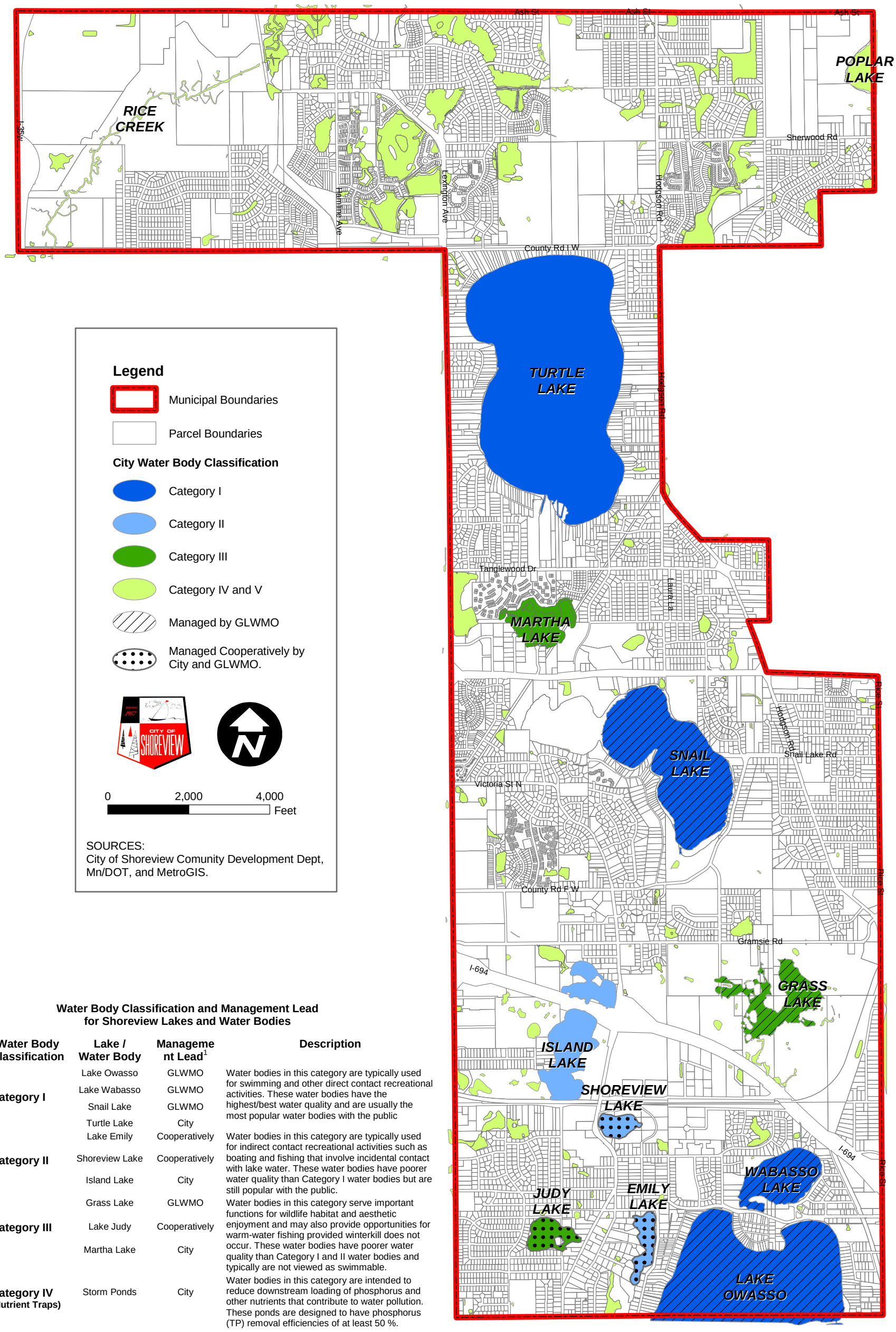
SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

FILE NO.
ASHORE0201.00

DATE:
01/27/04

Wetland Classification
City of Shoreview, Minnesota

Figure 10



Legend

- Municipal Boundaries
- Parcel Boundaries

City Water Body Classification

- Category I
- Category II
- Category III
- Category IV and V
- Managed by GLWMO
- Managed Cooperatively by City and GLWMO.

0 2,000 4,000 Feet

SOURCES:
City of Shoreview Comunity Development Dept, Mn/DOT, and MetroGIS.

Water Body Classification and Management Lead for Shoreview Lakes and Water Bodies

Water Body Classification	Lake / Water Body	Management Lead[1]	Description
Category I	Lake Owasso	GLWMO	Water bodies in this category are typically used for swimming and other direct contact recreational activities. These water bodies have the highest/best water quality and are usually the most popular water bodies with the public
	Lake Wabasso	GLWMO	
	Snail Lake	GLWMO	
	Turtle Lake	City	
Category II	Lake Emily	Cooperatively	Water bodies in this category are typically used for indirect contact recreational activities such as boating and fishing that involve incidental contact with lake water. These water bodies have poorer water quality than Category I water bodies but are still popular with the public.
	Shoreview Lake	Cooperatively	
	Island Lake	City	
Category III	Grass Lake	GLWMO	Water bodies in this category serve important functions for wildlife habitat and aesthetic enjoyment and may also provide opportunities for warm-water fishing provided winterkill does not occur. These water bodies have poorer water quality than Category I and II water bodies and typically are not viewed as swimmable.
	Lake Judy	Cooperatively	
	Martha Lake	City	
Category IV (Nutrient Traps)	Storm Ponds	City	Water bodies in this category are intended to reduce downstream loading of phosphorus and other nutrients that contribute to water pollution. These ponds are designed to have phosphorus (TP) removal efficiencies of at least 50 %.
Category V (Sediment Traps)	Storm Ponds	City	These water bodies are similar to Category IV water bodies but are too small to effectively remove a significant fraction of nutrients. These basins will generally have TP removal efficiencies of less than 50 %.

1. See GLWMO Plan Table 5-2 and 5-4 for more detail on management roles and responsibilities.

SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

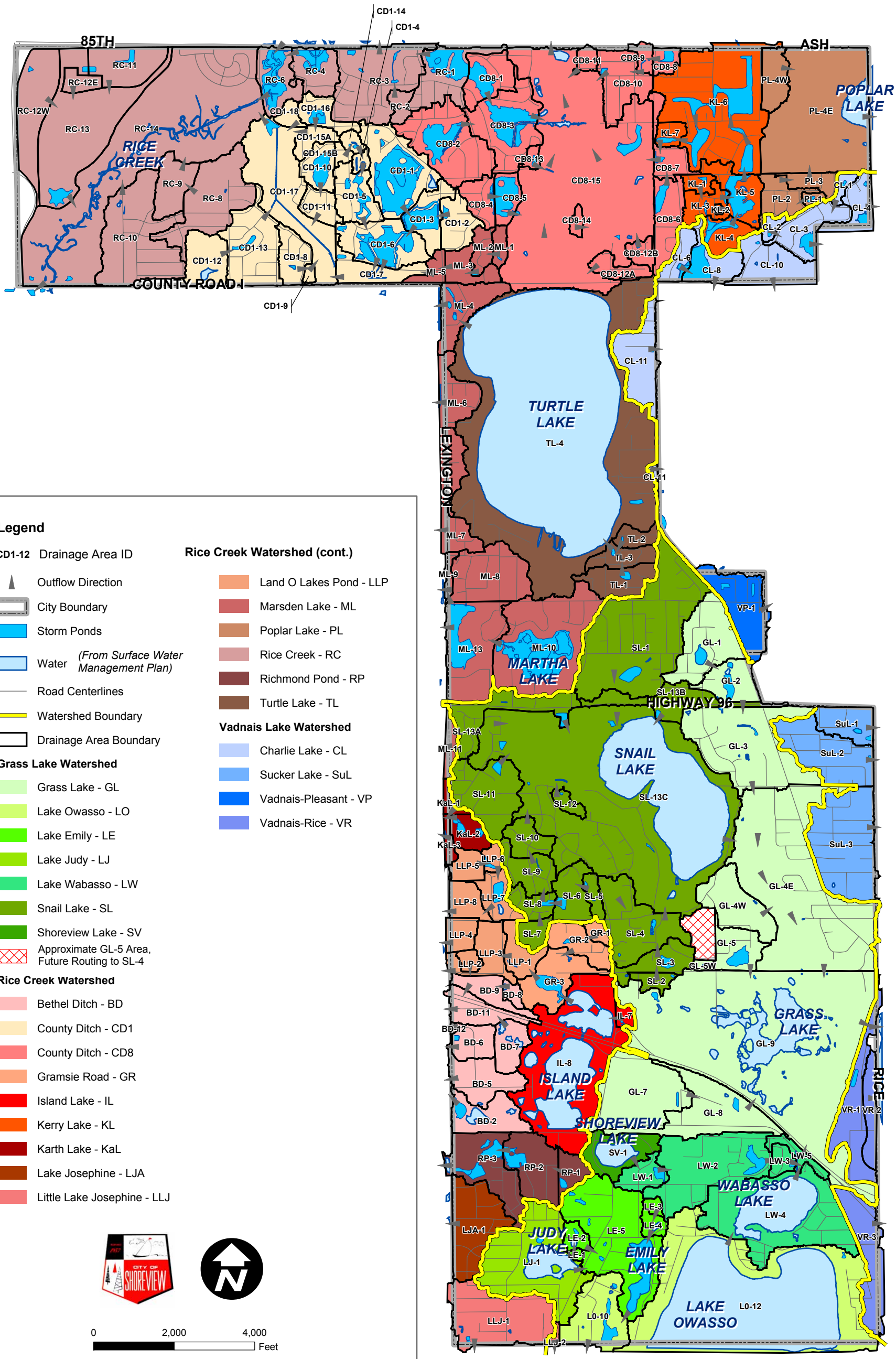
FILE NO.
ASHORE0201.00

DATE:
02/04/04

Water Body Classification
City of Shoreview, Minnesota

Figure 11

Map Document: (X:\PT\Shore\020100\GIS\Shoreview_WR\Figure 12_Watershed Boundaries Classified_11x17.mxd)
3/24/2005 -- 9:34:22 AM



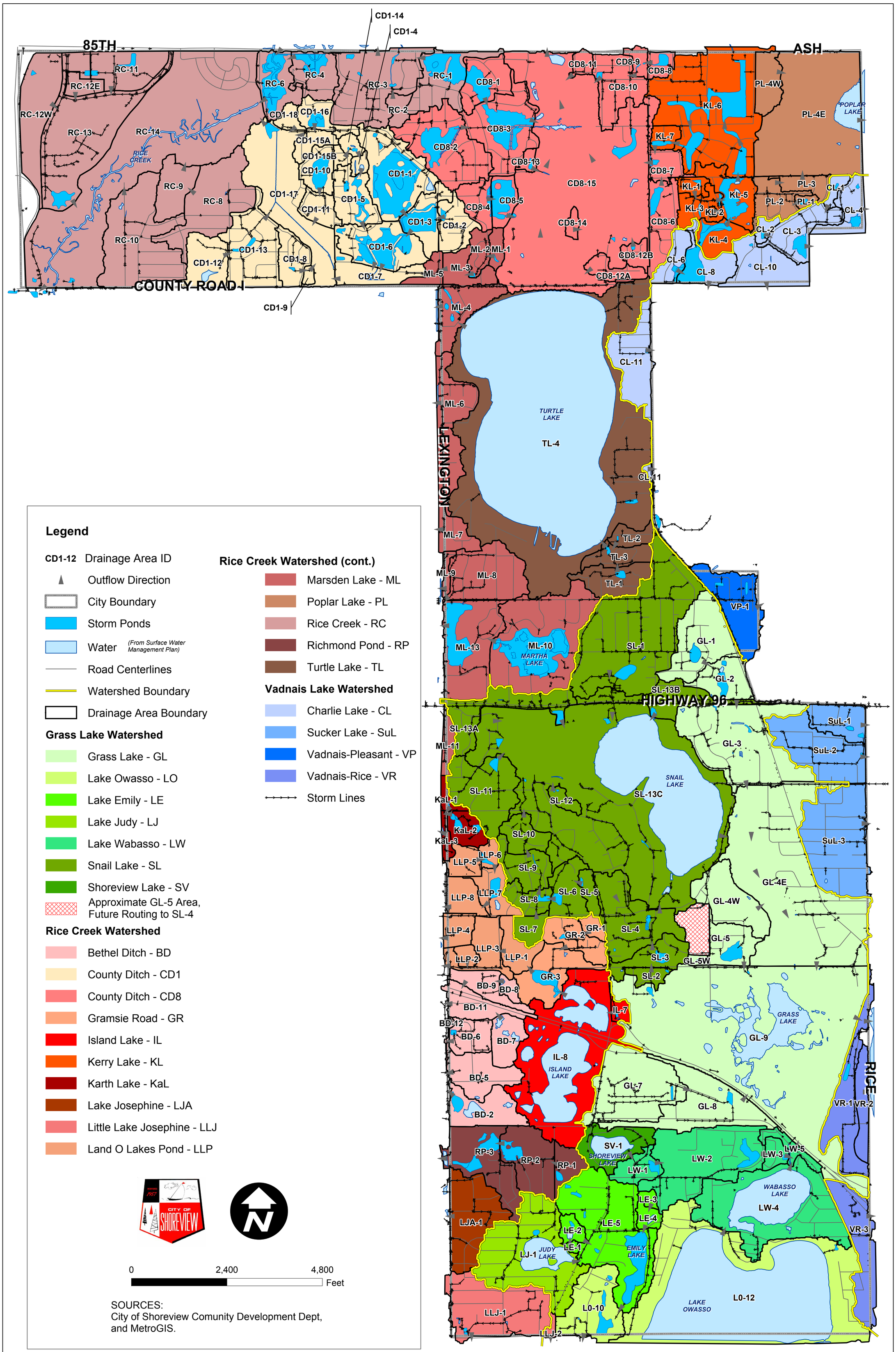
SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

FILE NO.
ASHORE0201.00

DATE:
03/24/05

Watershed and Drainage Area Boundaries City of Shoreview, Minnesota

Figure 12



SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

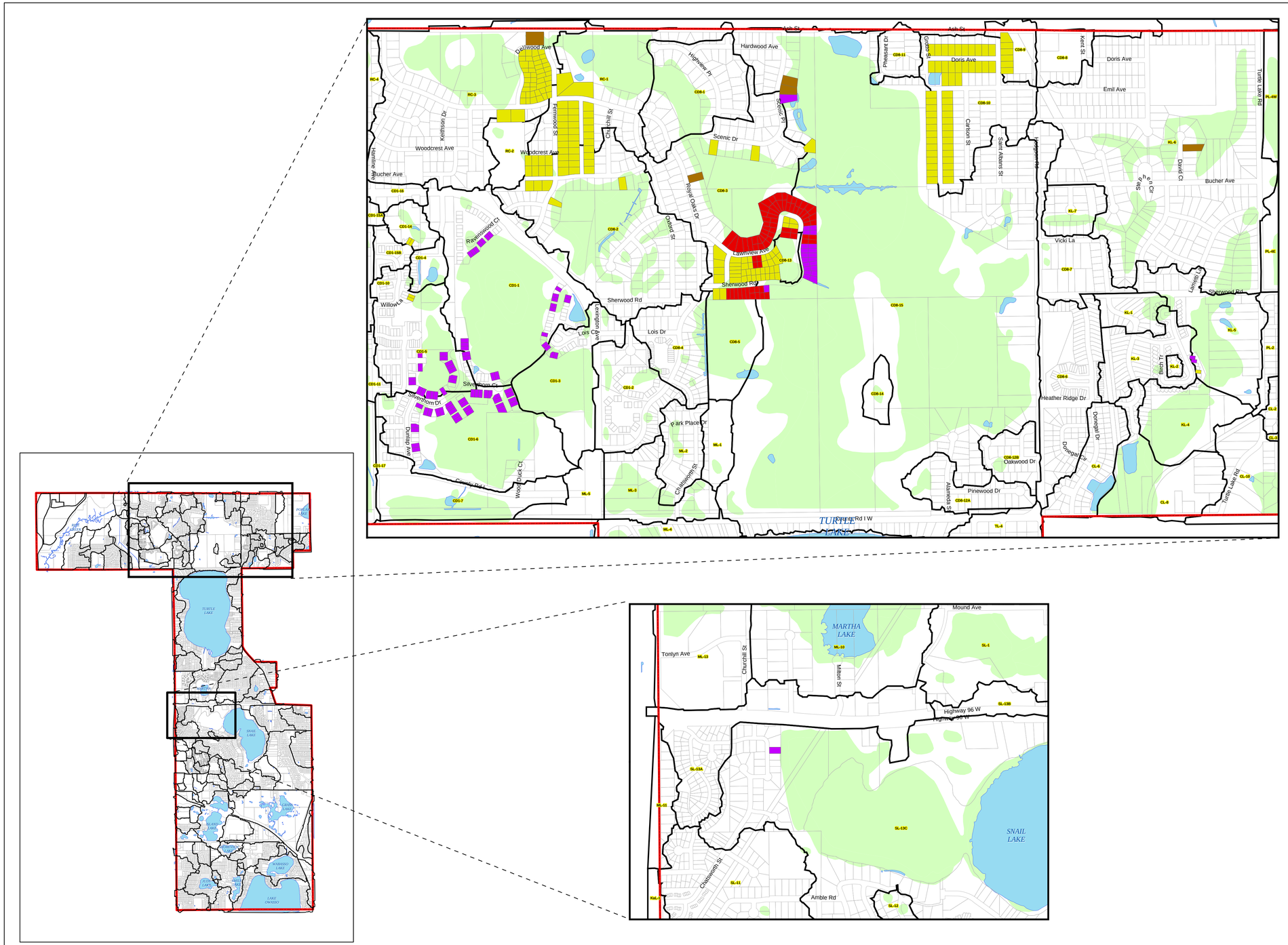
FILE NO.
ASHORE0201.00

DATE:
03/24/05

Watershed and Drainage Area Boundaries City of Shoreview, Minnesota

Figure 12A

Map Document: (X:\PT\Shore\020100\GIS\Shoreview_WR\Figure 12A_Watershed Boundaries Classified_D_Size.mxd)
3/24/2005 -- 9:38:12 AM



Legend

- Shoreview Boundaries
- Parcel Boundaries
- Watersheds
- Water
- Wetlands

Parcels with Letters of Map Changes

- Conditional Letter of Map Amendment (CLOMA)
- Letter of Map Amendment (LOMA)
- Letter of Map Revision (LOMR)
- Structure Removed *

* Structure Removed - This term refers to a building or structure that is located on a property partially or wholly in the regulatory flood boundary being removed from the regulatory floodplain by submittal and approval of a Letter of Map Revision or Letter of Map Amendment.

Source: SEH, Ramsey County, Metropolitan Council, and Mn/DOT.

0 2,000 4,000 8,000 Feet

Projection:
UTM Zone 15 Meters
NAD83

SEH
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

FILE NO.
ASHORE0201.00

DATE
01/27/2004 sh

Letters of Map Change to the City of Shoreview Flood Insurance Rate Map

Figure
13

Map Document: (X:\PT\Shore\020100\GIS\Shoreview_WR\Figure 13_LetterofMapChange.mxd) 01/2704 -- sh